**Case Studies in Enhanced Recovery and Improved Patient Outcomes:**

**Preventing Postoperative Ileus in Colorectal Surgeries**

**Target Audience**
This activity is intended for colorectal surgeons, general surgeons, and other gastrointestinal surgeons.

**Learning Objectives**
Upon completion of this activity, learners will have improved their ability to:

- Evaluate the efficacy and safety of current strategies to reduce perioperative complications in procedures involving gastrointestinal (GI) tract surgeries
- Manage patients who are candidates for procedures involving GI/gastrointestinal tract surgeries with evidence-based perioperative strategies to prevent postoperative ileus
- Articulate features of perioperative enhanced recovery after surgery protocols that might improve patient outcomes

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- Media Viewing Requirements: Flash Player or Adobe Reader
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Introduction

Colorectal procedures account for only 12.7% of general surgical cases, but they represent nearly 25% of all operative complications. To help minimize patient morbidity, Kehlet et al devised a comprehensive approach to improve postoperative organ function, accelerate rehabilitation, and reduce costs. Although the use of these “fast-track” protocols for patients undergoing both laparoscopic and colorectal surgery has been shown to improve several key outcomes, many centers around the country that perform these procedures have been slow to adopt them. A survey of 407 general and colorectal surgeons found that only 30% practiced in hospitals with a specific care pathway designed to accelerate gastrointestinal (GI) recovery. Other studies examining the outcomes of laparoscopic colorectal procedures on an enhanced recovery pathway program found that compliance with the pathway resulted in reduced use of opioids, shorter hospitalization, and fewer complications. Patient education regarding the nature of the procedure and the postoperative pathway being used are essential to improving outcomes.

Complications of Colorectal Surgery

Dr Sands: Colorectal surgeons face many unique challenges when performing a primary colon resection with anastomosis. The most devastating complication associated with this procedure is the possibility of anastomotic leakage. The incidence of this complication is approximately 3.8% based on a recent retrospective analysis of cases performed at hospitals affiliated with the American College of Surgeons National Surgical Quality Improvement Program. In addition, colorectal surgeons must address the possibility of wound infection, which is one of the more common complications, occurring in approximately 6% to 26% of patients who undergo colorectal procedures. The risk for deep venous thrombosis (DVT) is also higher in colorectal cases than in other general surgeries. Postoperative ileus is yet another problem that is commonly encountered, although the return of GI function seems to occur more rapidly with laparoscopic procedures, most likely due to the less-invasive techniques used and less bowel manipulation. All of these challenges can contribute to increased utilization of nursing resources, increased hospital length of stay (LOS), and higher costs.

Dr Marchetti: The time for bowel recovery can depend on the anatomic localization of the procedure. It may take 24 hours for GI function to return after surgeries that involve only the small bowel, whereas it may take 120 hours after procedures that involve the colon. Anything that contributes to a longer hospitalization can increase the patient’s morbidity and his or her financial costs. Other factors that can contribute to the development of ileus are the duration of the procedure, open surgical technique, and surgery involving the lower GI tract.

Enhanced Recovery After Surgery Protocols

The Enhanced Recovery After Surgery (ERAS) protocol was developed to expedite recovery of patients, minimize surgical complications, and decrease utilization of hospital resources, thereby lowering health care costs for patients. Following a standardized pathway may improve outcomes, such as the levels of postoperative pain, rate of GI recovery, and hospital LOS, all of which may lead to greater patient safety. The 3 main components of the ERAS program are preoperative patient care and counseling, intraoperative management, and postoperative care (Figure 1).

Preoperative

Several preoperative elements of ERAS protocols can enhance postoperative outcomes. Preoperative counseling of patients, including defining the operative procedure and postoperative course as well as setting proper expectations, is a key element of overall good patient care and a vital component of an effective ERAS protocol.

With respect to the merits of preoperative oral mechanical bowel preparation (OMBP) for colorectal surgery, there is still some degree of controversy. OMBP is widely practiced in the United States, with recent assessments showing more than 80% utilization among surgeons. Some studies have shown that OMBP prior to colorectal surgery does not provide statistically significant benefits, leading the Canadian

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Society of Colon and Rectal Surgeons to endorse the omission of bowel preparation for elective open left- or right-sided resections. A recent meta-analysis of evidence pertaining to the relative safety and efficacy of OMBP utilization could not exclude modest beneficial or harmful effects. In other words, the evidence regarding the use of OMBP was fairly equivocal. However, bowel preparation remains a part of most ERAS protocols. One recent study did find that the combination of oral antibiotics with mechanical bowel preparation reduced surgical site infection, ileus, and anastomotic leakage. However, no studies have specifically examined the efficacy of bowel preparation as part of an ERAS pathway.

With respect to DVT prophylaxis, most surgeons use compression boots intraoperatively and postoperatively, heparin preoperatively, and enoxaparin postoperatively. The incidence of DVT in patients who undergo colorectal procedures without prophylaxis is approximately 30%, which is much higher than that seen with other general surgical procedures.

Lastly, the use of preoperative carbohydrate loading has been associated with a significantly shorter hospital LOS and a trend toward a more rapid return of bowel function relative to fasting or preoperative oral water (1.5 days to first flatus vs 3 days in fasting/water groups; \( P = .13 \)).

**Intraoperative**

The nature of the procedures being performed can influence postoperative outcomes. Laparoscopic procedures are associated with less pain, reduced narcotic use, quicker return of bowel function, and decreased hospital LOS. Recent estimates of the use of the laparoscopic technique for colon resection now show rates exceeding 40%, increasing from 37.5% in 2008 to 44.1% in 2011. Surgical incisions clearly are smaller in laparoscopic procedures, many of which accomplish specimen extraction via a stoma site, obviating the need for surgical incision other than port sites. Patient satisfaction is greater with the improved cosmesis from laparoscopic surgery as well. Regardless of whether the surgery is done open or laparoscopically, ERAS pathways can, and should, be employed.

Intraoperative fluid management is another key component of optimizing patient outcomes. The amount of fluid administered to patients in the operating room (OR) should be limited in view of the fluid shifts that may occur after abdominal surgery. More recent data have shown an association between a fluid-restrictive regimen and improved outcomes in colorectal surgery. Excess fluids given intraoperatively have been associated with a higher risk for anastomotic leakage and greater incidence of postoperative wound infections as well as increased cardiopulmonary morbidity. Bleier et al found that using a restrictive fluid approach can reduce LOS.

Abraham-Nordling et al found that patients in a restricted IV fluid cohort had fewer major and minor complications \( (P = .027) \). The proper balance of fluids administered intraoperatively poses a real challenge that requires collaboration and effective communication between the surgeon and the anesthesiologist. The use of transesophageal Doppler to monitor stroke volume can guide fluid administration, but it might not be practical at many institutions.

**Postoperative**

Dietary advancement is a key aspect of ERAS protocols. It starts with removal of the nasogastric (NG) tube at the conclusion of the operative procedure and continues with the initiation of a liquid diet once patients are fully awake from anesthesia. The diet can be advanced by postoperative day (POD) 2. Studies have shown that this may accelerate the return of GI function after elective colorectal resections, even in patients undergoing open procedures. Routine placement of NG tubes has not been shown to improve GI recovery time; furthermore, the tube may cause greater patient anxiety and discomfort and may increase the likelihood of respiratory problems. The avoidance of NG tube placement has been a strong predictor of a shorter hospital LOS in patients undergoing operative treatment for colorectal cancer (CRC).
Because postoperative ileus has significant adverse effects on multiple patient outcomes, including postoperative pain, increased nausea and vomiting, prolonged time to regular diet, prolonged time to mobilization, increased health care costs, and prolonged hospitalization, there is clearly a need to use other methods to combat this problem. Additional interventions such as the use of gum chewing and the perioperative use of alvimopan in appropriate clinical situations have been studied individually, and both have been shown to help reduce postoperative ileus.9

**Perioperative Pain Management**

Pain management is a critical component to address in maximizing surgical outcomes, both intraoperatively and postoperatively. The influence of opioids on bowel function has been studied at length, and higher doses of opioid analgesics have associated with a greater incidence of postoperative ileus.32 Although opioids remain a part of patient analgesia, systemic and regional alternatives can help to provide satisfactory pain control while minimizing GI impairment.

Nonsteroidal anti-inflammatory drugs (NSAIDs), including ibuprofen and ketorolac, have been used; however, these medications have been associated with a risk for anastomotic leaks after colorectal surgery.33 As a result, perioperative pain management with NSAIDs should be evaluated meticulously on a case-by-case basis.34 Intravenous acetaminophen also has been studied as part of an ERAS protocol following laparoscopic colectomy. In a case-matched study, the addition of a transverse abdominis plane block and IV acetaminophen to an existing ERAS protocol significantly reduced hospital LOS from 3.7 to 2.6 days (P < .01).35

Although the use of epidural analgesia in laparoscopic colorectal surgery has been shown to be more efficacious than conventional analgesia, the benefit with respect to other outcomes and cost-effectiveness is not as certain.36,37 One retrospective analysis found that the use of epidural analgesia was linked with a longer hospital LOS of .60 days (P = .003), greater financial costs of $3,732.71 (P = .02), and a higher rate of urinary tract infections (P = .05).36

Surgeons also have used local wound infiltrations with bupivacaine. A recent analysis of 6 prospective, phase 4, sequential, cohort studies found that liposomal bupivacaine–based multimodal analgesia (incorporating NSAID and acetaminophen administration) reduced postsurgical opioid use and opioid-related problems, such as impaired GI motility, and may lead to better outcomes, including reduced hospital LOS, compared with conventional opioid–based regimens in patients undergoing laparoscopic colectomy.38 Similar findings have been demonstrated in studies looking at patients undergoing open colectomy.39

**ERAS Protocol Example: Dr Sands and Dr Marchetti**

**Preoperative:** We should risk stratify our patients and be certain that they are properly counseled prior to surgery to ensure that they understand what will happen and what is expected of them after surgery. We also need to ensure that the lesions that we intend to remove are appropriately marked with a tattoo in advance of the surgical procedure to help reduce intraoperative time. Reviewing the surgical plan with nursing and OR staff before the procedure is essential. The patients are given a mechanical bowel preparation. Antibiotics and DVT prophylaxis should be administered before the procedure, with placement of an epidural for pain control if one is to be used. Alvimopan should be given to the patients in the holding area preoperatively if they meet proper criteria.

**Intraoperative:** We try to perform many of our cases laparoscopically. Careful fluid management and blood sugar control can help optimize outcomes. NG tubes should be removed in the OR at the end of the case, and we do not use routine drain tube placement.

**Postoperative:** On POD 0, patients start a liquid diet. Typically, this is continued on POD 1, and if the patient is tolerating the liquid diet well, then the IV is locked with heparin. Urinary output is monitored closely, and we remove the Foley catheter, if possible, on POD 1. The patient is encouraged to chew gum on POD 1. Antibiotics are stopped after 24 hours; we usually just give 1 dose preoperatively, but antibiotics are allowed up to 24 hours by Surgical Care Improvement Project (SCIP) guidelines. For pain management, patients receive IV acetaminophen, ibuprofen, or ketorolac. Narcotics are ordered for breakthrough pain and given as needed. The patient is moved to a chair on POD 1 as well and is encouraged to ambulate, if possible.

On POD 2, the patient’s diet is advanced, and we make the transition to oral pain medications. The patient should be ambulating by POD 2.

On POD 3, the epidural catheter is removed if placed intraoperatively. Usually patients are sent home with adequate pain control if they are tolerating a diet and voiding. These are the key elements of our typical ERAS protocol.

Some patients are not ideal candidates for an ERAS pathway; however, we try to implement as many elements as possible. If a patient is unable to adhere to the protocol, we modify it to meet his or her needs. Patients who come into the emergency room with an acute abdomen or perforated viscus or showing signs of systemic sepsis with multiple comorbidities typically are not candidates for an ERAS protocol. However, it may be possible to implement some aspects of the protocol to assist with the patient’s overall recovery. The ideal patient for an ERAS protocol would be one who is motivated, has a low American Society of Anesthesiologists (ASA) Physical Status (PS) classification, and is undergoing elective surgery. Patients who require emergent surgery, have a high ASA PS classification, or who are severely malnourished are not going to conform to conventional methodologies and would be poor candidates for fast tracking.

There has been concern regarding the implementation of ERAS colorectal protocols due to the possibility of early readmission after discharge. However, several studies have shown that the readmission rate is not higher among patients who were on fast-track protocols.40-42

The SCIP measures should be followed, with careful attention to the role of DVT prophylaxis as well as prevention of infections and adverse cardiac events.43 There is great incentive to adhere to these performance measures, given the supportive alignment between the Joint Commission and the Centers for Medicare & Medicaid Services.43
CASE 1

A 48-year-old white male presents for assessment of rectal bleeding for the past 4 months and a change in bowel habits. He has a 6-month history of altered stool caliber, which is associated with cramping abdominal pain, rectal bleeding, a 4.54-kg weight loss over the past 3 months, and decreased appetite. His medical history is remarkable for hypertension, which is treated with a β-blocker, and mild benign prostatic hypertrophy, with no prior abdominal surgery. He has a family history of CRC. In particular, his father had CRC at age 65 and underwent a segmental colectomy with postoperative chemotherapy. His father has been disease free for more than 5 years after completing chemotherapy. The patient works as a banker, is an occasional social drinker, and denies any other history of smoking or illicit drug use.

After examination, the patient is advised to undergo a colonoscopy and a computed tomography (CT) scan to explore the etiology of his change in bowel habits, rectal bleeding, weight loss, and abdominal pain. His CT scan shows masses in each side of the colon. His carcinoembryonic antigen (CEA) level is 0.5 ng/mL (normal), and his exercise stress test is negative. His colonoscopy reveals several sessile and pedunculated polyps as well as 2 distinct colonic masses: 1 in the ascending colon and 1 in the sigmoid colon (Figure 2).

There are no rectal polyps. His biopsies show tubular adenomatous polyps and 2 invasive adenocarcinomas of the colon: 1 on the right side and 1 on the left side. The patient is scheduled to undergo a laparoscopic total abdominal colectomy with an ileorectal anastomosis.

The patient is fed a liquid diet the day before surgery and undergoes a full mechanical bowel preparation. He receives oral antibiotics, including 1 g of neomycin and 1 g of metronidazole, both at 7 PM and again at 11 PM the night before surgery. He is administered nothing orally after midnight before surgery. He receives preoperative counseling regarding the ERAS protocol. On the day of surgery, he receives DVT prophylaxis with 5,000 U of subcutaneous heparin. Antibiotic prophylaxis is administered with 1 g of IV ertapenem 30 minutes before surgery. He is taken to the OR, where he undergoes general anesthesia and is placed in a low-lying lithotomy position, with both arms tucked at his side. A Foley catheter and orogastric tube are placed for the time of surgery.

The patient’s procedure is performed laparoscopically and takes a total of 290 minutes. His urinary output is 150 mL, and he has 50 mL of blood loss. The orogastric tube is removed at the conclusion of the procedure. He is taken to the recovery room and is started on a clear liquid diet once he is awake, alert, and able to eat according to anesthesia recovery room guidelines. He is provided pain control with a morphine patient-controlled analgesia pump and is moved to a regular floor.

On POD 1, the patient mobilizes out of bed to the chair in his room. His urinary output is low, and he receives an IV fluid bolus and increase in his baseline IV rate. On POD 2, he is ambulating.

On POD 3, the patient complains of severe abdominal pain and is slightly tachycardic, without fever. On physical examination, his abdomen is tender and distended. This is felt to be consistent with a probable ileus, and the patient is restricted from oral consumption. He is given increased IV fluids for continued low urinary output. He has
a nonroutine laboratory assessment with a complete blood count to look for signs of bleeding or infection as well as an electrolyte panel. His abdominal x-ray shows dilated loops of the small bowel consistent with a postoperative ileus (Figure 3), and an NG tube is put in place.

Upon insertion of the NG tube, 850 cc of bilious material is aspirated from the patient’s stomach, and he is maintained on low continuous suction, with a plan to maintain the NG tube until his bowel function returns. The tube remains in place for 7 days, and he is started on total parenteral nutrition (TPN).

The patient’s bowel function eventually returns, and on POD 10, the NG tube is removed. On POD 11, a clear liquid diet is resumed. On POD 12, he starts a low-fat, low-residue diet, which is tolerated. On POD 13, he is discharged home. His pathology report reveals stage 3 disease (T3N1), with 2 adenocarcinomas and tubular adenomas, and he is referred to medical oncology for postoperative chemotherapy.

Case Discussion

Dr Marchetti: Dr Sands, what factors may have contributed to the prolonged LOS in this patient’s case?

Dr Sands: Laparoscopic total abdominal colectomies lasting longer than 270 minutes may be associated with more postoperative complications, longer time before resumption of a normal diet, and longer hospitalizations relative to shorter surgeries. Postoperative ileus has significant adverse effects on multiple outcomes, including increased health care costs and prolonged hospitalization.

Dr Marchetti: What strategies might have made a difference in LOS for this patient?

Dr Sands: He did not have opioid-sparing analgesia. Although opioids are used frequently, they decrease GI motility, inhibiting small and large bowel propulsion. Opioids may lead to other GI effects as well. Optimal practice would involve minimization of the use of opioids after surgery, looking at other options such as nonsteroidal medications, epidurals, IV lidocaine, liposomal-based bupivacaine for local injection, or gabapentin. Many of the investigations of opioid-sparing strategies have been conducted in patients after open colorectal surgeries, and the benefit for laparoscopic colorectal procedures is not quite as clear. Intravenous ketorolac has been used to reduce patient discomfort in cases of open and laparoscopic surgery.

Dr Marchetti: What is the effect of postoperative ileus in terms of cost and resource utilization?

Dr Sands: Postoperative ileus is a real entity with real complications, including increased morbidity and prolonged hospital LOS. It would be ideal to minimize narcotic use for pain control as much as possible. Sometimes it is not possible to avoid narcotic use completely, and alvimopan may be helpful in preventing postoperative ileus by allowing narcotic use without affecting bowel motility. Alvimopan is a peripherally acting μ-opioid receptor antagonist (PAMORA) agent that allows patients to experience the narcotic effect while not affecting the return of GI function. Studies have evaluated methylnaltrexone, another PAMORA agent, for
the treatment of postoperative ileus; however, these studies failed to demonstrate efficacy for postoperative ileus.\textsuperscript{47,48} Alvimopan has been studied extensively, showing a reduction in hospital LOS by about 1.1 days.\textsuperscript{49} It has been a component of several ERAS protocols, and we try to use it when appropriate within a comprehensive pathway that can improve outcomes. For patients undergoing total abdominal colectomy or longer procedures, strong consideration should be given to measures that can reduce postoperative ileus.

CASE 2

A 58-year-old woman presents for assessment of rectal bleeding. Her medical history is remarkable for hypertension, and she has a surgical history of a total abdominal hysterectomy–bilateral salpingo-oophorectomy 20 years ago, 2 cesarean deliveries, and an appendectomy as a child. Her family history is negative for CRC. She undergoes a colonoscopy, which reveals midsigmoid colon cancer. The lesion is marked with India ink, and a biopsy reveals adenocarcinoma. A CT scan of the chest, abdomen, and pelvis is negative for metastatic disease. Her CEA level is 3.1 ng/mL, and her other laboratory results are normal.

The operative plan is for the patient to undergo a laparoscopic sigmoid colectomy. She receives a mechanical bowel preparation before the procedure as well as preoperative IV antibiotics, DVT prophylaxis, and alvimopan.

The patient has an open Hasson port placed above her umbilicus. She is noted to have numerous dense adhesions, and additional ports are placed cautiously. She undergoes laparoscopic adhesiolysis. Several serosal tears are noted, and 2 segments of the bowel are injured, with exposed mucosa and enteric spillage.

The surgery is converted to an open procedure. Extensive enterolysis is performed, with 2 small bowel resections in addition to the colectomy. An NG tube is placed, and the total operative time is 4.5 hours.

Fast-track protocols used at the hospital are unable to be initiated and maintained. Postoperatively, the patient is taken to the intensive care unit, where she remains for 3 days. Intravenous antibiotics are continued due to the intraoperative spillage of her enteric contents. TPN is initiated on POD 3. She experiences a prolonged postoperative ileus. The NG tube remains in place for 10 days until she experiences passage of flatus and stool on POD 12. Intravenous fluids are maintained. A clear liquid diet is started on POD 13. Her diet is advanced over the next few days, and she is discharged home on POD 16.

Case Discussion

Dr Sands: Dr Marchetti, what are the key problems in this case?

Dr Marchetti: The procedure should have been converted to an open surgery sooner, before the bowel injury. Although laparoscopy is associated with reduced LOS, quicker bowel recovery, less postoperative pain, fewer problems with wound infection, and improved cosmesis,\textsuperscript{10,50} proceeding with laparoscopic enterolysis with multiple bowel injuries delayed postoperative recovery and increased this patient’s operative morbidity. ERAS protocols can be done with both open and laparoscopic procedures. However, in this case, fast-track protocols could not be followed due to the surgical complications.

Dr Sands: What are your thoughts on the role of IV fluid administration in this patient’s case?

Dr Marchetti: You certainly want to obtain a balance of fluid in a situation in which excess IV fluid can contribute to several complications. You can see increases in interstitial volume and total body water. Ambulation can be more difficult, and patients may experience greater cardiopulmonary morbidity. Studies have compared standard and restrictive fluid administration protocols, and a meta-analysis has suggested some benefit to the practice of fluid restriction, with less morbidity after colorectal resection.\textsuperscript{51} However, fluid management remains very challenging and requires coordination between the surgeon and the anesthesiologist.

CASE 3

A 60-year-old white male presents for assessment of rectal bleeding. His medical history is remarkable for hypertension, with no surgical history. His family history is negative for CRC. A colonoscopy reveals right colon cancer, and the lesion is marked with India ink. A biopsy of the area indicates adenocarcinoma, and the patient’s CEA level is 3.3 μg/dL. His other laboratory values are normal. A CT scan of the chest, abdomen, and pelvis is negative for metastatic disease.

The operative plan is for the patient to undergo a robotic-assisted right colectomy with intracorporeal anastomosis. He receives preoperative counseling. Before his procedure, he receives a mechanical bowel preparation, DVT prophylaxis, alvimopan, and IV antibiotics. Robotic ports are placed along the patient’s midline, and he undergoes a robotic right colectomy with intracorporeal anastomosis, which is stapled in a side-to-side fashion with the common enterotomy hand sewn with the robot. The duration of the procedure is 75 minutes, and he receives a bupivacaine liposome–injectable suspension for local anesthetic treatment of his wounds.

The patient is started on a clear liquid diet in the recovery room. He receives IV acetaminophen and ketorolac for pain control, with IV hydromorphone for postoperative breakthrough pain. The Foley catheter is removed on POD 1. He continues alvimopan postoperatively and also starts chewing gum. A regular diet is offered to the patient on POD 2. He passes flatus and moves his bowels on POD 2 and is discharged home on POD 3.

Case Discussion

Dr Sands: Dr Marchetti, can you explain the rationale for having the patient chew gum as part of his postoperative protocol?

Dr Marchetti: Gum chewing can be an effective means of preventing postoperative ileus. It has been examined in several studies, and beneficial effects, such as decreased time to first passage of flatus, decreased time to first stool, and decreased hospital LOS, have been seen (Figure 4).\textsuperscript{52} Other components of ERAS protocols also address bowel recovery so it may be difficult to distinguish how much benefit comes from chewing gum in this context.

Dr Sands: What are your thoughts about the patient’s postoperative dietary pathway?
**Figure 4. Randomized Controlled Studies Examining the Association Between Outcomes and Gum Chewing**

Pooled estimates: reduction in time to passage of flatus by 14 hours (95% confidence interval [CI], 20 to 8 hours; *P* = .001).

Reduction in time to bowel movement by 23 hours (95% CI: -32 to -15 hours; *P* < .001).

Reduction in hospitalization time: 1.1 days (95% CI: -1.9 to -0.2 days; *P* = .016).

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**Dr Marchetti:** Early postoperative feeding can aid in quicker bowel recovery. A meta-analysis of 13 clinical trials in which oral/enteral nutrition was initiated within 24 hours of intestinal surgery found several interesting points. Mortality was reduced with early postoperative feeding, and the data were suggestive of reduced wound infections, a lower incidence of pneumonia, and a shorter LOS with early feeding. There was no evidence of increased risk for anastomotic dehiscence, and ultimately, no benefit to restricting postoperative oral/enteral nutrition.53

**Dr Sands:** Finally, what are your thoughts about the inclusion of alvimopan in this patient’s pathway?

**Dr Marchetti:** The use of alvimopan allows for a quicker return of bowel function and decreased LOS (Figure 5).49 A retrospective, matched-cohort study of patients undergoing bowel resection examined the potential influence of accelerated GI recovery on a variety of postoperative outcomes. The incidence of GI complications was lower in the group treated with alvimopan (29.8% vs 35.7%; \( P < .0001 \)).49 Cardiovascular, infectious, pulmonary, and thromboembolic complications were significantly lower in the group treated with alvimopan (Figure 5).49 The alvimopan-treated group had lower mortality (0.4% vs 1.0%; \( P = .0007 \)) and a lower mean intensive care unit LOS (0.3 vs 0.6 days; \( P < .0001 \)).49

Due to concerns regarding the potential risk for myocardial infarction that was seen in a long-term study (12 months), patients may receive alvimopan only for short-term use (<15 doses) in the hospital through a Risk Evaluation and Mitigation Strategy (REMS) program. In-service education is absolutely necessary for everyone involved in the prescription, dispensation, and administration of alvimopan. The responsibility for following these protocols ultimately lies with the surgeon at our institution. It is important for surgeons to have a close working relationship with pharmacists to enhance the efficiency and accuracy of the medical management of patients who have undergone surgical procedures.54

Cost is always a consideration as well. One analysis of patients undergoing laparotomy for bowel resection with primary anastomosis found a mean estimated hospital cost reduction of $879 to $977 for those who received alvimopan compared with those who received placebo.55 Another study showed that the mean cost savings associated with alvimopan use was $531 for patients undergoing laparoscopic bowel resection and $997 for patients undergoing open bowel resection.56

**Take-Home Points**

- Early postoperative feeding and avoidance of routine NG tube placement may enhance outcomes for patients undergoing bowel resection
- Patients who undergo bowel resection are at an elevated risk for venous thromboembolism relative to other surgical patients
- Careful management of intraoperative fluids can greatly enhance patient outcomes
- Chewing gum, use of alvimopan, and avoidance or minimization of opioid analgesia can facilitate GI recovery for patients undergoing bowel resection with primary anastomosis

![Figure 5. Clinical Complication Rates With and Without Alvimopan Use](image-url)
References


Post-Test

1. All of the following techniques may facilitate recovery of GI function after colorectal surgery except:
   a. Chewing gum
   b. Administration of alvimopan
   c. NG tube placement
   d. Avoidance of opioid analgesia

2. Which of the following patients would not be a candidate for placement on an ERAS pathway after colorectal surgery?
   a. Patients with an ASA classification of IV or higher
   b. Patients older than 65 years
   c. Patients with adenocarcinoma
   d. Patients who have not had previous abdominal surgery

3. Patients who undergo colorectal procedures without DVT prophylaxis have a ___% chance of developing a venous thromboembolic event.
   a. 10
   b. 20
   c. 30
   d. 60

4. Measures that may reduce reliance on opioid analgesia after colorectal procedures include all of the following except:
   a. Local wound infiltration with bupivacaine liposome
   b. Use of IV acetaminophen
   c. Use of epidural analgesia
   d. Placing the patient on nothing-by-mouth status following the procedure

5. A 72-year-old patient has just undergone a successful colonic resection for colon cancer. He has had an NG tube placed. His respiratory and GI outcomes may be improved by:
   a. Keeping the NG tube in place for 48 hours
   b. Keeping the NG tube in place for 72 hours
   c. Removing the NG tube as soon as possible
   d. Prompt initiation of TPN and keeping the NG tube in place for 48 hours

6. Early postoperative feeding after colorectal procedures is associated with which of the following outcomes?
   a. Increased risk for anastomosis dehiscence
   b. Increased risk for wound infections
   c. Increased risk for pneumonia
   d. None of the above

7. Which of the following statements regarding the use of mechanical bowel preparation before colorectal procedures is false?
   a. It is a practice employed by most colorectal surgeons in the United States
   b. Its use prior to left- and right-sided resections has not been endorsed by the Canadian Society of Colon and Rectal Surgeons
   c. It has been demonstrated conclusively to have only adverse effects on postoperative outcomes
   d. It has not been studied independently as part of an ERAS pathway

8. Which of the following IV fluid management strategies may improve outcomes for patients undergoing colorectal procedures?
   a. Aggressive IV fluid administration both intraoperatively and postoperatively
   b. Complete withholding of fluid during the operative procedure
   c. Careful administration of fluids, with monitoring of cardiac output through Doppler technology
   d. Administration of IV fluid in conjunction with routine NG tube placement

9. Which of the following statements regarding the use of alvimopan in cases involving bowel resection with primary anastomosis is false?
   a. It can be administered after patients are discharged from the hospital
   b. It should only be administered for fewer than 15 doses in total
   c. It may reduce hospitalization duration and cost
   d. It requires a REMS plan

10. As part of an ERAS protocol, patients may begin enteral feeding on POD:
    a. 0
    b. 2
    c. 3
    d. 4
Case Studies in Enhanced Recovery and Improved Patient Outcomes: Preventing Postoperative Ileus in Colorectal Surgeries

Please complete the following evaluation questions to receive your certificate.

1. What degree best describes you?
   - MD/DO
   - PA/PA-C
   - NP
   - RN
   - PharmD/RPh
   - PhD
   - Other, please specify:

2. What is your area of specialization?
   - Surgery, surgical oncology
   - Gastroenterology
   - Oncology, medical
   - Other, please specify:

3. Which of the following best describes your primary practice setting?
   - Solo practice
   - Group practice
   - Government
   - University/teaching system
   - Community hospital
   - HMO/managed care
   - Nonprofit/community
   - I do not actively practice
   - Other, please specify:

4. How long have you been in practice?
   - More than 20 years
   - 11-20 years
   - 6-10 years
   - 1-5 years
   - Less than 1 year
   - I do not directly provide care

5. Approximately how many patients do you see each week?
   - Less than 50
   - 50-99
   - 100-149
   - 150-199
   - 200+
   - I do not directly provide care

6. How many patients undergoing radical cystectomy do you currently see each week?
   - Less than 5
   - 5-15
   - 16-25
   - 26-35
   - 36-45
   - 46-55
   - 56 or more
   - I do not directly provide care

7. Please select the extent to which you agree/disagree that the activity supported the achievement of each learning objective

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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</thead>
<tbody>
<tr>
<td>Evaluate the efficacy and safety of current strategies to reduce perioperative complications in procedures involving gastrointestinal (GI) tract surgeries</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Manage patients who are candidates for procedures involving GI/penitourinary tract surgeries with evidence-based perioperative strategies to prevent postoperative ileus</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Articulate features of perioperative enhanced recovery after surgery protocols that might improve patient outcomes</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

8. Please select the extent to which you agree/disagree that the activity achieved the following:

<table>
<thead>
<tr>
<th>Activity Achieved</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The faculty were effective in presenting the material</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The content was evidence based</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The educational material provided useful information for my practice</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The activity enhanced my current knowledge base</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The activity provided appropriate and effective opportunities for active learning (eg, case studies, discussion, Q&amp;A, etc)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The opportunities provided to assess my own learning were appropriate (eg, questions before, during, or after the activity)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

9. Based upon your participation in this activity, do you intend to change your practice behavior? (Choose only one of the following options)
   - I do plan to implement changes in my practice based on the information presented
   - My current practice has been reinforced by the information presented
   - I need more information before I will change my practice

10. Thinking about how your participation in this activity will influence your patient care, how many of your patients are likely to benefit? Please use a number (eg 250): _______

11. If you plan to change your practice behavior, what type of changes do you plan to implement? (Check all that apply)
   - Apply latest guidelines
   - Choice of treatment/management approach
   - Change in pharmaceutical therapy
   - Change in current practice for referral
   - Change in nonpharmaceutical therapy
   - Change in differential diagnosis
   - Change in diagnostic testing
   - Other, please specify: ____________________________

12. How confident are you that you will be able to make your intended changes?
   - Very confident
   - Somewhat confident
   - Unsure
   - Not very confident

13. Which of the following do you anticipate will be the primary barrier to implementing these changes?
   - Formulary restrictions
   - Insurance/financial issues
   - Time constraints
   - Lack of multidisciplinary support
   - System constraints
   - Treatment-related adverse events
   - Patient adherence/compliance
   - Other, please specify: ____________________________

14. Was the content of this activity fair, balanced, objective, and free of bias?
   - Yes
   - No, please explain: ____________________________

15. Please list any clinical issues/problems within your scope of practice you would like to see addressed in future educational activities: __________________________________________

Request for Credit (*required fields)

Name* ____________________________

Degree* ____________________________

Organization ____________________________

Specialty* ____________________________

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Telephone ____________________________

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*Valid email address required for receipt of your certificate. You will receive your certificate from CEcertificate@pimed.com.

For Physicians Only
   - I participated in the entire activity and claim 1.25 credits.
   - I participated in only part of the activity and claim ________ credits.

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IMPORTANT: Your certificate will be EMAILED to your listed email address* below. (Please print legibly)