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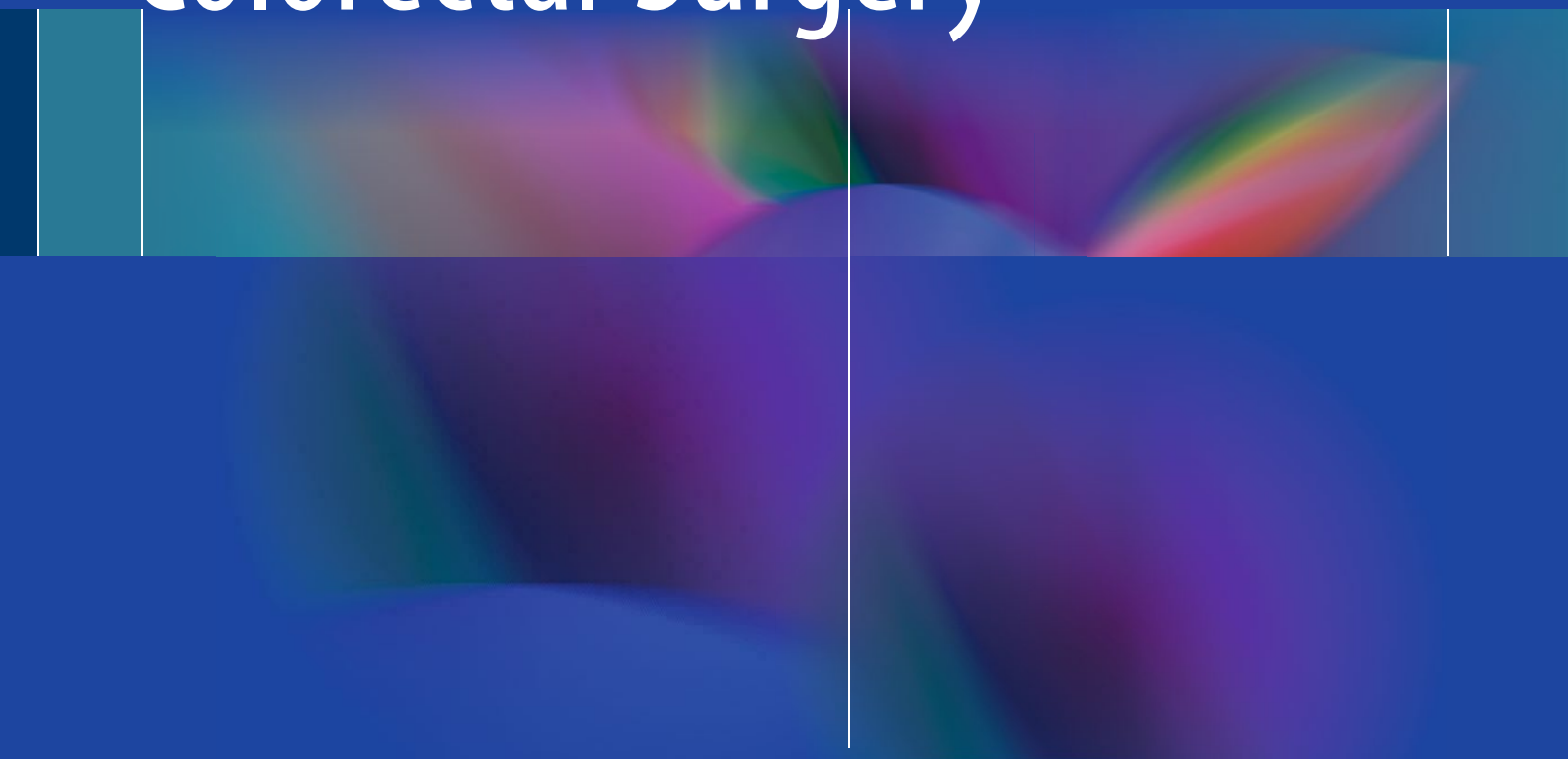
Operative Techniques in Single Incision Laparoscopic Colorectal Surgery



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Foreword

Laparoscopic surgery has revolutionized the field of colorectal surgery. Since its introduction over 25 years ago, the patient benefits and financial value continue to develop. Despite the undeniable benefits, growth of laparoscopy has been slow. After the landmark Clinical Outcomes of Surgical Therapy (COST) trial demonstrated the oncological equivalence of laparoscopic to open colectomy in 2004, we expected the rates of laparoscopic colectomy to rise exponentially in the United States. However, since the trial, rates of laparoscopy for all colorectal disease have only risen to about two-thirds of eligible patients, with an estimated 50% application in colon cancer and 10% in rectal cancer cases.

So why aren't more surgeons practicing laparoscopic colorectal surgery? The largest barrier to widespread utilization is education. Laparoscopic cases are technically demanding, and there is a significant learning curve and time investment for mastering the technology. For established surgeons, this creates a dilemma of taking the time out of practice to learn a new skill. For new graduates, laparoscopy is not adequately covered in surgical training, so dedication is needed to practice, and support is required to ascend the learning curve. However, the benefits for patients are worth the effort.

We can also increase the number of minimally invasive options available. This is where reduced and single port laparoscopic surgery come in. Single incision laparoscopic surgery – a hybrid of natural orifice transluminal endoscopic surgery (NOTES) and conventional laparoscopic surgery – has advanced the field of minimally invasive surgery, improving patient cosmesis, reducing postoperative pain, and further reducing length of stay compared to multiport laparoscopy. With all new technologies, there are technical challenges and a distinct learning curve. However, with experience and proper instruction, single incision laparoscopic surgery can be an integral part of your practice.

This text provides the education needed to learn this advanced minimally invasive technique. The book is designed in two sections. The first section presents the basics of perioperative care, room setup and patient positioning, available platforms with technical and ergonomic considerations, port placement, and dissection techniques. The second section details common colorectal procedures, with step-by-step conduct of the operation, pictures and video accompanying each procedure, and tips and tricks from masters of the technology. We feel this book will be a valuable tool for all minimally invasive surgeons, from novices of the technique to experienced surgeons looking to develop their skills further. Single incision laparoscopic surgery has been a huge impact in our practices, and we know with this tool, you and your practice can also reap the benefits.

Enjoy,
Debby, Eric, and Dan

Contents

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Enhanced Recovery Pathways in Colorectal Surgery

1

Justin T. Brady, Yuxiang Wen, and Conor P. Delaney

Introduction and Background

There are many components to successful outcomes in major surgery. Beyond sound technical skills, a growing focus has been placed on identifying factors that delay patient recovery. The development of fast-track or enhanced recovery after surgery (ERAS) began in the 1990s in Denmark, when Henrik Kehlet described protocols to expedite postoperative recovery [1, 2]. He subsequently reported these pathways for colorectal surgery in 1999, and our group started using and studying these pathways later that year [3]. Since then, there has been increasing adoption of ERAS and continued research to accelerated patient recovery leading to decreased hospitalization length of stay, improved healthcare utilization, and improved patient outcomes. In this chapter, we detail the development and components of enhanced recovery pathways in three sections: preoperative, intraoperative, and postoperative care (Table 1.1).

Preoperative

Patient Education and Expectations

Enhanced recovery begins with patient education and management of patient expectations. In addition to the normal stress and anxiety that come with undergoing major colorectal surgery, the thought of going home as soon as 24–48 h after surgery can be difficult for patients, if their preoperative expectations indicated a significantly longer hospital stay. Prior to ERP, stoma education was typically performed following the procedure at many centers – although at this institution, we have provided preoperative ostomy care for many years before we started using ERAS. With the addition of preoperative stoma education, the number of days needed for a patient to achieve independent stoma care and prevent delayed discharge has decreased dramatically [4, 5]. This is also an important component of managing postoperative hydration and dehydration, and starting the education of patients into perioperative fluid management.

Selective Bowel Preparation with Oral Antibiotics

The role of preoperative bowel preparation in ERPs continues to be debated in the literature. Mechanical bowel preparation (MBP) has been used for decades in elective colorectal surgery with the proposed advantages of decreasing intraluminal stool burden, which is felt to contribute to easier bowel handling, but was initially thought to reduce wound infection rates. Previous study has shown that patients undergoing MBP have statistically significant weight loss, exercise tolerance, and electrolyte changes; however, it is not clear if these have significant clinical effects on patient recovery after surgery [6]. The most recent Cochrane review in 2011 reported no significant difference in anastomotic leak or wound infection between patients who did or did not receive MBP [7].

What many surgeons discussing the use or avoidance of MBP had not appreciated was the evidence for oral antibiotics improving outcomes when used in conjunction with MBP. A recent meta-analysis evaluating the use of MBP with oral antibiotics for patients undergoing colorectal surgery showed a significant reduction in surgical site infections compared to patients who had MBP without antibiotics or no MBP at all [8]. This clearly tips the balance in favor of oral

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Table 1.1 Components of enhanced recovery pathways

Preoperative	Intraoperative	Postoperative
Patient education and expectations Selective bowel preparation with oral antibiotics Intravenous antibiotics Preoperative nutrition Alvimopan (selective use) Multimodal analgesia Venous thromboembolism prophylaxis	Maintenance of normothermia Laparoscopy when possible Avoid nasogastric tubes and drains Goal-directed fluid therapy Adequate anesthesia Multimodal analgesia	Multimodal analgesia Early feeding Early removal of urinary catheter Incentive spirometry Ambulation Discharge criteria

MBP, and in addition provides the favorable bowel handling at the time of surgery. Thus, the standard practice of the authors is mandatory MBP with oral antibiotics for patients undergoing colorectal resection. This is especially important in those who would have a diverting ileostomy, as randomized trials in Europe have clearly shown worse outcomes without MBP. Additionally, MBP is obviously important for those with planned intraoperative colonoscopy.

Preoperative Intravenous Antibiotics

In addition to evidence supporting the use of oral antibiotics with MBP, the use of prophylactic intravenous antibiotics for surgical site infection (SSI) prophylaxis is widely adopted. The Surgical Care Improvement Project (SCIP) guidelines were a catalyst for appropriate antibiotic selection and dosing protocols in colorectal surgery [9]. Literature has shown that the incidence of SSI in colorectal surgery patients decreases from 40% to 10% with the use of intravenous antibiotics [10]. Additional studies have shown that optimal timing for antibiotic infusion is within 60 min and ideally 30 min of incision time [11, 12]. SSI prevention is of particular importance to ERP because SSI is associated with significant patient morbidity and additionally increased length of stay [10].

Preoperative Nutrition

There has been a gradual change in the previous dogma of fasting after midnight prior to surgery. Both the European and American anesthesia societies now recommend fasting from clear liquids at least 2 h prior to surgery and solid foods 6 h prior to surgery [13, 14]. As part of an effort to diminish surgical stress, with the knowledge that clear liquids are safe to drink up to 2 h prior to surgery, multiple studies have been conducted on preoperative carbohydrate loading. Current data have shown that patients who consume a carbohydrate-rich beverage have decreased protein losses and improved insulin sensitivity [15, 16]. Current literature evaluating clinical outcome such as patient thirst, postoperative nausea and vomiting, hunger and length of stay is limited and further studies are needed of the colorectal surgery population to demonstrate a clinical benefit [15, 17–19].

Alvimopan

Postoperative ileus (POI) has a significant impact on postoperative nausea, vomiting, and delayed hospital discharge following colorectal surgery, affecting up to 25% of patients [20, 21]. Alvimopan (Entereg, Merck& Co., Kenilworth, NJ) is an orally administered, peripherally acting mu-opioid antagonist that has been shown to accelerate time to recovery of bowel function, decrease postoperative nausea and vomiting, and decrease length of stay for patients undergoing open bowel resection with primary anastomosis [21–25]. Studies have shown conflicting results for POI and overall length of stay reduction in patients undergoing laparoscopic resection [26, 27]. For this reason, the authors only use alvimopan for open resections without ostomy or for those laparoscopic patients at high risk of conversion to an open procedure. Alvimopan is given between 5 h and 30 min prior to surgery and twice daily after surgery until return of bowel function or for a maximum of 15 doses.

Multimodal Analgesia

Pain control in the surgical patient has usually been part of postoperative care but with ERPs, there has been interest in preoperative nonopioid medications to improve postoperative pain. GABA agonists, pregabalin and gabapentin, have both anxiolytic and analgesic properties. Meta-analyses of both pregabalin and gabapentin given preoperatively have shown decreased postoperative pain within 24 h after surgery and decreased opioid consumption [28, 29]. Patients did report increased drowsiness and visual disturbances compared to controls, and also had significantly lower rates of vomiting. Evidence-based guidelines on the dosage and duration of administration are still pending in abdominal surgery.

Venous Thromboembolism Prophylaxis

Deep vein thrombosis (DVT) and pulmonary embolus (PE) are important patient safety priorities. Up to 40% of colorectal surgery patients will develop DVT and 5% develop PE if not given prophylactic treatment [30]. Current guidelines recommend that patients at moderate risk for DVT or PE

receive low molecular weight heparin (LMWH) or low-dose unfractionated heparin (LDUH) if they are at low risk for bleeding or sequential compression devices if they are at high risk for bleeding [31, 32]. With the use of chemoprophylaxis, the incidence of DVT and PE in the colorectal surgery population is approximately 2% [33].

Intraoperative

Maintenance of Normothermia

Patients in the operating room are at significant risk of hypothermia, especially in colorectal cases, which require additional time for proper patient positioning, foley catheter placement, and skin preparation. Hypothermia is associated with an increased risk of blood loss and transfusion requirement [34]. The effect of perioperative hypothermia on wound infections needs further study, although it appears not unreasonable to maintain normothermia in the perioperative period [35–37].

Laparoscopy When Possible

Since the first laparoscopic colon resection in 1991, the adoption of laparoscopic surgery has increased to over 40% of colorectal procedures [38, 39]. Due to the known benefits of accelerated return of bowel function by 2–3 days and decreased length of hospital stay by 1–3 days, laparoscopy is encouraged when feasible [40–43]. Patients benefit from smaller incisions, less pain, fewer complications, and a diminished stress response [44, 45]. Long-term results have shown laparoscopy to be safe and feasible in oncological resections, as well [46–49].

Avoiding Nasogastric Tubes and Drains

Intraoperative use of nasogastric (NG) decompression helps to improve visualization and access to the abdominal compartment, especially in laparoscopic surgery. Over 20 years of data have shown that routine continuation of NG tube for more than 24 h after surgery, however, is associated with an increased time to return of bowel function and resumption of an oral diet, and more frequent respiratory complications [50, 51]. In addition, routine NG tube use beyond 24 h does not reduce pulmonary complications or decrease the incidence of anastomotic leak [50, 51].Empirically, NG tubes hinder early patient mobilization after surgery. For this reason, removal of the NG tube prior to reversal of anesthesia is a basic component of ERPs, consistent with known meta-analysis data existing since the 1980s.

Peritoneal drains have been used in colorectal surgery to allow for detection of anastomotic leak and prevent accumulation of fluid thought to be a source of infection. Multiple studies have shown that the use of drains for peritoneal fluid does not reduce mortality, increase surgical site infection rates, and provide early detection of anastomotic leak at best very rarely [52, 53]. Similar to NG tubes, peritoneal drains are a barrier to early patient mobilization. The authors avoid use of peritoneal drainage except for extensive pelvic dissections in selected rectal resections or multivisceral resections.

Goal-Directed Fluid Therapy

There is continued debate regarding optimal intraoperative and postoperative fluid management in colorectal surgery. Earlier literature compared liberal versus restrictive fluid management strategies. Liberal fluid management reported avoiding complications of hypovolemia such as organ dysfunction, postoperative nausea and vomiting, and increased length of stay but with increased bowel edema and risk of pulmonary complications [54, 55]. A more restrictive fluid management strategy can be associated with an accelerated time to tolerating a diet and decreased pulmonary complications, but with increased cardiac and renal complications; however, the data remain inconclusive [56, 57]. Current research is focused on goal-directed fluid therapy (GDFT) using esophageal doppler or noninvasive cardiac output monitoring. GDFT is associated with decreased overall fluid administration compared to a liberal fluid management approach but benefits remain elusive [55, 58, 59]. Future research is needed.

Anesthesia and Multimodal Analgesia

Beyond fluid management, there are little data on the anesthesia protocols as part of ERPs. There must be a balance between adequate anesthesia to allow for pneumoperitoneum in laparoscopic procedures and abdominal wall retraction in open procedures but at the same time avoiding overly deep sedation that will prolong time to mobilization.

Multimodal analgesia is an important component of ERPs and there have been many studies evaluating the types of medications and delivery method to accelerate patient recovery. Initial studies of epidural analgesia prior to ERP suggested improved pain scores and faster return of bowel function, but only if the epidural was opioid-free [60, 61]. However, with the implementation of ERPs, epidural analgesia was not found to offer superior recovery than that seen with patient-controlled analgesia (PCA) [62]. More recent evidence has shown that epidural anesthesia slows down

recovery after laparoscopic colorectal resections without adding obvious benefits, and is not recommended as part of an ERP [63]. The transversus abdominis plane (TAP) block has been evaluated as an adjunct intraoperative technique for abdominal wall analgesia. The injection of local anesthetic has been shown to improve postoperative pain scores throughout the patient's hospitalization [64, 65]. The effects of this analgesic technique on overall narcotic usage and length of stay are unclear [65, 66]. Given the documented analgesic benefits, the development of longer acting local analgesics may show greater promise for this technique in the future, and is another area ready for research. At the current time there is as yet no evidence to support the use of liposomal bupivacaine over standard bupivacaine alone.

Postoperative

Multimodal Analgesia

Optimal pain control postoperatively plays an important role in accelerated patient recovery and patient satisfaction. Despite the known side effect profile, opioid medications are commonly used for many patients. Patient-controlled analgesia (PCA) provides patients with the opportunity to titrate the amount of pain medication needed. Evidence shows that PCA users have better pain control and satisfaction scores compared to "as needed" dosing but with overall greater opioid consumption [67]. We transition patients from PCA to oral opioid medications as needed on postoperative day 1.Due to the known side effects of opioid, including nausea, vomiting, and decreased bowel motility that can contribute to ileus, additional opioid-sparing analgesics are given in scheduled doses to minimize narcotic usage.

Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used in combination with opioid medications to improve postoperative analgesia. They have been shown to reduce opioid consumption in surgical patients and provide superior pain control compared to patients receiving opioid alone in randomized controlled trials [68, 69]. They can be given both intravenously and orally. In addition to known risks of bleeding due to antiplatelet activity and risk of kidney injury, there has been recent concern about increased risk of anastomotic leak with NSAID use. One large retrospective analysis showed an increased risk of anastomotic leak, but only in the nonelective colorectal surgery population (OR 1.70, $P = 0.01$), while the other study did not show an increased risk of anastomotic leak but did show an increased incidence of sepsis (OR = 1.47, $P = 0.03$) [70, 71]. NSAIDs have clear benefits for ERP, but they must be weighed against potential risk of complications. Based on our evaluation of the literature and clinical outcomes, we have used them consistently for the last 15 years.

In contrast to NSAIDs, acetaminophen is a central-acting analgesic without the risks of antiplatelet activity, gastrointestinal or kidney injury, or limitations in patients with a cardiac history. Dosing is limited to 4000 mg daily due to risk of hepatotoxicity. Cochrane analysis demonstrated that acetaminophen alone can significantly reduce postoperative pain and the need for additional analgesia in postoperative patients [72]. Two other studies showed that combination of acetaminophen with ibuprofen or oxycodone provided superior pain relief than ibuprofen or oxycodone alone [73, 74]. Multimodal pain relief is a cornerstone of accelerated patient recovery following colorectal surgery. We use acetaminophen routinely, starting intravenous, and transitioning to oral as soon as the patient tolerates PO, even on the day of surgery.

Early Feeding

Due to the physiological ileus following surgeons, the same dogma that leads to routine NG tube decompression also dictated delayed patient feeding until resolution of ileus. Just as surgeons questioned the role of routine NG tube decompression, they also evaluated the safety and benefits of early feeding after colorectal surgery. Studies show that early enteral nutrition, defined as feeding within 24 h, is not associated with increased risks of pneumonia, ileus, anastomotic dehiscence or mortality [75, 76]. Overall patients tolerate early feeding well with similar rates of postoperative vomiting, and NG tube reinsertion [76].

Some patients, and surgeons, may be hesitant to resume oral feedings early after surgery, which can hinder return of bowel function. This leads to trailing sham feedings with chewing gum, thought to stimulate the cephalic phase of digestion. Multiple studies have evaluated the effects of chewing gum with overall positive results [77]. It is unclear if chewing gum decreases overall length of stay, but most evidence suggests that use of chewing gum is safe and associated with a faster time to passage of flatus and stool by approximately 1 day [78, 79]. It is not clearly defined whether this is a sorbitol-related benefit, or one related to cephalic stimulation of the GI tract.

Early Removal of Urinary Catheter

Urinary catheters are standard practice during colorectal surgery, as they help monitor urinary output, decompress the bladder for improved visualization intraoperatively, and manage urinary retention postoperatively. Indwelling urinary catheters are also a potential source of infection, and continuation of a urinary catheter beyond postoperative day 2 is associated with increased risk of urinary tract infection (UTI) [80]. For patients undergoing colon resection, catheter removal on post-