
Standardization of Care: Impact of an Enhanced Recovery Protocol on Length of Stay, Complications, and Direct Costs after Colorectal Surgery



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BACKGROUND: Colorectal surgery is associated with considerable morbidity and prolonged length of stay (LOS). Recognizing the need for improvement, we implemented an enhanced recovery (ER) protocol for all patients undergoing elective colorectal surgery at an academic institution.

STUDY DESIGN: A multidisciplinary team implemented an ER protocol based on: preoperative counseling with active patient participation, carbohydrate loading, multimodal analgesia with avoidance of intravenous opioids, intraoperative goal-directed fluid resuscitation, immediate postoperative feeding, and ambulation. Discharge requirements remained identical throughout. A before and after study design was undertaken comparing patients before (August 2012 to February 2013) and after implementation of an ER protocol (August 2013 to February 2014). Risk stratification was performed using the NSQIP risk calculator to calculate the predicted LOS for each patient based on 23 variables.

RESULTS: One hundred and nine consecutive patients underwent surgery within the ER protocol compared with 98 consecutive historical controls (conventional). The risk-adjusted predicted LOS was similar for each group at 5.1 and 5.2 days. Substantial reductions were seen in LOS, morphine equivalents, intravenous fluids, return of bowel function, and overall complications with the ER group. There was a \$7,129/patient reduction in direct cost, corresponding to a cost savings of \$777,061 in the ER group. Patient satisfaction as measured by Press Ganey improved considerably during the study period.

CONCLUSIONS: Implementation of an ER protocol led to improved patient satisfaction and substantial reduction in LOS, complication rates, and costs for patients undergoing both open and laparoscopic colorectal surgery. These data demonstrate that small investments in the perioperative environment can lead to large returns. (J Am Coll Surg 2015;220:430–443. © 2015 by the American College of Surgeons)

A variety of management strategies and protocolized care pathways have been developed during the last several decades in an effort to reduce the time required to recover

from surgery. The “enhanced recovery” (ER) concept, first proposed by Kehlet,¹ is based on the belief that traditional perioperative management practices, such as fasting in the preoperative period, liberal fluid administration in the intraoperative period, and the use of nasogastric tubes and opioid-centric pain-management strategies in the postoperative period, deserve re-evaluation and modification in light of the best-available evidence-based medicine. More than 10 case-control studies including >3,000 subjects have demonstrated a 3-day reduction in length of stay (LOS) associated with the development of an ER program in a variety of surgical patient populations.^{2–14} A meta-analysis of randomized controlled trials focused on ER

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Abbreviations and Acronyms

ER	= enhanced recovery
GDT	= goal-directed therapy
LOS	= length of stay
MBP	= mechanical bowel preparation
PACU	= postanesthesia care unit
PVI	= Pleth Variability Index
SSI	= surgical site infection

programs in colorectal surgical patients specifically found that LOS was reduced, on average, by 2.4 days.¹⁵

In colorectal surgery specifically, traditional fluid management strategies appear to be of particular importance.¹⁶ Most notably the “goal-directed therapy” (GDT) concept, pioneered by Shoemaker and colleagues,¹⁷ is based on the premise that maintaining oxygen delivery and use above a predetermined threshold can improve outcomes. Although not all studies have been positive,¹⁸ in aggregate it appears that adherence to GDT protocols can reduce the morbidity associated with major surgery.¹⁹⁻²¹ An extension of the GDT concept is the “fluid responsiveness” paradigm, which promotes the use of dynamic indicators of volume status to optimize preload.²² A major advantage of the fluid responsiveness paradigm is its noninvasive nature. Traditional GDT algorithms relied on cardiac output measurements derived from a pulmonary artery catheter. Randomized controlled trials examining the use of the less invasive esophageal Doppler²³⁻²⁹ and arterial waveform analyzers³⁰⁻³⁵ have demonstrated mean reductions in LOS of 3.7 and 2.2 days, respectively.

Most recently, the anesthesiology community has developed the concept of the “perioperative surgical home” in which a physician team leader (anesthesiologist, surgeon, or hospitalist) known as a “perioperativist” oversees the entire patient experience. Essential components of the perioperative surgical home include standardized care, adoption of best practices, efficient delivery of health care, coordination among multiple members of the care team (physicians and nonphysicians), and active involvement of patients and their family members.³⁶ Critical to the perioperative surgical home model is reduced variability and conversion of what is traditionally a disjointed confluence of discrete health care interactions into a smooth, continuous experience.³⁷

In an effort to improve clinical outcomes in patients undergoing colorectal surgery at the University of Virginia, we developed an institution-specific, colorectal ER pathway, which was implemented on August 1, 2013. Our colorectal ER pathway was created by amalgamating input from colorectal surgeons, postanesthesia care unit (PACU) and acute care nurses, as well as anesthesiologists

and pain medicine physicians. To assess the efficacy of this quality initiative, we sought to compare the outcomes of patients before and after protocol implementation.

METHODS

Study design

Approval was sought but deemed unnecessary by the IRB at the University of Virginia for this quality-control initiative. We analyzed all consecutive patients undergoing elective major colorectal surgery by 2 board-certified colon and rectal surgeons before (August 1 2012 to March 1, 2013) and after (August 1, 2013 to March 1, 2014) the development of an ER program. To remove the confounding effects of protocol discussion and development on clinical practice, a 6-month period of time immediately before initiation of the protocol was omitted (March 1, 2013 to August 1, 2013) from analysis. The primary outcomes of interest included risk-adjusted LOS, using the American College of Surgeons NSQIP Surgical Risk Calculator to estimate expected length of stay. Secondary clinical variables included unadjusted LOS, numeric pain scores on a 1 to 10 scale, return of bowel function (defined as days to passage of flatus), intravenous fluids received (in milliliters), and morphine equivalents received throughout the hospital stay. Other secondary outcomes included readmission to any medical facility within 30 days, unplanned intubation, 30-day all cause mortality, superficial surgical site infection (SSI), deep SSI, organ space SSI, thromboembolic events, progressive renal insufficiency, acute renal failure, urinary tract infection, MI, postoperative bleeding, sepsis, pneumonia, unplanned return to operating room, and total complications. Additionally, patient satisfaction and financial data were compared.

Management strategies

Preprotocol management

Before initiation of the ER program, the colon and rectal patients were generally managed in the following manner. All patients received a mechanical bowel preparation (MBP) the night before surgery consisting of 4 L GoLytely, as well as erythromycin (1 g × 3), neomycin (1 g × 3), and metoclopramide (10 mg × 3). They were placed on a clear liquid diet the morning of the day before surgery and were made npo after midnight. The patients received preoperative education in the colorectal surgery clinic and were generally told that they would be in the hospital for 3 to 5 days for laparoscopic procedures and 5 to 7 days for open procedures. Nonopioid analgesic agents were not used preoperatively. Most patients undergoing open surgical procedures received low thoracic

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