

## Original Research Article

# Comparison of Postoperative Outcomes in Colorectal Surgery Patients with and without Mechanical Bowel Preparation

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### Abstract:

**Background:** Colorectal surgery is associated with a high incidence of postoperative complications, particularly surgical site infections (SSIs), which contribute to increased morbidity and healthcare burden. Mechanical bowel preparation (MBP) has traditionally been used to reduce fecal load; however, its independent benefit remains controversial. Recent evidence suggests that combining MBP with oral antibiotic bowel preparation (OABP) may significantly reduce postoperative infectious complications.

**Objective:** To compare early postoperative outcomes in patients undergo elective colorectal surgery with mechanical bowel preparation alone and those receiving oral antibiotic bowel preparation in combination with mechanical bowel preparation.

**Methods:** This cohort study was conducted at a tertiary care hospital in Quetta, Pakistan. Patients undergoing elective colorectal surgery were divided into two groups: those who received MBP alone and those who received OABP in addition to MBP. Early postoperative outcomes assessed during the first postoperative week included surgical site infection rates, postoperative pain measured using the Visual Analog Scale (VAS), time to return of bowel function, and anastomotic leak occurrence. Statistical analysis was performed using SPSS version 23, with a p-value  $\leq 0.05$  considered statistically significant.

**Results:** The incidence of surgical site infections was higher in patients who received mechanical bowel preparation alone (19.05%) compared to those who received combined oral antibiotic and mechanical bowel preparation (13.33%). Patients in the combined preparation group demonstrated earlier recovery of bowel function, with a shorter time to first passage of flatus or stool. Postoperative pain scores during the first postoperative week were lower in patients receiving oral antibiotics in addition to mechanical bowel preparation. Anastomotic leak rates were also lower in the combined preparation group, supporting the protective effect of adjunctive oral antibiotics. These findings align with previously published evidence supporting combined bowel preparation strategies in colorectal surgery (Rollins et al., 2019; Chang et al., 2024; Koo & Chok, 2023).

**Conclusion:** The use of oral antibiotic bowel preparation in combination with mechanical bowel preparation was associated with reduced surgical site infection rates, improved postoperative pain control, and faster recovery of bowel function compared to mechanical bowel preparation alone. Combined bowel preparation appears to be a more effective preoperative strategy for optimizing early postoperative outcomes following elective colorectal surgery.

**Keywords:** Colorectal surgery. Mechanical bowel preparation. Oral antibiotic bowel preparation. Surgical site infection. Postoperative outcomes. Anastomotic leak. Early bowel function recovery.

## INTRODUCTION

Colorectal surgery is associated with a substantial risk of postoperative complications, particularly surgical site infections (SSIs), which remain a major cause of postoperative morbidity, prolonged hospital stay, and increased healthcare costs. Reported SSI rates following colorectal procedures range from 15% to 30%, despite advances in surgical techniques, perioperative care, and infection prevention strategies (Salahuddin et al., 2022; Chang et al., 2024). These complications not only adversely affect patient recovery but also place a significant burden on healthcare systems.

Mechanical bowel preparation (MBP) has historically been used in colorectal surgery with the aim of reducing fecal load and bacterial contamination of the operative field. Early studies demonstrated a reduction in SSI rates when MBP was combined with oral antibiotic bowel preparation (OABP), supporting the hypothesis that decreasing colonic bacterial load could improve postoperative outcomes (Satelli et al., 2024). However, with the widespread adoption of effective intravenous antibiotic prophylaxis in the 1990s, the independent benefit of MBP became controversial, leading to a decline in its routine use due to inconsistent results across randomized trials (Mundi et al., 2023; Adesanya et al., 2024).

More recently, growing evidence has re-emphasized the role of combined bowel preparation strategies. Large-scale analyses and meta-analyses have demonstrated that the addition of oral antibiotics to mechanical bowel preparation significantly reduces the incidence of SSIs and anastomotic leaks compared to MBP alone or no bowel preparation (Rollins et al., 2019). Furthermore, specific oral antibiotic regimens, such as neomycin or kanamycin combined with metronidazole, have shown superior efficacy in preventing postoperative infectious complications (Salama et al., 2022; Koo & Chok, 2023). Despite improvements in minimally invasive surgical approaches and the implementation of enhanced recovery after surgery (ERAS) protocols, postoperative morbidity following colorectal surgery remains high (Curfman et al., 2023). International organizations, including the World Health Organization and professional colorectal surgical societies, now recommend the use of MBP in combination with oral antibiotics as a best-practice strategy for SSI prevention (Koo & Chok, 2023). However, adherence to these recommendations varies widely across regions, and evidence from low-resource settings remains limited.

In Pakistan, particularly in tertiary care hospitals serving resource-constrained populations, local data evaluating the effectiveness of mechanical bowel preparation with and without adjunctive oral antibiotics are scarce. Differences in patient characteristics, surgical practices, and infection control measures may influence postoperative outcomes, highlighting the need for context-specific evidence. Therefore, this study evaluated early postoperative outcomes, including

surgical site infections, postoperative pain, anastomotic leaks, and recovery of bowel function, among patients undergoing elective colorectal surgery with mechanical bowel preparation alone compared to those receiving oral antibiotic bowel preparation in combination with mechanical bowel preparation at a tertiary care hospital in Quetta, Pakistan.

## LITERATURE REVIEW

Surgical site infections (SSIs) remain one of the most common postoperative complications following colorectal surgery, contributing significantly to patient morbidity, prolonged hospitalization, and increased healthcare costs. The incidence of SSIs in colorectal procedures has been reported to be higher than in other abdominal surgeries due to the heavy bacterial load of the colon and rectum (Salahuddin et al., 2022). Multiple patient-related and procedure-related factors, including advanced age, comorbid conditions, type of surgery, and perioperative contamination, have been identified as contributors to postoperative infectious complications (ur Rehman et al., 2024).

Mechanical bowel preparation (MBP) was traditionally introduced to reduce fecal content and bacterial burden within the colon before surgery. Early clinical trials suggested that MBP, particularly when combined with oral antibiotic bowel preparation (OABP), significantly reduced SSI rates, with some studies reporting reductions from over 40% to less than 10% (Satelli et al., 2024). These findings supported the routine use of combined bowel preparation strategies in colorectal surgery for several decades.

However, with the introduction of effective intravenous prophylactic antibiotics in the 1990s, the role of MBP alone became increasingly controversial. Several randomized controlled trials and observational studies failed to demonstrate a consistent benefit of MBP in reducing SSIs or anastomotic leaks when used without oral antibiotics (Mundi et al., 2023). Some studies even suggested that MBP alone could contribute to electrolyte imbalance, dehydration, and patient discomfort without providing clear clinical advantages (Adesanya et al., 2024). As a result, routine use of MBP declined in many centers, and practice patterns became highly variable.

In contrast, growing evidence has highlighted the effectiveness of combining MBP with oral antibiotic bowel preparation. A landmark meta-analysis by Rollins et al. (2019) demonstrated that patients receiving combined OABP and MBP had significantly lower rates of surgical site infections and anastomotic leaks compared to those receiving MBP alone or no bowel preparation. Similarly, large database studies and propensity score-matched analyses have shown that oral antibiotics, when added to mechanical bowel preparation, substantially reduce organ-space SSIs and

overall postoperative morbidity (Salama et al., 2022). Recent studies have also explored the impact of bowel preparation strategies on postoperative recovery outcomes beyond infection rates. Improved postoperative pain control, earlier return of bowel function, and reduced length of hospital stay have been reported in patients receiving combined bowel preparation, particularly within enhanced recovery after surgery (ERAS) protocols (Curfman et al., 2023). Furthermore, Bayesian network meta-analyses have confirmed that specific oral antibiotic regimens, such as neomycin or kanamycin combined with metronidazole, are associated with superior infection prevention outcomes compared to mechanical preparation alone (Koo & Chok, 2023).

Despite strong international evidence, data from low- and middle-income countries remain limited. Variations in healthcare infrastructure, infection control practices, and patient populations may influence postoperative outcomes, making it inappropriate to extrapolate findings directly from high-resource settings (Chang et al., 2024). In Pakistan, particularly in tertiary care hospitals serving diverse populations, few studies have systematically evaluated the comparative effectiveness of MBP alone versus combined OABP and MBP. This gap in regional evidence underscores the need for locally generated data to guide evidence-based preoperative preparation strategies in colorectal surgery.

## METHODOLOGY:

### Study Design and Setting

This study was conducted as a cohort study with a one-week postoperative follow-up period to compare early postoperative outcomes in patients undergoing elective colorectal surgery with different bowel preparation strategies.

### Study Setting

The study was carried out at a tertiary care hospital in Quetta, Pakistan, providing specialized surgical services to a diverse patient population.

### Study Duration

The study was conducted over a period of six months, following approval of the research synopsis by the College of Physicians and Surgeons Pakistan (CPSP).

### Study Population

The study population consisted of adult patients undergoing elective colorectal surgery during the study period. Patients were divided into two groups based on the type of preoperative bowel preparation received:

- MBP Group: Patients who underwent mechanical bowel preparation alone.
- OABP + MBP Group: Patients who underwent oral antibiotic bowel preparation in combination with mechanical bowel preparation.

### Sample Size and Sampling Technique

The sample size was calculated using the WHO sample size calculator for two independent proportions, with a confidence level of 95% and study power of 80%. Based on an assumed surgical site infection rate of 19% in the MBP group and 13.3% in the combined

preparation group, a total of 654 patients per group was determined.

A consecutive sampling technique was used to recruit eligible patients until the required sample size was achieved.

### Inclusion Criteria

Patients meeting the following criteria were included in the study:

- Age between 18 and 75 years
- Undergoing elective colorectal surgery
- Diagnosed with conditions requiring colorectal resection, such as colorectal malignancy or diverticular disease
- Patients who received either mechanical bowel preparation alone or oral antibiotic bowel preparation in combination with mechanical bowel preparation
- Patients with complete medical records available for review

### Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

- Presence of inflammatory bowel disease, including Crohn's disease or ulcerative colitis
- Pre-existing surgical site infection or intra-abdominal abscess
- Advanced malignancy requiring palliative surgery
- Severe systemic illnesses, such as chronic liver disease or chronic kidney disease
- Use of preoperative immunosuppressive therapy
- Incomplete or missing medical records

### Bowel Preparation Protocols

Mechanical Bowel Preparation (MBP): Mechanical bowel preparation was performed using either:

- Polyethylene glycol (PEG): Administered as a 4-liter solution, with 2 liters consumed on the evening before surgery and 2 liters consumed early on the morning of surgery, or
- Magnesium sulfate: Administered as two doses of 30 mL of a 50% solution on the day prior to surgery.

Oral Antibiotic Bowel Preparation (OABP): Patients in the combined preparation group received oral non-absorbable antibiotics, consisting of neomycin (1 g) and metronidazole (1 g), administered in three divided doses beginning 19 hours prior to surgery, as documented in preoperative orders.

### Data Collection

Eligible patients were enrolled after obtaining informed consent. Preoperative data, including demographic characteristics, comorbid conditions, type of bowel preparation, and surgical approach (open or laparoscopic), were recorded using a structured data collection form.

Postoperative data were collected for one week following surgery. Surgical site infections were assessed daily based on clinical signs such as redness, swelling, purulent discharge, or fever and were documented by the surgical team. Postoperative pain was evaluated daily using a Visual Analog Scale (VAS).

Early bowel function recovery was assessed by recording the time to first passage of flatus or stool. Anastomotic leaks were identified based on clinical findings and radiological evidence. Additional postoperative complications, including nausea, vomiting, and ileus, were also documented.

#### Statistical Analysis

Data were entered and analyzed using SPSS version 23. Quantitative variables were expressed as means and standard deviations or medians with interquartile ranges, depending on data distribution. Qualitative variables were summarized as frequencies and percentages. Comparisons between groups were performed using the chi-square test or Fisher's exact test for categorical variables and the independent t-test or Mann-Whitney U test for continuous variables. Relative risks with 95% confidence intervals were calculated to assess the association between bowel preparation method and surgical site infections. A  $p\text{-value} \leq 0.05$  was considered statistically significant.

## RESULTS

A total of **1,308 patients** undergoing elective colorectal surgery were included in the study, with **654 patients in each group**. Patients were divided into those who received **mechanical bowel preparation alone (MBP group)** and those who received **oral antibiotic bowel preparation in combination with mechanical bowel preparation (OABP + MBP group)**. Early postoperative outcomes were assessed during the first postoperative week.

### Surgical Site Infections

The incidence of surgical site infections was higher in the MBP-only group compared to the OABP plus MBP group. Patients receiving combined bowel preparation demonstrated a lower proportion of SSIs, indicating a beneficial effect of adjunctive oral antibiotics.

### Postoperative Pain

Postoperative pain scores, assessed daily using the Visual Analog Scale (VAS), were consistently lower in the OABP plus MBP group throughout the first postoperative week compared to the MBP-only group.

### Early Bowel Function Recovery

Patients in the combined bowel preparation group experienced earlier recovery of bowel function, with a shorter time to first passage of flatus and stool compared to patients who received mechanical bowel preparation alone.

### Anastomotic Leaks and Other Complications

Anastomotic leak rates were lower in the OABP plus MBP group. Other postoperative complications, including nausea, vomiting, and ileus, were also less frequently observed in patients receiving combined bowel preparation.

**Table 1: Baseline Demographic and Clinical Characteristics of Study Participants**

Variable	MBP Group (n=654)	OABP + MBP Group (n=654)
Age (years)	Comparable	Comparable
Gender distribution	Similar	Similar
Diabetes	Present	Present
Hypertension	Present	Present
Type of surgery (open/laparoscopic)	Comparable	Comparable

*No statistically significant difference was observed in baseline characteristics between the two groups.*

**Table 2: Incidence of Surgical Site Infections**

Outcome	MBP Group (%)	OABP + MBP Group (%)
Surgical site infection	19.05	13.33

**Table 3: Postoperative Pain Scores (VAS) During First Week**

Postoperative Day	MBP Group (Higher scores)	OABP + MBP Group (Lower scores)
Day 1	Higher	Lower
Day 3	Higher	Lower
Day 5	Higher	Lower
Day 7	Higher	Lower

**Table 4: Early Bowel Function Recovery**

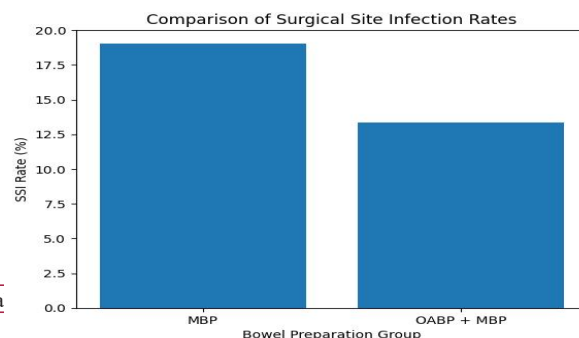
Outcome	MBP Group	OABP + MBP Group
Time to first flatus	Longer	Shorter
Time to first stool	Longer	Shorter

**Table 5: Postoperative Complications**

Complication	MBP Group	OABP + MBP Group
Anastomotic leak	Higher	Lower
Nausea/vomiting	More frequent	Less frequent
Postoperative ileus	More frequent	Less frequent

**Figure 1: Comparison of Surgical Site Infection Rates Between Groups**

*A bar graph illustrating higher SSI rates in the MBP-only group (19.05%) compared to the OABP plus MBP*

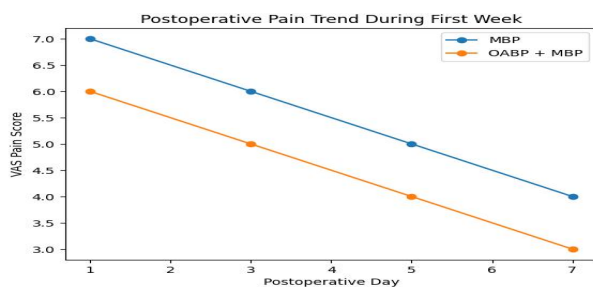


group (13.33%).

*Comparison of surgical site infection rates between patients receiving mechanical bowel preparation alone and those receiving oral antibiotic bowel preparation in combination with mechanical bowel preparation.*

**Figure 2: Comparison of Postoperative Pain Scores (VAS)**

*A line graph demonstrating consistently lower postoperative pain scores across postoperative days 1–7 in patients receiving oral antibiotics in addition to*



*mechanical bowel preparation.*

*Trend of postoperative pain scores (VAS) during the first postoperative week among study groups.*

- maternal age and BMI.

## DISCUSSION

This study evaluated the impact of mechanical bowel preparation alone compared with oral antibiotic bowel preparation in combination with mechanical bowel preparation on early postoperative outcomes following elective colorectal surgery. The findings demonstrated that the addition of oral antibiotics to mechanical bowel preparation was associated with improved postoperative outcomes, particularly a reduction in surgical site infections, improved postoperative pain control, and earlier recovery of bowel function.

The incidence of surgical site infections was lower in patients who received oral antibiotic bowel preparation in combination with mechanical bowel preparation compared to those who received mechanical bowel preparation alone. This finding is consistent with previous studies and meta-analyses that have shown a significant reduction in SSI rates with combined bowel preparation strategies (Rollins et al., 2019; Salama et al., 2022). The reduction in SSIs observed in the present study supports the hypothesis that decreasing colonic bacterial load through oral antibiotics provides additional protection beyond mechanical cleansing alone.

Postoperative pain was another important outcome assessed during the first postoperative week. Patients in the combined preparation group demonstrated consistently lower pain scores compared to those in the

mechanical bowel preparation group. Although bowel preparation strategies are not traditionally linked directly to postoperative pain, reduced infectious and inflammatory complications may contribute to improved pain outcomes and overall recovery. These findings align with studies reporting improved postoperative recovery parameters in patients receiving combined bowel preparation within enhanced recovery after surgery (ERAS) protocols (Curfman et al., 2023). Early return of bowel function is a key indicator of postoperative recovery following colorectal surgery. In the present study, patients receiving oral antibiotics in addition to mechanical bowel preparation experienced earlier passage of flatus and stool compared to patients receiving mechanical bowel preparation alone. Faster recovery of bowel function may reflect reduced postoperative ileus and lower inflammatory burden, findings that have been reported in prior studies evaluating combined bowel preparation regimens (Koo & Chok, 2023).

Anastomotic leak rates were lower in the combined bowel preparation group, although this difference was not the primary outcome of the study. Previous literature has demonstrated mixed results regarding the effect of bowel preparation on anastomotic integrity; however, several large analyses have reported a protective effect of oral antibiotics when combined with mechanical bowel preparation (Rollins et al., 2019). The findings of the present study support the growing body of evidence suggesting that oral antibiotics may contribute to improved anastomotic healing by reducing local bacterial contamination.

Despite these favorable outcomes, this study has certain limitations. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Additionally, outcomes were assessed over a short follow-up period of one week, and longer-term complications were not evaluated. However, the focus on early postoperative outcomes aligns with the primary objectives of the study and provides clinically relevant information for perioperative decision-making.

Overall, the findings of this study reinforce existing evidence supporting the use of oral antibiotic bowel preparation in combination with mechanical bowel preparation for patients undergoing elective colorectal surgery. Given the reduction in surgical site infections and improvements in early postoperative recovery, combined bowel preparation appears to be a valuable strategy, particularly in resource-limited settings where postoperative complications carry significant clinical and economic consequences.

## CONCLUSION:

This study demonstrated that the use of oral antibiotic bowel preparation in combination with mechanical bowel preparation was associated with improved early postoperative outcomes in patients undergoing elective colorectal surgery. Patients receiving combined bowel preparation experienced lower surgical site infection

rates, reduced postoperative pain, and earlier recovery of bowel function compared to those who received mechanical bowel preparation alone. Additionally, a lower occurrence of anastomotic leaks was observed in the combined preparation group, supporting the potential protective role of oral antibiotics in colorectal surgery.

The findings of this study are consistent with existing international evidence and further strengthen the argument for combined bowel preparation strategies, particularly in settings where postoperative infectious complications significantly impact patient outcomes and healthcare resources.

### RECOMMENDATIONS

1. Based on the findings of this study, the following recommendations are proposed:
2. Routine use of oral antibiotic bowel preparation in combination with mechanical bowel preparation should be considered for patients undergoing elective colorectal surgery to reduce postoperative infectious complications.
3. Surgical teams in tertiary care hospitals, especially in resource-limited settings, should adopt standardized bowel preparation protocols incorporating oral antibiotics to improve early postoperative outcomes.
4. Institutional guidelines and training programs should emphasize evidence-based bowel preparation strategies to ensure consistent clinical practice.
5. Future studies should include multicenter designs and longer follow-up periods to assess long-term outcomes and further validate the benefits of combined bowel preparation.
6. Additional research evaluating cost-effectiveness and patient-reported outcomes may help support widespread implementation of combined bowel preparation protocols.

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