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REVIEW

Mechanical Preparation of the Colon before Colorectal Surgery – Is It Still Actual?

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ABSTRACT

Mechanical bowel preparation (MBP) has long been a subject of debate in colorectal surgery. While it was historically regarded as a standard preoperative practice, recent evidence has questioned its necessity and effectiveness, especially when used in isolation. This review explores the evolving role of MBP, its combination with oral antibiotics (OA), and its impact on postoperative outcomes, such as surgical site infections (SSI) and anastomotic leakage (AL). Studies suggest that MBP combined with OA offers superior benefits compared to MBP alone, particularly in left-sided colorectal and rectal surgeries. However, the role of MBP remains contentious in right-sided resections, with conflicting evidence regarding its effectiveness. Furthermore, concerns about patient discomfort, dehydration, and electrolyte imbalances have raised doubts about its routine use. Our comprehensive analysis, based on 11 years of published research, highlights that the decision to employ MBP should be individualized, taking into account the type of surgical intervention, patient comorbidities and overall health status. While MBP+OA shows promise in reducing SSI rates, further research is needed to evaluate its broader clinical implications and to explore alternatives, including newer antibiotics, to minimize reliance on MBP.

Keywords: mechanical bowel preparation, colorectal surgery, oral antibiotics.

ABBREVIATIONS

MBP: mechanical bowel preparation
AL: anastomotic leakage
SSI: surgical site infection
OA: oral antibiotics
PEG: polyethylene glycol
ERAS: enhanced recovery after surgery
OAMBP: oral antibiotics and mechanical bowel preparation

INTRODUCTION

Mechanical bowel preparation (MBP) is a preoperative procedure designed to reduce bacterial load and eliminate fecal content from the large intestine. In laparoscopic surgeries, an empty colon is preferable as it is easier to handle and allows lesion identification

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through palpation (1). Mechanical bowel preparation is employed to prevent postoperative infectious complications such as surgical site infections (SSI) in the colon, as well as to reduce the risk of anastomotic leakage and intra-abdominal abscesses.

The types of mechanical bowel preparation are classified into three categories, including osmotic agents (absorbed or non-absorbed), stimulant laxatives and regimens combining laxatives with osmotic agents (1). Polyethylene glycol-based solutions are currently the most commonly used (2). Other methods, such as enemas, dietary regimens and fasting/restrictive diets, are also used for colon cleansing but are not classified as MBP (1, 3).

The aim of this article is to assess the current role of MBP in colorectal surgery with anastomoses, focusing specifically on its impact on surgical outcomes, such as postoperative complications, anastomotic healing and infection rates, to determine its clinical utility in modern practice. ❑

MATERIALS AND METHOD

A comprehensive literature search was conducted using Web of Science, PubMed and SpringerLink databases. The search strategy included combinations of the following keywords: "mechanical", "bowel preparation", "MBP", "colorectal surgery" and "oral antibiotics." Filters were applied to select only full-text articles published in the last 11 years. Articles not published in English were excluded from the review to ensure consistency and reliability in data interpretation.

The selection process involved several steps. First, duplicate articles were removed. Then, the titles and abstracts of the remaining articles were screened to identify studies relevant to the topic. Articles that did not directly address mechanical bowel preparation or its outcomes in colorectal surgery were excluded. After the initial screening, the full texts of the remaining articles were reviewed in detail to assess their relevance and methodological quality.

To ensure a high standard of evidence, priority was given to randomized controlled trials (RCTs), meta-analyses and large cohort studies. Observational studies and case reports were included only when they provided unique insights or filled gaps in existing research. Studies focusing on pediatric populations or unrelated surgical specialties were excluded.

After careful consideration, articles that were most pertinent to the objectives of our review were included. Ultimately, a total of 40 articles met the inclusion criteria and formed the basis of our analysis. This approach ensured that the findings presented in this review are supported by the most relevant and up-to-date scientific evidence. ❑

RESULTS AND DISCUSSIONS

The use of mechanical bowel preparation in colorectal surgery remains a controversial topic, particularly in the context of colon surgery, with limited data available for rectal surgery. The rationale behind MBP is its potential to reduce bacterial colonization and fecal impaction at the anastomotic site, thereby minimizing postoperative complications such as anastomotic leakage (AL) and SSI. Additionally, bowel preparation facilitates colon emptying (4), making it easier to handle and simplifying laparoscopic procedures (5-8).

However, the impact of the procedure on increasing the operative field space is minimal, and in some cases, it may cause intestinal lumen distension, which could complicate operation (7). A 2016 study on laparoscopic colon resections demonstrated that omitting MBP did not affect operative time, conversion rates, or postoperative complications and morbidity (9). Nonetheless, recent studies report significantly lower rates of postoperative complications, particularly SSI, when MBP is employed (10). Furthermore, MBP has no influence on ileostomy closure outcomes (2).

For laparoscopic right colectomy, evidence suggests that MBP is unnecessary and may even lead to increased complication rates (8). According to the rapid guideline jointly issued by the European Association for Endoscopic Surgery (EAES), the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Society of Coloproctology (ESCP), specific recommendations are provided for preoperative bowel preparation in minimally invasive colorectal surgeries. These recommendations are tailored to the type of surgical procedure and include: a) minimally invasive right-sided colon resections – the guideline suggests either oral antibiotics (OA)

alone or a combination of MBP and OA; b) minimally invasive right-sided colon resections with planned intracorporeal anastomosis – for these procedures, the guideline recommends the use of both MBP and OA; c) minimally invasive rectal surgeries – a combination of MBP, OA and enema is recommended to optimize surgical outcomes; d) minimally invasive left-sided colon and sigmoid resections – the guideline advises the use of both MBP and OA for these surgeries; and e) minimally invasive colorectal surgeries where intraoperative lesion localization is anticipated – in such cases, the guideline recommends the use of MBP and OA to facilitate lesion identification during the operation.

Mechanical bowel preparation contributes to the liquefaction of fecal matter, which increases the risk of spillage and contamination during operation. Furthermore, histological changes in the intestinal mucosa have been observed in subjects who underwent MBP, including significant epithelial cell loss, edema of the lamina propria and lymphocytic and polymorphonuclear infiltration (6).

Some of the most commonly used solutions for bowel preparation include polyethylene glycol (PEG), sodium phosphate, mannitol, milk of magnesia, liquid paraffin and senna (1, 2, 5).

Among oral laxatives, PEG-based solutions are the most frequently used preparation agents. However, these solutions have notable drawbacks, such as patient discomfort due to the need to consume large volumes of an unpalatable liquid. Studies have shown no significant differences between PEG solutions and bisacodyl in terms of AL, wound infections, or reoperation rates. Nevertheless, bisacodyl is preferred due to its higher tolerability and patient compliance (12).

Historically, MBP was considered effective in reducing the risk of AL, which led many surgeons to favor its use (13). However, recent literature indicates no significant differences between MBP and its omission regarding AL, postoperative morbidity, or mortality rates (6, 13-15).

In previous years, MBP was widely used as a standard preoperative method, often without the addition of OA. While recent studies advocate for the combined use of MBP and OA, it is important to consider specific clinical contexts where MBP alone may still hold relevance. These include patients with antibiotic allergies, contraindications to antibiotic use, or scenarios requiring improved patient compliance. In such cases, earlier data supporting the efficacy of MBP without OA may remain applicable (16).

Research has also examined the intensity of MBP administration. Findings suggest that low-intensity MBP is associated with better prognostic outcomes compared to high-intensity MBP regimens (13).

Regarding the reduction of postoperative complications, no significant benefits have been observed with the use of MBP (4, 7, 14, 17).

However, performing MBP prior to operation provides an added layer of safety for anastomoses, as the risk of AL remains present. This supports the argument that administering MBP to patients, despite causing discomfort, is preferable to the potential risk of fecal peritonitis (14).

Conversely, it has been suggested that MBP may increase the risk of intraoperative spillage of intestinal contents, potentially leading to more severe infectious complications (7).

A growing body of evidence and recent studies suggest abandoning MBP for surgeries strictly involving the colon, as this procedure may increase the incidence of SSI. However, studies specifically addressing MBP in rectal surgeries remain limited (18).

The enhanced recovery after surgery guidelines indicate that MBP has no clinical significance in colon surgery and may even lead to dehydration and patient discomfort. However, MBP is recommended for rectal surgery (19). Besides dehydration and discomfort, MBP has also been associated with electrolyte imbalances (7, 14, 20), particularly hypocalcemia and hypokalemia, with elderly patients being the most vulnerable (5, 6). These concerns have made many surgeons hesitant to administer MBP in combination with OA (21).

Enhanced recovery after surgery represents a multidisciplinary evidence-based perioperative care pathway and a quality improvement initiative. When carefully implemented, ERAS has been shown to enhance patient mobilization, reduce postoperative complications, shorten hospital stays and decrease healthcare costs (22). Additionally, a 2016 study suggests that all types of colorectal surgeries can be performed without prior mechanical bowel preparation (6).

The absence of MBP in rectal cancer surgery has been associated with grade III, IV or V complications according to the Dindo-Clavien classifica-

tion (23). The Dindo-Clavien classification is a standardized system used to assess and report postoperative complications, providing an objective measure of their severity. A recent study emphasizing the efficacy of MBP in rectal cancer demonstrated a higher incidence of AL in the group of patients who did not receive MBP (18).

However, a comprehensive 2018 meta-analysis, which included 21,658 patients, analyzed a subgroup undergoing rectal surgery and concluded that MBP was not associated with postoperative complications, regardless of whether patients received a rectal enema (5). While enemas promote bowel contraction and stool evacuation, they should be used cautiously as complications such as perforation or metabolic disturbances can occur (24).

A key factor in postoperative complications, including SSI, AL, postoperative ileus and *Clostridium difficile* infection, is the composition of the intestinal microbiome (25). Significant shifts in bacterial composition have been observed, including an increase in *Enterococcus*, *Lactobacillus* and *Streptococcus*, alongside a decrease in *Bacteroides*, *Faecalibacterium* and *Roseburia*. A marked reduction in *Faecalibacterium* has been linked to AL, while *Streptococcus* and *Enterococcus* were associated with dysbiotic stress (25). Studies indicate that isolated MBP does not significantly alter the microbiome, with minimal impact that is reversible within 10 days postoperatively.

Pathogens such as *Enterococcus faecalis* and *Pseudomonas aeruginosa*, which are commonly isolated at the site of AL, are not only difficult to eradicate but are also implicated in causing AL (26).

Evidence suggests that standalone MBP has no significant effect on reducing SSI and is no longer recommended as a standard practice. Instead, its combination with oral antibiotics (OA) is preferred (4, 26-31). However, the use of OA raises concerns due to its potential association with postoperative *Clostridium difficile* infections (21, 27, 32).

The strategy of combining MBP with OA and perioperative intravenous antibiotics is considered the most effective method for reducing SSI (4, 24, 33, 34).

Preoperative factors influencing the decision to administer OA alongside MBP include patients with fewer comorbidities, better functional status and those undergoing minimally invasive treatments (21).

The combination of OA with MBP has proven significantly more effective than MBP alone in reducing SSI risk (10, 17, 20, 35). Notably, a significant reduction in SSI has also been observed with OA administration alone (30). The presumed efficacy of the MBP and OA combination lies in the enhanced distribution of antibiotics within the colon, a level of delivery that is difficult to achieve with intravenous antibiotics alone (26, 36).

The effectiveness of this combination varies depending on the site of operation. Left-sided resections, including the descending colon, sigmoid and rectum, are more commonly associated with the benefits of MBP and OA, whereas right-sided resections, involving the ascending colon, show no clear advantages (29, 32, 35). The most significant protective effect has been observed in left colectomies compared to right colectomies (32).

However, a 2023 analysis challenges these findings, demonstrating no significant differences in SSI rates between groups with or without MBP for right colectomies ($p=0.510$) or left colectomies ($p=0.338$) (37).

Criticism has emerged regarding MBP, OA, or their combination (OAMBP), as these methods have been associated with an increased risk of postoperative urinary tract infections, with no substantial benefits in cases where no preparation was performed (38).

The 2024 MECCA study suggests that combining OA with MBP significantly reduces SSI incidence compared to MBP alone, a finding supported by several prior studies (28, 30, 35, 39). However, this approach showed no effect in reducing other postoperative complications, such as AL or prolonged hospital stays. Contradictory findings from a previous study indicate that AL rates were lower in the MBP + OA group, while those receiving only MBP had a 2.2-fold higher risk of AL (40).

The most commonly used antibiotic class includes macrolides, with neomycin (an aminoglycoside) and erythromycin being the preferred combination (33).

An emerging but unproven assertion is that newer antibiotics may be equally effective in preventing SSI, potentially allowing MBP + OA to be omitted entirely (36). However, further research is required to substantiate this claim. ❑

CONCLUSION

The use of mechanical bowel preparation in colorectal surgery should be tailored to specific surgical contexts. Evidence suggests that MBP alone is no longer recommended as a standard practice due to its limited efficacy in reducing surgical site infections and anastomotic leakage and its association with patient discomfort and potential complications such as dehydration and mucosal injury. However, the combination of MBP with oral antibiotics has been shown to significantly reduce SSI, particularly in left-sided colectomies and rectal surgeries, where its benefits are most pronounced. For right-sided colon surgeries, MBP is generally unnecessary and may even increase complication risks, except in cases of planned intracorporeal anastomoses where MBP + OA might provide some advantage. Enhanced recovery after surgery guidelines reflect these findings, discouraging MBP use in colon surgeries while supporting its inclusion in rectal procedures as part of a multimodal care pathway.

Practical application of these findings emphasizes the need for patient- and procedure-specific preoperative preparation. While MBP + OA is recommended for left-sided and rectal surgeries, OA alone may suffice in certain cases, offering a simpler alternative with significant SSI reduction benefits. Low-intensity MBP regimens are preferred to minimize patient discomfort and adverse effects. Clinicians should remain cautious about potential risks of MBP, such as fecal spillage and microbiome alterations, and consider evolving evidence, including newer antibiotic regimens, to optimize surgical outcomes. Future research may further refine these protocols, potentially simplifying preparation strategies and improving patient safety. ❑

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