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[Ludovít Danihel](#)<sup>\*</sup>, Marián Cerný, Ivor Dropco, Petra Zrníková, Milan Schnorrer, [Marek Smolár](#), Miloslav Misaník, Stefan Durdík

Posted Date: 27 June 2024

doi: 10.20944/preprints202406.1965.v1

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Article

# Preoperative Mechanical Bowel Preparation Does Not Affect the Impact of Anastomosis Leakage in Left Side Colorectal Surgery – A Single Center Observational Study

Ludovít Danihel <sup>1,2</sup>, Marián Černý <sup>3</sup>, Ivor Dropco <sup>4</sup>, Petra Zrníková <sup>5</sup>, Milan Schnorrer <sup>1</sup>, Marek Smolár <sup>6</sup>, Miloslav Mišánik <sup>6</sup> and Štefan Durdík <sup>7,\*</sup>

<sup>1</sup> 3rd Surgical Clinic, Faculty of Medicine, Comenius University in Bratislava, Slovakia,

<sup>2</sup> Surgical Department Bory Pentahospitals, Bratislava, Slovakia

<sup>3</sup> Klinik für Allgemein-, Viszeral-, Thorax-, Adipositas-, Gefäß- und Kinderchirurgie, Passau, Germany

<sup>4</sup> Klinik und Poliklinik für Chirurgie Universitätsklinikum Regensburg, Germany

<sup>5</sup> Medicalen, Martin, Slovakia

<sup>6</sup> Clinic of General, Visceral and Transplant Surgery, Jessenius Faculty of Medicine, Martin, Comenius University Bratislava, Slovakia

<sup>7</sup> Department of Surgical Oncology, Faculty of Medicine, Comenius University in Bratislava, Slovakia)

\* Correspondence: stefan.durdik@ousa.sk

**Abstract:** Even despite rapid advances in colorectal surgery, morbidity and mortality rates in elective gastrointestinal surgery play a significant role. For decades, there have been tempestuous discussions on preventive measures to minimize the risk of anastomotic dehiscence. When mechanical bowel preparation before elective procedure, one of the key hypotheses, has been introduced into practice, it was assumed that it would decrease number of infectious complications and anastomotic dehiscence. The advancements in antibiotic treatment supported concomitant administration of oral antibiotics and mechanical bowel preparation. In the prospective study conducted at our clinic, we performed left-side colorectal procedures without the prior mechanical preparation. All patients enrolled in the study underwent the surgery and had been observed in the 3rd Surgical Clinic, Faculty of Medicine, Comenius University in Bratislava, Slovakia, from January 2019 to January 2020. As a control group we used similar group of patients with MBP. Our observed group included 87 patients with tumors in the left part of their large intestine (lineal flexure, descendent colon, sigmoid colon, and rectum). Dixon laparoscopic resection was performed in 26 patients. Sigmoid laparoscopic resection was performed in 27 patients. In 12 patients, the procedure was started laparoscopically but had to be converted due to adverse anatomical conditions. The conservative approaches mostly included Dixon resections (19 patients), sigmoid colon resection (5 patients) and left side hemicolectomy (6 patients), and Miles' tumor resection with rectal amputation (4 patients). Our study highlighted the fact that MBP does not have the unequivocal benefit for patients with colorectal infection, which has an impact on development of anastomotic dehiscence.

**Keywords:** mechanical bowel preparation; colorectal surgery; anastomosis leakage; antibiotics; safety

## 1. Introduction

Infectious complications in colorectal surgery are frequent problems, despite the attempt to reduce SSI (5.4-22.4%) and anastomotic dehiscence, the incidence rate of which remains 2-10%. The risk of anastomotic dehiscence increases in low rectal resections or complex inflammatory diseases [1,2]. The first doubts about the need for mechanical bowel preparation were identified when improved well-being was observed in patients who underwent urgent gastrointestinal surgical

procedures. Several studies have presented similar outcomes of surgical procedures, including complications, regardless of the form of pre-operative preparation. Apart from that, in pre-operative preparation there are no standardized procedures, so each clinic follows their routine practices. Despite a high number of studies with ambiguous results of preferring MBP available since 1990 [3,4], When MBP has been introduced into practice, the key hypothesis assumed that intraluminal content, feces, will get reduced, and thus minimize the risk of anastomotic dehiscence and incidence of infection (SSI). Secondary benefits included the possibility of performing perioperative tumor palpation and perioperative colonoscopy. As opinion on MBP has been changing over time, regimens and agents used for bowel preparation developed as well. Dietary restrictions, even fasting, and colon lavage were an original framework of pre-operative preparation of the large intestine. However, discomfort of the patient related to clyster and laxatives, a threat of non-adequate low-calorie intake prior exacting surgical procedure as well as several days of pre-operative hospitalization, during which basic food is served, have been identified as unimportant and expensive. Then an orthograde colon lavage with an intake of a large volume of saline was used [5].

Mannitol (a type of sugar alcohol used as a sweetener) compared to saline has been found to be a great lavage agent with minimum side effects on the human body. The case reports and fear of explosion resulting from the use of electrocautery during the surgery prevented global acceptance of this agent for the pre-operative preparation of the large intestine [6].

Polyethylene glycol (PEG) lavage solution was introduced for the first time in 1980 [7]. Several studies have confirmed their safety, efficacy and tolerability compared to conventional regimes of bowel preparation [8]. When a PEG regime was used, changes in mucosa in the intestinal wall had been observed, in particular loss of surface mucus and epithelial cells as well as inflammatory changes [9].

Despite a large number of scientific research studies on MBP in colorectal surgery, there is a question if MPB is necessary at all. The first doubts about the necessity of performing MBP were published in the study by Hughes in 1972 [10]. The counter-theory claims that the routinely performed mechanical bowel preparation is no longer recommended in the era of antibiotic therapy, because there is a risk of developing electrolyte disbalance such as hypokalemia and hypocalcemia, especially in the older adults. At the same time, dilution of feces is believed to increase the probability of leakage and contamination by feces [11]. Also, the ERAS protocol questions its importance [12]. The National Institute of Health and Clinical Excellence (NICE) in the United Kingdom does not recommend performing MBP any more in order to decrease SSI and risk of anastomotic dehiscence [13]. Various meta-analyses have not shown any significant benefit of MBP for the patients with an elective colorectal procedure when compared to the patients who did not undergo it [14,15]. Nowadays, intravenous antibiotic prophylaxis at the beginning of anesthesia administration is considered the standard procedure in elective colorectal surgery [16]. Opinions on this topic vary widely in clinical practice, not only between health professionals in different countries and towns, but also between those working at the same clinic, which indicates that the approach to this procedure remains yet ununified.

Our study analyses the incidence of anastomotic dehiscence and early post-operative complications in patients after an elective left side surgical procedure without mechanical bowel preparation.

## 2. Methods

All patients enrolled in the study underwent the surgery and had been observed in the 3rd Surgical Clinic, Faculty of Medicine, Comenius University in Bratislava, Slovakia, and Merciful Brothers University Hospital in Bratislava from January 2019 to January 2020. They were provided detailed information about the type of the study and gave their consent to take part in it. The study was approved by the ethics committee.

Our observed group included 87 patients with tumors in the left part of their large bowel (lienal flexure, descendent colon, sigmoid colon, and rectum). The pre-operative bowel preparation we prefer starts at home. It includes a low-residue home-made diet, which the patient eats for 5 days before the scheduled hospital admission for the procedure to be performed (Table 1). Composition

of allowed foods and the way of their preparation is described in Table 1. After hospital admission, one day before the procedure, the patient intakes liquids only. In the evening before the day of the procedure, a “large” clisma (1,000 ml hot water + 150 ml borax-glycerin) was administered. In the morning before the procedure, a “smaller” clisma (50 ml hot water + 100 ml borax-glycerin) was administered.

Shortly before the surgical procedure, all patients were administered i.v. prophylactic antibiotics currently approved by the antibiotic committee in our hospital. On the day of the surgery, 2 hours before the procedure, the patients were advised to drink 200 ml of sweet tea or fruit juice without flesh.

An important part of our pre-operative preparation approach is also a correct triage of the patients by their malnutrition risk (Table 2). Pre-operative administration of a nutridrink is not necessary in the low-risk patients. In addition to the recommended diet, the patients in moderate and high risk are administered 1-2 nutridrinks a day. All patients in both groups had a low malnutritional risk, therefore consumption of nutridrinks prior the surgical procedure was not necessary.

In the group of our interest, we observed a type of surgical procedure, a type of anastomosis performed (hand-sewn anastomosis or stapled anastomosis), a degree of conversion from laparoscopy to laparotomy, and morbidity and mortality rates. We evaluated early post-operative complications by their type (wound complications, anastomotic leakage, need for re-surgery). To have a control group, in order to evaluate our results objectively, we compared our group of patients with a group of patients with mechanical bowel preparation, with comparable peri- and postoperative risks as well as similar comorbidities.

### 3. Results

In total, 87 patients, 54 men and 33 women, were enrolled in our study with an average age of 64.02 years.

Dixon laparoscopic resection was performed in 26 patients. Sigmoid laparoscopic resection was performed in 27 patients. In 12 patients, the procedure was started laparoscopically but had to be converted due to adverse anatomical conditions. The conversion rate was 18.46%. The conservative approaches mostly included Dixon resections (19 patients), sigmoid colon resection (5 patients) and left side hemicolectomy (6 patients), and Miles’ tumor resection with rectal amputation (4 patients). In 75 cases (86.2%), the anastomosis was performed by a circular stapler. In the rest of the cases (9,19%), the anastomosis was performed by hand-sawing.

Five patients from the other observed group experienced anastomotic leakage confirmed by the CT scan. One patient needed re-surgery. In 4 cases, the post-operative increase of sanguinolent waste to drain has occurred. Conservative therapy was successful in all these cases (Table 3). Postoperative complication rates of the patients were analyzed according to the Clavien-Dindo complication grade and when all groups were evaluated, major complication (3b and above) was seen in 3 patients.

Wound complications in a form of surgical wound seroma have occurred in 2 patients (2.3%). Their treatment included drainage and re-dressing (Table 4).

Our control group enrolled 98 patients, 63 men and 35 women, with an average age of 65,12 years. Laparoscopic resection was done by 73 patients and conservative therapy by 22 patients. Conversion from laparoscopy to laparotomy was needed by 4 patients.

We did not find a significant difference between the two groups, which basically conditions the fact that MBP is not decisive in relation to the occurrence of anastomotic leakage in left-sided colorectal procedures

### 4. Discussion

Pre-operative mechanical bowel preparation has been introduced to visceral surgery more than 120 years ago. The primary reason was a high rate of infectious complications in an elective colorectal surgery. It has been even believed that besides surgeon’s experience, the outcomes of the surgical procedure are influenced by a degree of bowel clearance. Since then, mechanical bowel preparation methods have found their place in a wide range of procedures. The discovery of antibiotics and their combination with MBP have decreased the number of perioperative infections.

In the 1970s in the 20th century, MBP became a commonly used and accepted technique by surgeons. During this period, a wide range of various methods had been developed, ranging from dietary restrictions to lavages by large volumes of saline solution administered by a nasogastric tube [17,18].

Polyethylene glycol solutions used up to date have been introduced shortly after this period as a better option to former regimes. Benefits included better tolerability by the patient, minimal systemic absorption with a decreased disruption of the inner environment of the human body and electrolytes, and their use was less time-consuming. In 1972, Hughes was first who questioned the role of MBP. He claimed that a threat of sepsis and complications related to anastomoses is not higher in the unprepared bowel, and thus bowel preparation is not important at all [10]. In 1987, Irving and Scrimgeour confirmed this evidence in their publication consisting of a series of case reports with patients without bowel preparation and without anastomotic complications [19]. Evidence for this theory was observed mainly in traumatological patients with a low percentage of post-operative infections after urgent intestinal procedures without prior bowel preparation, which also resulted in re-evaluation of MBP [20,21].

Thanks to advances in surgical techniques, instruments, and post-operative care, the well-being of patients who underwent the urgent procedure has improved. This raised the question if MBP is necessary in the elective procedure at all. Negative impact of MBP on the anastomotic dehiscence rate, the insufficient effectivity of mechanical preparation and its application have decreased its use in clinical practice [22]. The results of randomized trials and meta-analyses conducted in recent years helped to understand that mechanical bowel preparation does not have any benefit for post-operative outcomes [23,24].

The pre-operative and perioperative administration of oral and/or venous antibiotics prior to MBP has been getting a more significant role. The number of randomized multicentric studies evaluating various types of preparation and their combination has increased. Currently, it is known that the incidence rate of SSI in elective colorectal surgery is approximately 11.4% (5-22%). Based on the doubts about the role of MBP, first randomized clinical trials comparing the procedures with and without MBP had been conducted and published in Latin America and Europe in the 1990s [25–27], which were followed by other studies. The results were limited by the variability of the methods and the inclusive criteria applied. The most well-known one was a critical analysis of the key question comparing the procedures with and without MBP in the Cochrane Library Systemic Database review published in 2003, updated in 2005 and 2011 [28]. Surprisingly, statistical analysis revealed more insufficient anastomoses (AL) in the MBP group (6.2%) compared to the group without MBP (3.2%;  $p=0.003$ ). The authors concluded that there is no clear evidence of MBP related to decreased occurrence of AL after elective intestinal resections.

However, the system meta-analysis conducted in 2022 [29] and the publication by Toh et al. [30] pointed out that the administration of oral antibiotics was associated with a non-significant decrease in anastomotic dehiscence (AL). The summary of all the results of the randomized clinical trials revealed that the combination of oral and venous antibiotics administered to the patients undergoing an elective colorectal surgical procedure decreased the incidence rate of SSI. The most recent meta-analysis conducted by Woodfield et al. from New Zealand was published in JAMA Surgery in 2022 [29] (Table 5). They summarized data from all randomized clinical trials (RCT) conducted before 2021 available in Medline, Embase, Cochrane and Scopus databases, which aimed to match various strategies of bowel preparation with post-operative outcomes.

Primary results were focused on the incidence rates of SSI and AL. Secondary results included other infections, mortality rate, ileus, and adverse effects of the preparation. In total, 8,377 patients from 35 RCTs were identified. The combination of methods is shown in Table 5.

Important contribution has brought the MOBILE trial which compared a group with MBP and antibiotic prophylaxis with a group without mechanical bowel preparation. Especially the results of left side procedures are important for description of MBP and future trends. According to this trial, SSI in left side procedures reached 6% in patients with MBP and 10% in patients without it (OR=0.57, 95% CI=0.18-1.82;  $p=0.338$ ) [31].

The most important factor of the morbidity and mortality rate in patients with colorectal procedure is the incidence of anastomotic dehiscence. Several guidelines present dehiscence up to 8% as acceptable. Various trials and meta-analyses confirmed that MBP does not have a significant benefit in any of the defined primary goals [32–34]. These works are long-term trials published over the last 10 years, supporting the evidence that they are not tendentious works, but research based on real data [35,36] (Tables 6 and 7).

It is important to consider the role of the microbiome, which has not been sufficiently described so far. It is known that microbiome is significantly influenced by MBP and oral antibiotic prophylaxis which results in post-operative complications. Alverdy et al. supported this theory by demonstrating that the disruption of the fine balance between pathogen proliferation and natural suppression of normal microflora rearrangement [37].

The microbiome has a very wide range of health benefits for the host [38], and disrupted intestinal ecology influences both the efficacy and toxicity of adjuvant chemotherapy [39]. The importance of microbiome therefore varies, and it is unclear what harm may result from attempting to eradicate the entire microbiome of the large intestine. Diversity of intestinal microflora is considered a key component of health, and therefore, the relevance of eradicating the entire flora to surgical outcomes is questionable.

To date, no international or national surgical association has approved in their guidelines a standard scheme of pre-operative preparation of the large intestine prior to the elective colorectal surgery, nor have recommendations been made to abandon mechanical bowel clearance alone. Similarly, Canadian and Australian guidelines do not consider it necessary [40] (Table 8).

The only clearly defined recommendation is part of the ERAS (enhanced recovery after surgery) concept, which claims that mechanical bowel preparation alone has no clinical benefits and may cause dehydration and discomfort and should not be routinely performed in colorectal surgical procedures, but may be used in rectal surgical procedures.

Our study supported the evidence from the international studies. We believe that MBP in elective colorectal surgery is more than just a questionable approach and should not be performed on a regular basis, because only some patients can benefit from it. Of course in situation when a NOTES operation is made, or intracorporal anastomosis, MBP is profitable for the patient, because the contamination of intraperitoneal space is minimized due this approach. Still the new trends doesn't recommend a routine MBP. The discussion is still not over and probably it will take years to get a high recommendation from the guidelines.

Surgical site infections are in an Achilles heel condition after colorectal surgery. Within the framework of the ERAS protocols, mechanical and oral antibiotic bowel preparations have been abandoned for decades. However, the rate of anastomotic leakage, one of the most feared complications after colorectal surgery, has not changed. Contrary to dogma and popular belief, data from patients who did not undergo mechanical bowel preparation were analyzed and discussed with the current literature in this study. Surgical site infection, postoperative mortality, intraabdominal collection rates, and anastomotic leakage were similar [41].

Currently, optimized peri-surgical management should be mandatory in elective surgical procedure, because it improves post-operative recovery of a patient and decreases the morbidity rate and infectious complications [42].

## 5. Conclusion

The approach to MBP in elective colorectal surgery remains a widely discussed topic. Despite the wide range of specialized studies conducted, bowel preparation using MBP is still unclear. Although there was initial enthusiasm for MBP, gradually its role began to be questioned. Recent studies have strongly supported the evidence that not all patients can benefit from MBP. On the contrary, they confirmed that MBP can result in increased number of complications. The data from various studies have shown that MBP does not play a role in risk of developing anastomotic dehiscence. However, the future of this hypothesis depends on professional associations.

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