Preoperative Bowel Preparation: Surgical Standard or Past?

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Key Words

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Abstract

Background: Preoperative bowel preparation is still routinely used prior to colorectal surgery. This concept is based on traditional and personal empiricism and usually not evidence based. The objective of the present review was to reassess this dogma against the background of the highest level of evidence published thus far. **Methods:** The Medline database was searched using the search terms 'preoperative', 'bowel' and 'preparation' limited to 'randomized controlled trials' and 'meta-analyses'. Ten randomised controlled trials and seven meta-analyses comparing orthograde bowel cleansing to no preoperative bowel preparation were considered for rates of anastomotic leakages, surgical infections and other types of complications, reoperations and mortality. **Results:** All the most recent meta-analyses showed a significant increase of anastomotic dehiscences in patients with preoperative orthograde bowel cleansing. Additionally, a trend towards higher rates of surgical infectious complications and re-operations was revealed. Mortality remained unchanged by preoperative orthograde bowel cleansing. **Conclusion:** Routine preoperative orthograde bowel cleansing is no longer justified prior to colorectal surgery in general due to increased risk of anastomotic leakages. Further investigations should focus on different types of bowel

preparation in situations where preoperative bowel preparation still may have a role such as total mesorectal resection with low anastomosis and protective ileostomy.

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Introduction

Bowel preparation by orthograde cleansing prior to colorectal surgery is still commonly recommended in several practical guidelines [1, 2]. Accordingly, surveys in Europe [3] and the USA [4] showed a widespread application of preoperative bowel preparation with more than 99% surgeons using it in the USA. The main intention of such a practice is to reduce postoperative complications in addition to easing the intra-operative handling of the bowel. Especially the idea of decreasing postoperative complications such as anastomotic dehiscences, intra-abdominal septic complications and wound infections was nourished by the fact that these kinds of complications caused about half of the postoperative deaths in earlier patient series [5, 6]. Since both the rate of anastomotic dehiscences and infections were attributed to an elevated intestinal contamination [7, 8], emptying the colon of its content seemed to be a logical step prior to interventions. Thus, preoperative bowel cleaning was established as a dogma in the early seventies [8–10]. However, there has always been little evidence to base the concept of preoperative bowel preparation on. Hughes [11] in 1972 was the

first to question the importance of preoperative bowel preparation in a randomized trial comparing preoperative enemas to no preoperative bowel preparation. Further indications of the limited utility of preoperative bowel preparation came from emergency colon surgery [12, 13] and from uncontrolled patient series [14, 15]. Here, low rates of anastomotic leakage and postoperative infection were achieved not with preoperative bowel preparation, but rather with consistent antibiotic prophylaxis that proved to be effective in reducing infections after colon surgery [16].

Fortunately, today we have access to better evidence. Thus, we reviewed the literature with the highest level of evidence in order to reassess the dogma of preoperative bowel preparation and to clarify how essential it is, if at all.

Methods

In order to find the latest literature with the highest level of evidence to base the following statements on, a MEDLINE database search was performed with the search terms 'preoperative', 'bowel' and 'preparation' limited to 'randomized controlled trials' (RCTs) and 'meta-analyses'. Regarding RCTs, only trials published as original articles comparing orthograde bowel cleansing (OBC) to no preoperative bowel preparation were considered. All the reference lists in the selected articles were screened for additional trials using the same criteria.

Nine relevant RCTs [17–25] (table 1) and 7 meta-analyses conducted by 5 different authors [26–32] (table 2) were retrieved. The meta-analyses included 3 RCTs published only as abstracts [33–35]. Two of these, however, were published later as original articles [17, 19] and therefore also listed in table 1. One additional RCT [36] not displayed in table 1 was included as a subgroup in the subsequent larger RCT by Fa-Si-Oen et al. [19]. The RCT by Fillmann et al. [20, 37] was published twice and thus, only counted once.

Results

Anastomotic Dehiscences

Because prevention of anastomotic dehiscence is one of the main goals of OBC, all trials considered here focused on this issue. Apart from Burke et al. [18] all other RCTs showed fewer anastomotic dehiscences without OBC. Due to lack of power all but the trials of Tabusso et al. [24] and Brownson et al. [33] (1.5% for no OBC versus 11.9% for OBC; only published as abstract and therefore not included in table 1) failed to reach statistical significance. All the meta-analyses suggested no OBC to be superior. However, only the 5 or 4 most recent, respectively (2 of them [29, 32] included the same 9 RCTs and were

performed by the same author group), reached the level of significance.

A few RCTs stratified the risk of anastomotic dehiscence to the site of anastomosis. Most of the authors investigated study populations with all kinds of colorectal resections. Burke et al. [18] and Bucher et al. [17] included only left-sided colectomies; Fa-Si-Oen et al. [19] excluded ileocolonic and extraperitoneal colorectal anastomoses. Burke et al. [18] distinguished between patients with left-sided hemicolectomies (n = 54; 28 without, 26 with OBC), anterior resections (n = 40; 23 without, 17 with OBC) and low anterior resections (n = 75; 36 without, 39 with OBC). No patient with left-sided hemicolectomy and anterior resection suffered any anastomotic problems. After low anterior resection anastomotic dehiscence was present in 7 patients regardless of whether OBC had been done or not (11.1% for no OBC versus 7.7% for OBC; p = 0.91). Miettinen et al. [21] reported 5 of 7 anastomotic dehiscences to be found in patients with low colonic anastomosis with a trend towards higher leakage rates in the group with OBC (14.3% for no OBC versus 33.3% for OBC; p = 0.28). In the series of Ram et al. [22] the 3 anastomotic dehiscences all occurred after anterior resection with a trend towards higher leakage rates in the group without OBC (10.0% for no OBC versus 3.3% for OBC; p value not stated). Fa-Si-Oen et al. [19] summarized that regarding the occurrence of anastomotic dehiscences between left and right hemicolectomies there was no significant difference. The only meta-analyses stratifying the risk of anastomotic dehiscence to the site of anastomosis are those by Guenaga et al. [28, 29]. In the updated version of 2005 [29], they calculated similar odds ratios (OR) regarding OBC for patients with low anterior resections (1.45; 95% confidence interval (CI) 0.57–3.67) as for patients with other colonic resections (OR 1.8; CI 0.68–4.75).

Another interesting observation was made by Slim et al. [31] in their meta-analysis. They assessed trials in which polyethylene glycol (PEG) was used as an OBC solution, opposed to trials with other kinds of OBC solutions. After OBC with PEG the rate of anastomotic leakage was significantly higher than without OBC (OR 1.92; CI 1.03–3.60). Although the results still favored no OBC they were not significant for other preoperative bowel preparation regimes (OR 1.43; CI 0.59–3.45).

Surgical Infectious Complications

Another main issue of OBC is to limit surgical infectious complications after colorectal resections. Accordingly, this issue was also investigated in all the studies considered. Two main types of surgical infections –

Table 1. Randomized controlled trials comparing no preoperative bowel preparation versus orthograde bowel cleansing regarding main issues such as anastomotic dehiscences and surgical infectious complications

Author	Number of patients	Solution for OBC	Anastomotic dehiscences, %	Wound infections, %	Intra-abdominal infections, %
Burke et al. [18]	87 vs. 82	sodium picophosphate	4.6 vs. 3.7	3.4 vs. 4.9	not available
Santos et al. [23]	77 vs. 72	mannitol	5.2 vs. 9.7	11.7 vs. 23.6*	not available
Fillmann et al. [20] (Portuguese)	30 vs. 30	mannitol	3.3 vs. 6.6	6.7 vs. 3.3	not available
Miettinen et al. [21]	129 vs. 138	PEG	2.3 vs. 3.6	2.3 vs. 3.4	3.1 vs. 2.2
Tabusso et al. [24] (Spanish)	23 vs. 24	mannitol or PEG	0 vs. 20.8*	0 vs. 8.3	0 vs. 13
Zmora et al. [25]	193 vs. 187	PEG	2.1 vs. 3.7	5.7 vs. 6.4	1.0 vs. 1.1
Bucher et al. [17]	75 vs. 78	PEG	1.3 vs. 6.4	5.3 vs. 12.8	2.6 vs. 2.6
Fa-Si-Oen et al. [19]	125 vs. 125	PEG	4.8 vs. 5.6	5.6 vs. 7.2	not available
Ram et al. [22]	165 vs. 164	sodium phosphate	0.6 vs. 1.2	6.1 vs. 9.8	0.6 vs. 0.6

OBC = Orthograde bowel cleansing; PEG = polyethylene glycol.

* Statistically significant.

Table 2. Meta-analysis comparing no preoperative bowel preparation versus orthograde bowel cleansing regarding main issues such as anastomotic dehiscences and infectious complications

Author	Number of trials	Number of patients	Anastomotic dehiscences (rates in %)	Wound infections (rates in %)	Intra-abdominal infections (rates in %)
Platell et al. [30]	3	497	rates: 8.1 vs. 10.8 OR: not available	rates: 7.4 vs. 10.8* OR: not available	rates: not available OR: not available
Bucher et al. [27]	5	1,144	rates: 5.3 vs. 2.8 OR: 1.76; CI 0.96–3.22	rates: 5.7 vs. 6.4 OR: 1.37; CI 0.86–2.19	rates: 1.9 vs. 3.2 OR: 1.48; CI 0.62–3.56
Guenaga et al. [28]	6	1,159	rates: 2.9 vs. 5.5 OR: 1.94; CI 1.09–3.43*	rates: 5.7 vs. 7.4 OR: 1.33; CI 0.85–2.13	rates: 8.4 vs. 9.8 OR: 1.2; CI 0.70–2.04
Bucher et al. [26]	7	1,297	rates: 2.8 vs. 5.6 OR: 1.84; CI 1.08–3.22*	rates: 5.5 vs. 7.5 OR: 1.38; CI 0.89–2.15	rates: 2.0 vs. 3.7 OR: 1.69; CI 0.76–3.75
Slim et al. [31]	7	1,454	rates: 5.6 vs. 3.2 OR: 1.74; CI 1.05–2.90*	rates: 5.7 vs. 7.4 OR: 1.33; CI 0.88–2.03	rates: not available OR: not available
Wille-Jørgensen et al. [32]	9	1,592	rates: 3.2 vs. 6.2 OR: 2.03; CI 1.28–3.26*	rates: 5.4 vs. 7.4 OR: 1.46; CI 0.97–2.18	rates: 8.4 vs. 9.8 ^a OR: 1.2; CI 0.70–2.04 ^a

Rates in percent. OR = Odds ratio (values >1.0 favor no bowel preparation); CI = 95% confidence interval.

* Statistically significant; ^a only reported in the publication by Guenaga et al. [28].

wound infections and other intra-abdominal infections – were focused on.

Wound infection rates were higher in all the RCTs after OBC except for the one of Fillmann et al. [20] (table 1). However, the difference of 6.7 vs. 3.3% in this study was not significant. The trial of Santos et al. [23] was the only one with a significantly higher wound infection rate of 23.6% after OBC compared to 11.7% after no OBC. Remarkable was the overall high rate of wound infections of 17.4% in this study. All meta-analyses revealed a trend towards decreased wound infection rates with Platell et

al. [30] being the only one who found a significant advantage for no OBC (table 2).

Intra-abdominal infections such as abscesses and peritonitis were investigated in only 5 RCTs [17, 21, 22, 24, 25] (table 1) and 3 meta-analyses [26–28] (table 2). Three trials showed similar results regardless if OBC was performed or not [17, 22, 25]. Only in the RCT of Miettinen et al. [21] was a slight advantage revealed in favor of OBC, but this was not statistically significant. Tabusso et al. [24] found an insignificant increase of intra-abdominal infections after OBC, and Brownson et al. [33], whose results

Table 3. Randomized controlled trials comparing no preoperative bowel preparation versus orthograde bowel cleansing regarding additional issues such as other than surgical infectious complications, re-operations, mortality and hospital stay

Author	Number of patients	Others than surgical infectious complications, %	Re-operations, %	Mortality, %	Hospital stay, days
Burke et al. [18]	87 vs. 82	10.3 vs. 9.8	not available	0 vs. 2.4	not available
Santos et al. [23]	77 vs. 72	not available	1.3 vs. 5.6	0 vs. 0	not available
Fillmann et al. [20] (Portuguese)	30 vs. 30	16.6 vs. 10.0	not available	not available	not available
Miettinen et al. [21]	129 vs. 138	5.0 vs. 8.0	2.3 vs. 5.1	0 vs. 0	8 vs. 8
Tabusso et al. [24] (Spanish)	23 vs. 24	not available	0 vs. 0	not available	11 vs. 14*
Zmora et al. [25]	193 vs. 187	28.0 vs. 28.3	not available	1.6 vs. 1.6	8 vs. 8
Bucher et al. [17]	75 vs. 78	10.6 vs. 24.4*	2.7 vs. 9.0	0 vs. 0	10 vs. 15*
Fa-Si-Oen et al. [19]	125 vs. 125	not available	8.8 vs. 10.8	not available	9 vs. 10
Ram et al. [22]	165 vs. 164	27.3 vs. 33.5	1.2 vs. 1.2	1.2 vs. 1.2	8 vs. 8

* Statistically significant.

were only published as an abstract, calculated even a significant disadvantage for OBC (2.2% for no OBC versus 9.3% for OBC). Probably as a consequence of including also the results of Brownson et al. [33], all 3 meta-analyses dealing with intra-abdominal infections showed a slight but not significant advantage in favor of no OBC.

Other Complications

Other complications were analyzed in 6 of 9 RCTs (table 3). A significant difference in favor of no OBC was reported in the study of Bucher et al. [17]. Additionally, in the studies of Miettinen et al. [21] and Ram et al. [22] a trend towards an increase of such complications was seen after OBC. The only study indicating a decrease was the one by Fillmann et al. [20]. There were three meta-analyses, the second one of Bucher et al. [26] and both by Guenaga et al. [28, 29] focusing on these kinds of complications. Bucher et al. [26] calculated an OR of 1.15 (CI 0.79–1.7) in favor of no OBC. Guenaga et al. [28, 29] differentiated between infectious (OR 0.87; CI 0.41–1.87 in both studies) and noninfectious (1.19; 0.61–2.32 in the earlier and 1.09; 0.75–1.58 in the later study) extra-abdominal complications (an OR >1 favouring no OBC). Four authors looked at the duration of postoperative bowel restoration and ileus, respectively, as a particular postoperative problem. Miettinen et al. [21] and Zmora et al. [25] reported equal rates of postoperative ileus regardless of whether OBC was done (1.6% for no OBC versus 0.7% for OBC and 3.1 vs. 3.7%, respectively). Fa-Si-Oen et al. [19] and Bucher et al. [17] recorded the postoperative time until the first bowel movements. Fa-Si-Oen

et al. [19] found the same duration in both groups. Bucher et al. [17], however, had a significantly prolonged bowel restoration after OBC of 3.9 vs. 2.5 days.

Re-Operations

Six RCTs investigated the rate of re-operations (table 3). When OBC was applied re-operation rate was either higher or similar but not lower in any trial. A distinct trend towards increased re-operation rates was detected in the trials of Santos et al. [23], Miettinen et al. [21] and Bucher et al. [17] but none of the findings was statistically significant. Meta-analyses dealing with re-operation rates were those of Bucher et al. [26, 27] and Guenaga et al. [28, 29]. Bucher et al. [17] calculated insignificant higher re-operation rates in both of his meta-analyses (OR 1.54; CI 0.64–3.72 in the earlier and 1.72; 0.81–3.65 in the later study), similar to the results of Guenaga et al. [28, 29] (1.40; 0.56–3.49 and 1.8; 0.81–3.98, respectively). Four authors itemized the reasons for re-operations [17, 21–23]. Twenty of 27 re-operations in total (74.1%) were related to anastomotic dehiscences and surgical infectious complications.

Mortality

Mortality was a rare event and equally occurring in both the no OBC and OBC group (table 3). Only in the study of Burke et al. [18] there was a slight difference with no mortality in the no-OBC group with 36 patients, compared to 2 deaths in the OBC group with 39 patients. Four of 12 deaths (33.3%) reported in 6 studies [18, 19, 21–23, 25] were related to surgical infectious complications, the

remaining ones to cardiopulmonary problems. Five of 7 meta-analyses went for the calculation of an OR for mortality although there was only a maximum of 8 deaths in the most recent study by Guenaga et al. [29]. The respective ORs were 1.42 (CI 0.37–5.45) by Bucher et al. [26], 7.95 (0.49–128.34) in the earlier study of Guenaga et al. [28], 1.56 (0.45–5.45) by Slim et al. [31] and 1.72 (0.43–6.95) in the two most recent studies by the same author group of Guenaga, Wille-Jørgensen et al. [29, 32] (an OR >1 favoring no OBC).

Conclusion

Regarding anastomotic dehiscence and surgical infectious complications, current clinical research offers no evidence to support the claim that OBC should be performed prior to colorectal surgery. In a critical retrospective view this idea essentially seems to have been promoted by the belief that the absence of stool in the intestine must be advantageous. At no point did the current literature prove that preoperative OBC could reduce postoperative complications. On the contrary, all the most recent meta-analyses (table 2) revealed a significant increase of risk for anastomotic dehiscences after OBC. Indeed, this observation is in accordance with some experimental studies indicating histological damage and impairment of anastomotic healing after bowel preparation prior to colonic resection [38–40]. But even the rate of surgical infectious complications such as wound infections, abscesses and peritonitis could not be lowered by preoperative OBC according to the highest level of evidence in the literature. This also is not surprising when one takes into account that preoperative bowel preparation does not reduce bacterial contamination in either the abdominal cavity or the subcutis [36]. Furthermore, potential side-effects such as electrolytic and hydration disorders, patient discomfort, medical and nursing labor and – as a consequence – costs have to be taken into consideration. Omitting OBC may, for example, decrease

hospital stay which was indicated by the RCTs of Tabusso et al. [24] and Bucher et al. [17]. Hospital stay may not only be reduced due to the shortening of the preoperative phase but may also be attributed to a decreased re-operation rate and reduction of postoperative ileus. Thus, our review revealed a trend towards higher re-operation rates. Concerning postoperative ileus, which was intended to be shortened by preoperative bowel preparation, our review showed no advantage for OBC. Bucher et al. [17] as 1 of 4 authors [17, 19, 21, 25] focusing on this issue reported in his RCT even a prolongation of time until the first bowel movements.

Probably, there may be particular situations in which OBC could be useful. For example, rectum resection with total mesorectal excision and low anastomosis may benefit from OBC. In these operations, a protective stoma is commonly recommended because, in spite of an excellent technique, the rate of anastomotic leakages remains a problem in this region [41]. In this regard, a cleaned bowel might be an advantage for the further course when anastomotic leakage occurs. Otherwise, no protective stoma would be needed. Furthermore, the question whether anastomotic dehiscence can be prevented at least in the low extraperitoneal region is unanswered. Although, all authors [18, 19, 21, 22, 28, 29] stratifying the risk of anastomotic dehiscence to the site of anastomosis failed to find an advantage for OBC after low colorectal anastomosis. Another issue might be the type of solution used for OBC. If there remains a reason for performing OBC then it would be of use to know the best tolerated and most effective agent for it. An observation in this regard was made by Slim et al. [31] in their meta-analysis, as they had recognized that anastomotic dehiscences were only increased significantly after OBC with PEG but not with other OBC solutions.

In conclusion, OBC as a general recommendation before colorectal resections should be omitted. There might be some exceptions with a benefit for OBC worthy of future investigations.

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