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ORIGINAL ARTICLE

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Is mechanical bowel preparation mandatory for left-sided colonic anastomosis? Results of a prospective randomized trial

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Abstract Background Preoperative mechanical bowel preparation is aimed to reduce the risk of infectious complications, and its utility is a dogma in left-sided large bowel anastomosis. The aim of this study was to specifically assess whether colocolonic and colorectal anastomoses may be safely performed without preoperative mechanical bowel preparation. **Methods** Patients undergoing elective colon and rectal surgery with primary colocolonic or colorectal anastomosis were prospectively randomized into two groups. The "prep" group had mechanical bowel preparation prior to surgery, while the "non-prep" group had surgery without pre-operative mechanical bowel preparation. **Results** Two hundred forty-nine patients were included in the study, 120 in the prep group and 129 in the non-prep group. Demographic characteristics, indications for surgery, and type of surgical procedure did not significantly differ between the two groups. There was no difference in the rate of surgical infectious complications between the two groups. Overall infectious complication rate was 12.5% in the prep group and 13.2% in the non-prep group. Wound infection, anastomotic leak, and intra-abdominal abscess occurred in 6.6%, 4.2%, and 1.6% of patients in the prep group and in 10.0%, 2.3%, and 0.7% of patients in the non-prep group, respectively (p=NS). **Conclusions** These results suggest that elective left-sided anastomosis may be safely performed without mechanical preparation. Multicenter studies to test the reproducibility of these results are required, to support a change in this time-honored practice.

Key words Colon surgery • Prospective study • Polyethylene glycol • Preoperative care • Postoperative complications

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Introduction

Postoperative infectious complications account for a significant rate of morbidity in colon and rectal surgery. Most of these infections are caused by enteric bacteria, which are normal hosts of the large bowel and may contaminate extraintestinal sites during surgery or in the early postoperative period. The clinical presentation of these post-operative infections may vary from wound infection to anastomotic leak or disruption, abdominal abscess, and diffuse peritoneal infection.

Mechanical bowel preparation before colon and rectal surgery is aimed to rid the bowel of feces, in order to reduce the postoperative infection rate. In the past decades, this practice has become a surgical dogma, and primary colonic anastomosis is considered unsafe in an unprepared

bowel. Several studies suggested, however, that when an ileocolonic anastomosis is planned, for instance in a right, subtotal or total abdominal colectomy, surgery can be safely performed without mechanical bowel preparation [1, 2]. Advocates of this approach suggested that since the column of stool proximal to the anastomosis, which may mechanically disrupt the anastomosis, is avoided in these cases, mechanical cleansing may not be required. We have previously reported that mechanical bowel preparation did not reduce infectious complications in patients undergoing colon and rectal surgery with variety types and locations of colonic anastomosis [3]. There is no literature, however, specifically addressing the safety of elective colon and rectal surgery with primary colocolonic, colorectal or colo-anal ("left-sided") anastomosis without mechanical bowel preparation.

The aim of this study was, therefore, to assess whether left-sided large bowel anastomosis may be safely performed in the elective setting without mechanical bowel preparation.

For purposes of any future meta-analysis, it is important to emphasize that a large portion of these patients were included in our previous report [3]. However, based on our experience and comments to our previous report, we felt that this subgroup analysis (with modest increase in the number of patients) would be of practical interest to surgeons.

Materials and methods

Patients undergoing elective colon and rectal surgery between 1997 and 2001 were prospectively randomized into two groups. Patients in the "prep" group received mechanical bowel preparation with one gallon of polyethylene glycol one day prior to surgery. Patients of the "non-prep" group had colon and rectal surgery without mechanical bowel preparation. In order to specifically assess the safety of left-sided anastomosis, only patients in whom a primary colocolonic, colorectal or colo-anal anastomosis was performed were included in the data analysis. Patients who had a diverting stoma proximal to the left-sided anastomosis were excluded from the data analysis. Patients with tumors preoperatively assessed to be of less than 2 cm in diameter were not eligible for randomization in this study, since intraoperative endoscopy may be required for tumor localization.

All patients were allowed to have a regular diet until midnight before surgery, and were not required to have a low residue or liquid diet as part of their preparation. Patients were admitted the day before surgery, and mechanical bowel preparation was routinely given to prep group patients after dinner the evening prior to the procedure.

Preoperatively, all patients received 3 oral doses of non-absorbable antibiotics (1 g neomycin and 1 g erythromycin) the day prior to surgery and one intravenous dose of broad-spectrum antibiotics (500 mg metronidazole, 240 mg gentamicin, and 1 g ampicillin) on call to the operating room. Patients in either group who were planned for rectal surgery were given one phosphate enema on the day of surgery, to avoid extrusion of stool when using a transanal stapler.

Postoperative complications were recorded for one month after surgery. Infectious complications, such as wound infection and anastomotic leak, were detected clinically, and imaging studies such as computed tomography (CT) or water-soluble contrast enema were used only on clinical demand. Wound infection was defined as a wound erythema requiring initiation of antibiotic treatment, or drainage of purulent collection. Anastomotic leak was called if demonstrated by imaging or documented in surgery, or if fecal drainage was evident through a peri-anastomotic drain. Abdominal abscess was defined as fluid collection demonstrated by CT, in conjunction with elevated temperature or white blood cell count.

The study was approved by the institutional review board for clinical studies, and all patients signed an informed consent form prior to enrollment.

Statistical analysis was performed using Fischer's exact test, or Student's unpaired t test, as appropriate. A p value less than 0.05 was considered statistically significant.

Results

Two hundred forty nine patients fulfilled the criteria to enter the study, after the exclusion of seven patients who had a diverting stoma performed proximal to the left-sided anastomosis (4 who had preparation and 3 who did not have). Overall, 120 patients had colon and rectal surgery with mechanical cleansing (prep group) while 129 patients were treated without mechanical preparation (non-prep group). Carcinoma of the colon and rectum was the most common indication for surgery, accounting for 72% of the cases. Age and gender distribution did not significantly differ between the two groups, nor did the indication for surgery (Table 1).

There was no significant difference between groups in the types of surgeries performed (Table 2). Surgery with colocolonic anastomosis was performed in 21% of prep

Table 1 Demographic and clinical characteristics of 249 patients who underwent colon and rectal surgery with left-sided colonic anastomosis, by study group (with and without mechanical bowel preparation). Differences between the groups were not statistically significant

	Prep (n=120)		Non-prep (n=129)	
Age, years[a]	68 (22–82)		70 (30–92)	
Male, n (%)	67	(56)	65	(50)
	53	(44)	64	(50)
Indication for surgery, n (%)				
Carcinoma of the colon or rectum	81	(68)	98	(76)
Diverticular disease	21	(18)	18	(14)
Inflammatory bowel disease	5	(4)	2	(2)
Benign polyp	4	(3)	5	(4)
Other	9	(7)	6	(4)

[a] Values are mean (range)

group patients and in 25% of non-prep group patients; colorectal anastomosis was performed in 74% and 73%, and colo-anal anastomosis was performed in 5% and 2%, respectively. Infectious complications were more common after surgery with colorectal anastomosis as compared to colocolonic anastomosis, but this difference was not statistically significant (13.7% vs. 8.6%, p=0.37).

Table 2 Surgical procedures performed in 249 patients, by study group. Values are number (percentage) of patients. Differences between groups were not significant

	Prep (n=120)	Non-prep (n=129)
Surgical procedure		
Left colectomy	12 (10)	21 (16)
Sigmoidectomy	38 (32)	56 (43)
Anterior resection	43 (36)	40 (31)
Low anterior resection	6 (5)	2 (2)
Closure of Hartmann's	21 (17)	10 (8)
Anastomosis		
Stapled	107 (89)	117 (91)
Handsewn	13 (11)	12 (9)

Postoperative infectious complications occurred in 12.4% of prep group patients and in 13.0% of non-prep group patients; this difference was not significant (Fig. 1a). There was a slight trend towards higher rates of anastomotic leak and abdominal abscess in patients who did undergo mechanical cleansing, and a slightly higher rate of wound infection in patients who did not receive mechanical bowel preparation, but these differences were statistically insignificant. Overall morbidity was also similar between groups (Fig. 1b).

Stapled anastomosis was performed in 71% of all cases (89% in prep group and 91% in non-prep group), whereas in 29% of the cases handsewn anastomosis was performed. Anastomotic leak rate was not related to anastomotic type, both for the entire study population (3.1% in stapled anastomosis vs. 3.3% in handsewn, p=1.0), and for the two groups.

Average time of the first bowel movement was 4.0 days in the prep group and 4.2 days in the non-prep group, and average length of hospital stay was 8.7 and 8.5 days, respectively (p=0.40 and p=0.73, respectively). Mortality within 30 days of surgery occurred in 1.6% of prep group patients, and 0.7% of non-prep group patients (p=0.61). One patient of each group expired due to infectious complications.

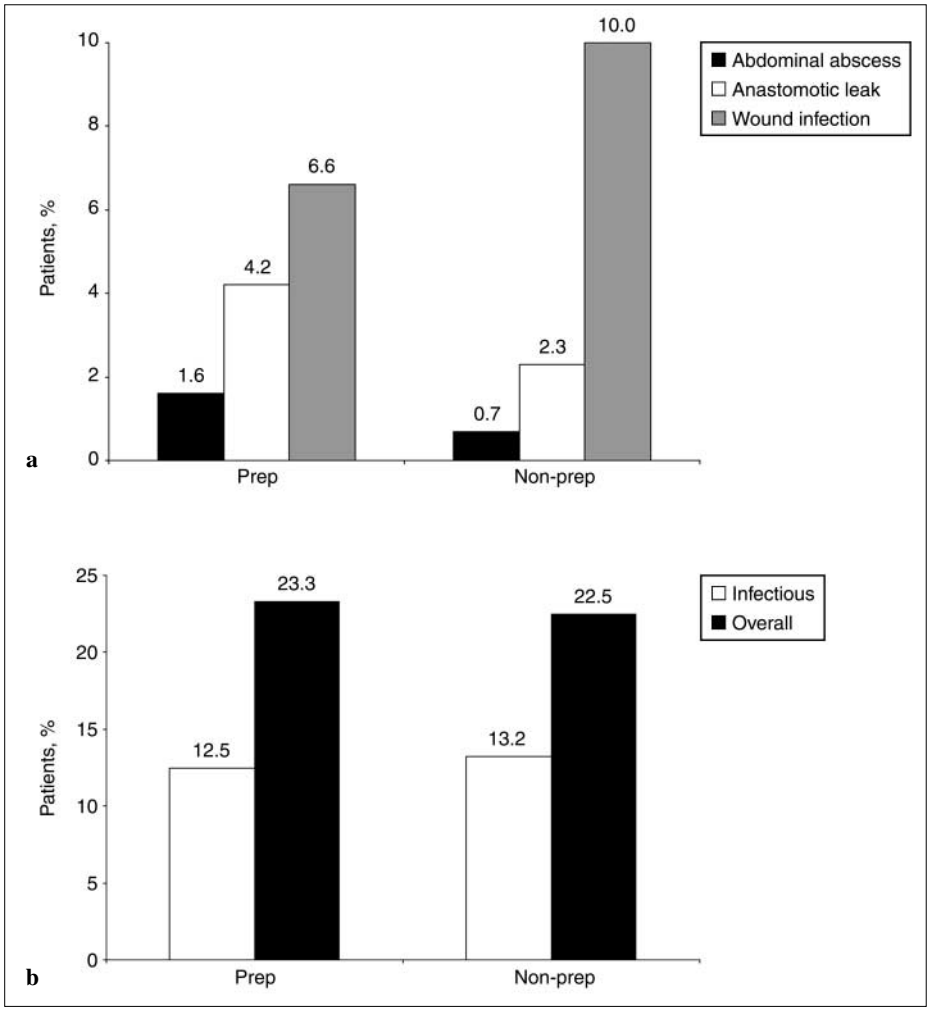

Fig. 1a, b *Postoperative complications in 249 patients 1 month after colon and rectal surgery, by study group*. **a** Infectious complications. **b** Infectious vs. total complications. Differences between groups for each type of complication are not significant

Discussion

The large bowel is loaded with a microbacterial flora, which under normal conditions remains within the colon, in symbiotic relationship with the bowel, and is not pathogenic. In the perioperative period, this symbiotic balance may lose its normal equilibrium, resulting in an infection in sites outside the colon, such as wound infection or peritoneal sepsis [4]. It seems logical to assume that colonic bacteria leak into these sites when the bowel ends are opened during surgery. In the postoperative period, bacteria may pass through the healing anastomosis, if not completely sealed, or translocate through the nonfunctioning bowel wall. Thus, it seems only logical that reduction of the bacterial load within the colon may reduce the risk of infectious complications. For this reason, orally administered, intraluminal non-absorbable antibiotics are prescribed by some surgeons [5, 6]. Animal studies showed that the use of a combination of erythromycin and neomycin, for instance, significantly reduced bacterial counts within the colon [7]. The effect of antibiotic treatment on post-operative infectious complications, however, was not clearly demonstrated.

Although mechanical bowel preparation can rid the bowel of feces, it does not eliminate the bacterial load in the colon [8]. Some data suggest that mechanical bowel preparation by itself may cause translocation of bacteria from the colon to mesenteric lymph nodes [9, 10], but the clinical significance of this phenomenon is not clear.

The relation of colonic bacteria to the pathophysiology of anastomotic leak is even less understood, as it is clear that bacterial flora exists in the normal anastomosis, whereas anastomotic leak is an infrequent event. However, solid feces within the colon, which pass through a freshly created anastomosis, may theoretically disrupt the anastomosis [11]. Whereas content of the small bowel is liquid, it becomes progressively solid within the large bowel. Thus, if this theory is true, it is reasonable to expect that anastomosis between the small bowel and the colon may be safe without mechanical bowel preparation, whereas in left-sided anastomosis, leak rate may be higher without mechanical cleansing.

Two studies describing emergency colonic surgery reported that the anastomotic leak rate was not higher when ileo-colonic anastomosis was performed, although the bowel was not prepared [1, 2]. In a multicenter trial, 97 patients with malignant left colonic obstruction were randomized to have either a segmental colon resection with on-table bowel lavage, or a subtotal colectomy. Although there was a slight trend towards a higher infectious complication rate in the subtotal colectomy group, the difference was not statistically significant [1].

The current prospective randomized study suggests that there may also be no advantage to mechanical bowel preparation when a left-sided anastomosis is electively performed. There was no significant difference in the rate of postoperative anastomotic leak, wound infection, abdominal abscess, and overall infectious complications, between patients who had an elective primary left-sided large bowel anastomosis with mechanical bowel preparation and without mechanical cleansing. These data stand against the theory that anastomotic leak is a result of mechanical disruption of the anastomosis by feces, and infectious complications are related to the colonic fecal load. The results of this study are in line with the results of animal models of left-sided anastomosis without mechanical bowel preparation [12], and with previous randomized [3, 13–16] and non-randomized [17–19] prospective studies with mechanical bowel preparation in unselected groups of patients, showing no advantage of mechanical bowel preparation.

As it is our policy to routinely divert most of the cases requiring colo-anal anastomosis, regardless of the type of preparation, the number of such cases in the current series (8 cases, 3% of the entire series) is low, and caution should be used applying these results to rectal surgery with colo-anal anastomosis. Specific data on the safety of a colo-anal anastomosis without mechanical bowel preparation should be the scope of further investigation, before firm conclusions regarding this type of anastomosis can be drawn.

The results of this prospective randomized study suggest that elective left-sided anastomosis may be safely performed without mechanical preparation. Multicenter studies should test the reproducibility of these results, however, before a change in this time-honored practice can be recommended.

References

1. The SCOTIA Study Group (1995) Single-stage treatment for malignant left-sided colonic obstruction: a prospective randomized clinical trial comparing subtotal colectomy with segmental resection following intraoperative irrigation. Subtotal colectomy versus on-table irrigation and anastomosis. Br J Surg 82:1622–1627
2. Torralba JA, Robles R, Parrilla P et al (1998) Subtotal colectomy vs. intraoperative colonic irrigation in the management of obstructed left colon carcinoma. Dis Colon Rectum 41:18–22
3. Zmora O, Mahajna A, Bar-Zakai B et al (2003) Colon and rectal surgery without mechanical bowel preparation. A randomized prospective trial. Ann Surg 237:363–367
4. Brachman PS, Dan BB, Haley RW et al (1980) Nosocomial surgical infections: incidence and cost. Surg Clin North Am 60:15–25
5. Coppa GF, Eng K (1988) Factors involved in antibiotic selection in elective colon and rectal surgery. Surgery 104:853–858
6. Clarke JS, Condon RE, Bartlett JG et al (1977) Preoperative oral antibiotics reduce septic complications of colon operations: results of prospective, randomized, double-blind clinical study. Ann Surg 186:251–259

7. Groner JI, Edmiston CE Jr, Krepel CJ et al (1989) The efficacy of oral antimicrobials in reducing aerobic and anaerobic colonic mucosal flora. Arch Surg 124:281–284
8. Lindsey JT, Smith JW, McClugage SG Jr, Nichols RL (1990) Effects of commonly used bowel preparations on the large bowel mucosal-associated and luminal microflora in the rat model. Dis Colon Rectum 33:554–560
9. Kale TI, Kuzu MA, Tekeli A et al (1998) Aggressive bowel preparation does not enhance bacterial translocation, provided the mucosal barrier is not disrupted: a prospective, randomized study. Dis Colon Rectum 41:636–641
10. Poole GV (1991) Spontaneous bacterial peritonitis during bowel preparation: an example of clinical translocation. South Med J 84:1412–1413
11. O'Dwyer PJ, Conway W, McDermott EW, O'Higgins NJ (1989) Effect of mechanical bowel preparation on anastomotic integrity following low anterior resection in dogs. Br J Surg 76:756–758
12. Schein M, Assalia A, Eldar S, Wittmann DH (1995) Is mechanical bowel preparation necessary before primary colonic anastomosis? An experimental study. Dis Colon Rectum 38:749–752
13. Brownson P, Jenkins S, Nott D, Ellenbogen S (1992) Mechanical bowel preparation before colorectal surgery: results of a prospective randomized trial. Br J Surg 79:461–462 (abstract)
14. Burke P, Mealy K, Gillen P et al (1994) Requirement for bowel preparation in colorectal surgery. Br J Surg 81:907–910
15. Santos JC Jr, Batista J, Sirimarco MT et al (1994) Prospective randomized trial of mechanical bowel preparation in patients undergoing elective colorectal surgery. Br J Surg 81:1673–1676
16. Miettinen RP, Laitinen ST, Makela JT, Paakkonen ME (2001) Bowel preparation with oral polyethylene glycol electrolyte solution vs. no preparation in elective open colorectal surgery: prospective, randomized study. Dis Colon Rectum 43:669–675
17. Gekdere D, Fa-Si-Oen P, Noach LA et al (2002) Complications after colorectal surgery without mechanical bowel preparation. J Am Coll Surg 194:40–47
18. Memon MA, Devine J, Freeney J, From SG (1997) Is mechanical bowel preparation really necessary for elective left sided colon and rectal surgery? Int J Colorectal Dis 12:298–302
19. Duthie GS, Foster ME, Price-Thomas JM, Leaper DJ (1990) Bowel preparation or not for elective colorectal surgery. J R Coll Surg Edinb 35:169–171