Preoperative Optimization of Crohn's Disease

Jonathan E. Efron, M.D.[1] and Tonia M. Young-Fadok, M.D.[1]

ABSTRACT

Patients with Crohn's disease often present to the surgeon for operative intervention in poor overall condition. They may be taking multiple immunomodulators to attempt to manage their disease, may have significant weight loss and evidence of malnutrition, and 10 to 30% of the time will have intraabdominal sepsis in the form of an abscess or fistula. Preoperative optimization of these patients, when possible, may decrease morbidity and mortality, and may avoid formation of stomas for fecal diversion. Enhancing nutritional status and streamlining immunomodulator therapy prior to surgery may improve outcomes. Medical management of intraabdominal sepsis with percutaneous drainage of abdominal or pelvic abscesses may decrease postoperative septic complications, and may even avert the need for surgical intervention altogether.

KEYWORDS: Crohn's disease, percutaneous drainage, immunomodulator therapy, malnutrition, preoperative optimization

Objectives: On completion of this article, the reader should be able to identify several methods for optimizing patients with Crohn's disease who require abdominal surgery to decrease morbidity or the need for fecal diversion.

Crohn's disease poses unique and difficult challenges for the surgeon. The disease is not curable by surgery alone; therefore, gastroenterologists and patients attempt to delay surgical intervention as long as possible. This delay often means that patients can present in a weakened, malnourished state with significant immunosuppression. Furthermore, the development of intraabdominal abscesses or fistulas is the natural progression of Crohn's disease and often complicates the operative management of the patient. In this article, we will review preoperative interventions that allow for (1) optimization of patients with Crohn's disease who require surgery, and (2) improved surgical outcomes.

PREOPERATIVE IMMUNOTHERAPY

Almost all patients with Crohn's disease are taking immunomodulator therapy when they present for surgery. The most commonly used agents include steroids, azathioprine, 6-murcaptopurine (6-MP), methotrexate, infliximab, and most recently adalimumab. Many patients will be on combinations of multiple agents such as steroids, 6-MP, and infliximab. The impact of these immunosuppressive agents on surgical outcome is debatable. Tay et al[1] performed a multivariate analysis of 100 patients who underwent segmental anastomosis with primary anastomosis or stricturoplasty while on immunomodulators. They had an 11% rate of intraabdominal septic complications and found that patients on immunotherapy actually had a significantly lower intraabdominal septic complication rate than those who were not on therapy.

Colombel et al[2] reviewed the Mayo Clinic Rochester experience of operating on patients with Crohn's disease who were on immunosuppressants. They operated on 270 patients on a variety of immunomodulators

[1]Division of Colon and Rectal Surgery, Mayo Clinic, Scottsdale, Arizona.

Address for correspondence and reprint requests: Jonathan E. Efron, M.D., Division of Colon and Rectal Surgery, Mayo Clinic, 1340 E. Shea Blvd., Scottsdale, AZ 85259 (e-mail: efron.jonathan@mayo.edu).

Crohn's Disease; Guest Editor, Steven D. Wexner, M.D.

Clin Colon Rectal Surg 2007;20:303–308. Copyright © 2007 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.
DOI 10.1055/s-2007-991029. ISSN 1531-0043.

including 11 patients on steroids, 105 patients on azathioprine, 6-MP, or methotrexate, and 52 who were on infliximab. Nineteen percent of the patients had septic complications (52 of 270) including wound infections (10%), anastomotic leak (3%), intraabdominal abscess (2%), and extraabdominal infections (7%). They found no association between the use of any of the immunomodulators preoperatively and postoperative septic complication rate.

In contrast, Yamamoto et al[3] found a significantly higher intraabdominal septic complication rate in their patient population that underwent abdominal surgery for Crohn's disease while on steroids. They performed a multivariate analysis on 343 patients who underwent 566 operations for Crohn's disease. They found that the use of steroids preoperatively, low albumin (< 3.0 g/l), intraabdominal sepsis or fistula were independent risk factors for higher postoperative intraabdominal septic complications. Conflicting data has been published on the risk of performing bowel anastomoses in patients on immunomodulators.

Marchal et al[4] also examined the risk of operating on patients who were receiving infliximab. They performed a case control study matching 40 patients who received infliximab within 12 weeks of surgery to 39 patients who did not. Although they did not see a statistical difference in the complication rates or length of stay between the two groups, there was a trend to significance in the infectious complication group. The lack of statistical significance may be due to the low patient numbers in the study.

Recent data has shown an increased complication rate in patients with ulcerative colitis who undergo surgery while being treated with infliximab. Mor et al[5] from the Cleveland Clinic reported on 35 patients who underwent restorative proctocolectomy with ileal pouch anal anastomosis for ulcerative colitis. They matched these to 35 patients with respect to demographics, use of steroids and other immunomodulators, disease extent, and disease activity. The postoperative complication rate was significantly higher in the infliximab group as compared with controls (77 versus 51%). Selvasekar et al[6] examined the recent Mayo Clinic experience with infliximab. They identified 47 patients who received infliximab prior to restorative proctocolectomy with ileal pouch anal anastomosis and compared them to 254 patients from the same period who received none. They found a significantly higher septic complication rate, pouch-specific septic complication rate, and anastomotic leak rate. Although these studies were performed in patients on Infliximab undergoing operations for ulcerative colitis and not Crohn's disease, the high infectious and complication rates seen in these patients may potentially be extrapolated to patients with Crohn's disease undergoing major abdominal procedures.

Controversy still exists as to the risk of postoperative complications in those patients receiving immunomodulators for Crohn's disease prior to surgery. In particular, the risks of infliximab are still being debated. In addition to the type of immunomodulator the patient is taking, the number of drugs may be problematic. No studies have been published on the risk of being on multiple immunomodulators, but several presentations have been made in the last year at scientific meetings demonstrating a higher complication rate in patients taking infliximab plus other immunomodulators such as 6-MP and steroids. Although not absolutely contraindicated, caution should be used when performing bowel anastomoses in malnourished patients on multiple immunomodulators.

No human studies have been performed looking at potential drugs that may be used to reverse the deleterious effects of immunosuppressants on bowel anastomosis, but several animal studies have been performed looking specifically at the role of insulin-like growth factor-I (IGF-I) on reversing these effects. IGF-I has been shown to reverse the inhibitory effects of corticosteroids and methotrexate that occur on healing colonic anastomoses in rats.[7,8] Mantrozoros et al[7] found that leakage rates, anastomotic bursting strength, and inflammatory cell response were significantly lower in corticosteroid-treated rats. The bursting strength and inflammatory response were corrected in the rats treated with corticosteroids and IGF-I. No clinical trials have been published to date on the use of IGF-I in immunosuppressed patients undergoing bowel resection; however, the above-mentioned studies are encouraging in demonstrating that the inhibitory effects of immunosuppressors on wound healing may be temporarily reversed to allow for safer primary bowel resections.

PREOPERATIVE NUTRITION

Patients with Crohn's disease are at risk for developing complications from malnutrition. The use of parenteral nutrition in these patients is widely practiced if patients' disease states are active and they cannot tolerate enteral nutrition. Total parenteral nutrition (TPN) may be used as an adjunct to prepare patients for surgical intervention by improving their nutritional state, or used in combination with medical therapy to avoid surgical intervention in cases of complicated Crohn's disease.

Evans et al[9] examined the utility of using short course home TPN for patients with complicated Crohn's disease as an intervention to prevent prolonged hospitalization prior to surgery or to prevent operation. Twelve of the 15 patients in the study successfully completed home TPN with planned progression to definitive surgery in 8 patients or resolution of conditions requiring TPN in 4 patients. One patient developed sepsis and one

patient developed dehydration requiring admission to the hospital.

The utility of preoperative TPN in Crohn's patients was examined by Lashner et al.[10] The authors performed a retrospective review of 103 individuals comparing patients with Crohn's disease who underwent bowel resection with and without preoperative TPN. They found those patients who received preoperative TPN and underwent ileocolic or small bowel resections had significantly less intestine resected than the patients who did not receive TPN. The TPN patients had significantly longer postoperative stays. No differences were seen in the patients undergoing colonic resections. In contrast to this, Seo et al[11] found that administration of TPN to patients hospitalized with severe Crohn's colitis resulted in resolution of symptoms and avoidance of surgery in 11 of the 12 patients studied. This was in contrast to patients with ulcerative colitis who saw no benefit to receiving TPN.

Poor nutrition has been shown to be an independent risk factor for postoperative complications in patients with Crohn's disease.[12] Despite this fact, there is limited evidence for the use of preoperative TPN in malnourished Crohn's patients to minimize postoperative complications. Fasth et al[13] examined the utility of postoperative TPN in patients with Crohn's disease. They found that patients with evidence of malnutrition preoperatively did not necessarily have a higher complication rate and that treating postoperatively with TPN did not reduce postoperative morbidity. To date, no good studies, either prospective or retrospective, have looked at the benefit of preoperative administration of TPN in patients with Crohn's disease undergoing surgery. As mentioned above, malnutrition has been demonstrated to be an independent risk factor for postoperative complications, and if patients are severely malnourished and stable, treating with preoperative TPN may decrease the risk of those postoperative complications.

PREOPERATIVE MANAGEMENT OF INTRAABDOMINAL SEPSIS IN PATIENTS WITH CROHN'S DISEASE

Patients with Crohn's disease are known to develop intraabdominal sepsis because of fistulizing disease; they may present with free perforation of stool or pus. These patients require initial fluid resuscitation followed by laparotomy or laparoscopic exploration. If the patients are unstable, initiation of pressors may be required prior to induction of general anesthesia.

Presentation with a contained intraabdominal abscess is initially treated with percutaneous drainage rather than surgical intervention if the abscess cavity is accessible. The theoretical benefit in treating intraabdominal abscesses with antibiotics and drainage prior to surgery is to decrease the inflammatory response in the abdomen thereby facilitating surgery. A large series by Alves et al[12] examined 161 patients who underwent primary ileocolic resection without diversion for Crohn's disease. They performed a multivariate analysis and found that the presence of an intraabdominal abscess was an independent risk factor for postoperative septic complications.

Table 1 Outcomes of Percutaneous Drainage of Intraabdominal Abscesses

Study	Year	*N*	Success Rate %
Gutierrez et al[15]	2006	37	100.0
Golfieri et al[16]	2006	87	84.3
Harisinghani et al[17]	2003	140	96.0
Gervais et al[18]	2002	32	96.0
Jawahari et al[19]	1998	36	53.0
Sahia et al[14]	1997	24	56.0

Drainage of abscesses discovered prior to surgery may allow for resection with primary anastomoses without the risk of postoperative sepsis as described by Alves and colleagues. Numerous studies have demonstrated the safety and feasibility of percutaneous drainage of intraabdominal abscesses (see Table 1).[14–19]

The management of intraabdominal abscesses in Crohn's patients has changed over the past 20 years. In 1996 Ayuk et al[20] reported 40 patients with Crohn's disease that were followed over a year period. These patients had 54 abscesses, the majority of which (76.7%) were treated with laparotomy, drainage, and bowel resection. Laparotomy had a 93% success rate. Eight patients with spontaneous abscesses were treated with percutaneous drainage, but only 3 (37.5%) successfully. These results differ significantly from those published by Rypens et al[21] this year. They examined 14 pediatric patients with intraabdominal or pelvic abscesses who underwent percutaneous drainage. Their initial approach to all patients was percutaneous drainage. Fifty percent of the drainage attempts resulted in complete resolution of the sepsis and 12 patients went on to resection with primary anastomosis.

Medical management of intraabdominal abscesses with or without percutaneous drainage may allow surgical intervention to be delayed or avoided altogether. Lee et al[22] examined 24 patients who were admitted for Crohn's-related abscesses over a 7-year period. Their median follow up was 47.5 months and 19 of the 24 patients were treated medically with 5 patients having percutaneous drainage of their abscesses. They had a 66.7% success rate with this nonsurgical approach and a 12.5% abscess recurrence rate at 7 months. Both the presence of a concomitant fistula and the use of steroids predicted failure.

Sahia et al[14] examined their success rates with percutaneous drainage of abscesses in patients with

Crohn's disease. They had a 56% success rate in 27 drainage procedures performed in 24 patients. Patients who had an initial abscess as opposed to recurrent abscesses, had small abscesses, or had an abscess located in the right lower quadrant had a higher success rate. Those patients who did have successful drainage had lower fistula formation rates. Only 2 of the 15 patients with successful drainage went on to require surgery after a 543 patient month follow-up.

Gutierrez et al examined all patients with Crohn's disease and intraabdominal or pelvic abscesses treated at a single institution over a 10-year period. Sixty-six patients were identified, of whom 29 initially received surgery and 37 underwent percutaneous drainage. They found no difference in the length of therapy required for resolution of the infectious process between the two groups. Two thirds of the patients that underwent percutaneous drainage required surgical intervention within the first year of drainage.[15]

Crohn's patients who develop abscesses may be effectively treated with medical therapy including percutaneous drainage. At least 50% of these patients will not progress to require surgery in the acute setting. Recurrence of infection or progression of the disease will require surgical intervention for those patients who initially respond to medical therapy 12 to 33% of the time.

BOWEL PREPARATION

There have been no studies examining the role of bowel preparation in patients with Crohn's disease; however, many randomized trials have been performed in the past 15 years examining the necessity of bowel preparation for elective open colorectal surgery. A Cochrane Review was published in 2004 examining all studies that randomized elective patients undergoing a colon or rectal resection either to bowel preparation or no bowel preparation.[23] The primary outcome used for the review was the rate of anastomotic leakage. This was defined as "a discharge of feces from the anastomosis site and the presence of peritonitis or pelvic sepsis confirmed by clinical or radiological investigation." Operations were divided into two groups: low anterior resection (extraperitoneal anastomosis) and colonic anastomosis (intraperitoneal anastomosis). Secondary endpoints examined were mortality (within 30 days of surgery), peritonitis, reoperation, wound infection, infectious extraabdominal complications, noninfectious extraabdominal complications, and overall infections in surgical sites.

Six randomized controlled studies were included (out of 11 total) in the review with a total of 1204 patients. There were 595 patients who underwent bowel preparation and 609 who had no bowel preparation. There was a significantly lower anastomotic leak rate in the unprepped patients (see Table 2). There were no other significant differences between the two groups in the categories examined, including mortality rates and wound infections. When broken down into colonic anastomosis versus low anterior resections, there was no significant difference with respect to anastomotic leak rate (Low anterior resection: 12.5% versus 12%, NS; Colonic resections: 1.16% versus 0.6%, NS). There was no publication bias demonstrated in the funnel plot applied to the six studies.

The authors concluded that there was no benefit from mechanical bowel preparation for elective colorectal resections and they questioned the use of routine bowel preparation in colorectal surgery. The benefits of not performing bowel preparation were not explored in this article.

In 2004, a meta-analysis of randomized clinical trials of colorectal surgery with or without mechanical bowel preparation was published in the *British Journal of Surgery* by Slim et al.[24] Seven trials of 11 were included in the analysis with 1454 patients. These trials are listed in Table 3.[25–31] Patients who underwent bowel preparation had a significantly higher anastomotic leak rate (5.6%) then nonprepped patients (3.2%, $p = 0.032$). Other endpoints examined in the study included wound

Table 2 Outcome of Patients Randomized to Bowel Preparation or No Bowel Preparation for Elective Colorectal Resections

Category	Bowel Preparation *N* (%)	No Bowel Preparation *N* (%)	Significance *p*
Total patients	595	609	
Anastomotic leak	32/576 (5.5)	17/583 (2.9)	0.02
Mortality	2/329 (0.6)	0/326 (0)	NS
Peritonitis	13/254 (5.1)	7/252 (2.8)	NS
Reoperation	11/329 (3.3)	8/326 (2.5)	NS
Wound infection	44/595 (7.4)	35/609 (5.7)	NS
Infection extraintestinal	14/168 (8.3)	15/159 (9.4)	NS
Extraabdominal complication	20/250 (8.0)	17/246 (7.0)	NS
Surgical site infection	31/325 (9.8)	27/322 (8.3)	NS

Adapted from Guenaga et al.[23]

Table 3 Randomized Studies Comparing Mechanical Bowel Preparation to None

Study	Year	Number of Patients	Antibiotic Prophylaxis	Leak Rate (Prep/No Prep)
Brownson et al[25]	1992	179	Yes	Sig. ↑ in prep
Burke et al[26]	1994	186	Yes	No difference
Santos et al[27]	1994	149	Yes	Sig. ↑ in prep
Miettinen et al[28]	2000	267	Yes	No difference
Fillmann and Filmann[29]	2001	60	Yes	No difference
Zmora et al[30]	2003	415	Yes	No difference
Fa-Si-Oen et al[31]	2003	250	Yes	No difference

infection, other septic complications, and nonseptic complications, all of which showed no significant difference between the groups. The authors also performed a subgroup analysis that showed patients who underwent bowel preparation with polyethylene glycol (PEG) solution as opposed to those who had no prep had a significantly higher anastomotic leak rate. These authors applied a funnel plot to the seven studies demonstrating no publication bias. Their conclusions were that mechanical preparation with PEG solution should be omitted before elective colorectal surgery.

Review of the randomized trials on bowel preparation and colectomy has clearly demonstrated that bowel preparation is not needed when performing bowel resections with anastomoses in open colectomy patients. These studies were performed in elective, nonobstructed patients. When facing a patient with Crohn's disease and a bowel obstruction, the surgeon must decide at the time of operation as to whether performing a primary bowel anastomosis is warranted. This will depend on the patient's nutritional status, the presence of sepsis, and the condition of the bowel being anastomosed. No prospective studies have been performed in patients with or without Crohn's disease on the feasibility of performing laparoscopic colectomies in patients who have not undergone bowel preparations. This question still remains to be answered.

CONCLUSIONS

Patients with Crohn's disease are difficult patients to manage and often present with many comorbid conditions that will negatively influence their surgical outcome. Immunosuppressants have been shown to increase intraabdominal septic complications in many studies. No medications or therapies have been shown to reverse this risk, but newer therapies may be available soon, based on promising results in animal studies. Every attempt should be made to improve nutrition prior to surgical intervention if possible, and all intraabdominal abscesses that are accessible to percutaneous drainage prior to surgery should be drained. Finally, mechanical bowel preparation for an elective, open colectomy in a patient with Crohn's disease is not required.

REFERENCES

1. Tay GS, Binion DG, Eastwood D, Otterson MF. Multivariate analysis suggests improved perioperative outcome in Crohn's disease patients receiving immunomodulator therapy after segmental resection and/or strictureplasty. Surgery 2003;134(4):565–572; discussion 572–563
2. Colombel JF, Loftus EV Jr, Tremaine WJ, et al. The safety profile of infliximab in patients with Crohn's disease: the Mayo clinic experience in 500 patients. Gastroenterology 2004;126(1):19–31
3. Yamamoto T, Allan RN, Keighley MR. Risk factors for intra-abdominal sepsis after surgery in Crohn's disease. Dis Colon Rectum 2000;43(8):1141–1145
4. Marchal L, D'Haens G, Van Assche G, et al. The risk of post-operative complications associated with infliximab therapy for Crohn's disease: a controlled cohort study. Aliment Pharmacol Ther 2004;19(7):749–754
5. Mor I, Sherr B. Infliximab in ulcerative colitis is associated with an increased risk of postoperative complications after restorative proctocolectomy. Dis Colon Rectum 2007;50(5): 734
6. Selvasekar CR, Cima RR, Larson DW, et al. Effect of infliximab on short-term complications in patients undergoing operations for chronic ulcerative colitis. J Am Coll Surg 2007;204(5):956–963
7. Mantzoros IKI, Angelopoulos S, Koliakos G, et al. The effect of insulin-like growth factor I on healing of colonic anastomoses in cortisone-treated rats. Dis Colon Rectum 2006;49:1431–1438
8. Howarth GSCJ, Bourne AJ, Ballard FJ, Read LC. Insulin-like growth factor-I (IGF-I) stimulates regrowth of the damaged intestine in rats, when administered following, but not concurrent with methotrexate. Growth Factors 1998;15: 279–292
9. Evans JP, Steinhart AH, Cohen Z, McLeod RS. Home total parenteral nutrition: an alternative to early surgery for complicated inflammatory bowel disease. J Gastrointest Surg 2003;7(4):562–566
10. Lashner BA, Evans AA, Hanauer SB. Preoperative total parenteral nutrition for bowel resection in Crohn's disease. Dig Dis Sci 1989;34(5):741–746
11. Seo M, Okada M, Yao T, Furukawa H, Matake H. The role of total parenteral nutrition in the management of patients with acute attacks of inflammatory bowel disease. J Clin Gastroenterol 1999;29(3):270–275
12. Alves A, Panis Y, Bouhnik Y, Pocard M, Vicaut E, Valleur P. Risk factors for intra-abdominal septic complications after a first ileocecal resection for Crohn's disease: a multivariate analysis in 161 consecutive patients. Dis Colon Rectum 2007; 50(3):331–336

13. Fasth S, Hulten L, Magnusson O, Nordgren S, Warnold I. The immediate and long-term effects of postoperative total parenteral nutrition on body composition. Int J Colorectal Dis 1987;2(3):139–145
14. Sahai A, Belair M, Gianfelice D, Cote S, Gratton J, Lahaie R. Percutaneous drainage of intra-abdominal abscesses in Crohn's disease: short and long-term outcome. Am J Gastroenterol 1997;92(2):275–278
15. Gutierrez A, Lee H, Sands BE. Outcome of surgical versus percutaneous drainage of abdominal and pelvic abscesses in Crohn's disease. Am J Gastroenterol 2006;101(10):2283–2289
16. Golfieri R, Cappelli A, Giampalma E, et al. CT-guided percutaneous pelvic abscess drainage in Crohn's disease. Tech Coloproctol 2006;10(2):99–105
17. Harisinghani MG, Gervais DA, Maher MM, et al. Transgluteal approach for percutaneous drainage of deep pelvic abscesses: 154 cases. Radiology 2003;228(3):701–705
18. Gervais DA, Hahn PF, O'Neill MJ, Mueller PR. Percutaneous abscess drainage in Crohn disease: technical success and short- and long-term outcomes during 14 years. Radiology 2002;222(3):645–651
19. Jawahari A, Kamm MA, Ong C, Forbes A, Bartram CI, Hawley PR. Intra-abdominal and pelvic abscess in Crohn's disease: results of noninvasive and surgical management. Br J Surg 1998;85(3):367–371
20. Ayuk P, Williams N, Scott NA, Nicholson DA, Irving MH. Management of intra-abdominal abscesses in Crohn's disease. Ann R Coll Surg Engl 1996;78(1):5–10
21. Rypens F, Dubois J, Garel L, Deslandres C, Saint-Vil D. Percutaneous drainage of abdominal abscesses in pediatric Crohn's disease. AJR Am J Roentgenol 2007;188(2):579–585
22. Lee H, Kim YH, Kim JH, et al. Nonsurgical treatment of abdominal or pelvic abscess in consecutive patients with Crohn's disease. Dig Liver Dis 2006;38(9):659–664
23. Guenaga K, Atallah AN, Castro AA, Matos DDM, Wille-Jorgensen P. Mechanical bowel preparation for elective colorectal surgery. Cochrane Database Syst Rev 2005;1: CD001544
24. Slim K, Vicault E, Panis Y, Chipponi J. Meta-analysis of randomized clinical trials of colorectal surgery with or without mechanical bowel preparation. Br J Surg 2004;91: 1125–1130
25. Brownson P, Jenkins S, Nott D, et al. Mechanical bowel preparation before colorectal surgery: results of a prospective randomized trial. Br J Surg 1992;79:461–462
26. Burke P, Mealy K, Gillen P, Joyce W, Traynor O, Hyland J. Requirement for bowel preparation in colorectal surgery. Br J Surg 1994;81:907–910
27. Santos JCMBJ Jr, Sirimarco MT, Guimaraes AS, Levy CE. Prospective randomized trial of mechanical bowel preparation in patients undergoing elective colorectal surgery. Br J Surg 1994;81:1673–1676
28. Miettinen RP, Laitinen ST, Makela JT, Paakkonen ME. Bowel preparation with oral polyethylene glycol electrolyte solution vs. no preparation in elective open colorectal surgery: prospective randomized study. Dis Colon Rectum 2000;43(5): 669–675
29. Fillmann EEP FH, Filmann LS. Elective colorectal surgery without prepare. Revista Brasileira de Coloproctologia 1995;15(2):70–71
30. Zmora O, Mahajna A, Bar-Zakai B, et al. Colon and rectal surgery without mechanical bowel preparation: a randomized prospective trial. Ann Surg 2003;237(3):363–367
31. Fa-Si-Oen PRBJ, van Geldere D, deWaard JW, et al. The effect of preoperative bowel preparation with polyethylene glycol on surgical outcome in elective colorectal surgery—a randomized multicentre trial. Abstract presented at: the Fourth Belgian Surgical Week, 2003, Ostnede, Belgium