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Comparison of the Efficacy and Safety of Three Bowel Preparation Regimens for Colonoscopy

Primerjava učinkovitosti in varnosti treh različnih režimov čiščenja za kolonoskopijo

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***Ključne besede**: čistost črevesa, Moviprep, Plenvue, Donat Mg*

ABSTRACT

Introduction: Colonoscopy is essential for the detection and prevention of colorectal diseases, with its effectiveness dependent on high-quality bowel preparation. This study compares three bowel preparation regimens – Moviprep with Donat Mg, Plenvu, and Plenvu with Donat Mg – to determine their efficacy, safety, and patient satisfaction.

Methods: A randomised study involving 101 patients undergoing colonoscopy was conducted. Participants were assigned to one of the three preparation protocols and evaluated using the Boston Bowel Preparation Scale (BBPS), polyp detection rate (PDR), and adenoma detection rate (ADR). Patient experiences, adverse effects, and adherence were assessed through questionnaires. Statistical analysis included ANOVA, t-test and chi-square tests.

IZVLEČEK

Uvod: Kolonoskopija je ključna preiskava za odkrivanje in preprečevanje bolezni debelega črevesja in danke, njena učinkovitost pa je odvisna od visokokakovostne priprave črevesja. V naši študiji smo primerjali tri režime priprave črevesja (Moviprep z Donat Mg, Plenvu in Plenvu z Donat Mg), da bi ugotovili njihovo učinkovitost, varnost in zadovoljstvo pacientov.

Metode: Napravili smo randomizirano študijo, v katero smo vključili 101 pacienta, ki so opravili kolonoskopijo. Ocenjevali smo očiščenost črevesja s pomočjo Bostonske lestvice za pripravo črevesja (BBPS), stopnjo odkrivanja polipov (PDR) in stopnjo odkrivanja adenomov (ADR). S pomočjo vprašalnika smo ocenjevali izkušnje pacientov, neželene učinke in upoštevanje navodil priprave na kolonoskopijo. Statistično analizo smo opravili s pomočjo testov ANOVA, t-testa in hi-kvadratni testa.

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Results: Adequate bowel cleansing (BBPS ≥ 6) was achieved in over 94% of cases across all groups, with no significant differences in BBPS scores. PDR and ADR were comparable among the groups. Patient-reported adverse effects, such as thirst, bloating, and nausea, were mild and similar across groups.

Discussion: The findings demonstrate equivalent efficacy and safety among the regimens. Moviprep with Donat Mg and Plenvu preparations provide comparable bowel cleanliness and lesion detection rates. High patient satisfaction and adherence underscore the feasibility of all three methods in clinical practice.

Conclusions: Moviprep with Donat Mg, Plenvu, and Plenvu with Donat Mg are effective, safe, and well-tolerated bowel preparation regimens, suitable for routine use in colonoscopy procedures. Further research may clarify the role of adjunctive agents like Donat Mg in enhancing preparation outcomes.

Rezultati: Ustrezno čiščenje črevesja (BBPS ≥ 6) smo dosegli v več kot 94 % primerov v vseh skupinah, brez pomembnih razlik v ocenjenem BBPS. PDR in ADR sta bila primerljiva med skupinami. Neželeni učinki, kot so žeja, napenjanje in slabost, so bili blagi in podobni med skupinami.

Razprava: Z našimi rezultati smo dokazali enakovredno učinkovitost in varnost vseh treh režimov. Z Moviprep z Donat Mg, Plenvu in Plenvu z Donat Mg dosežemo primerljivo in zadovoljivo očiščenost črevesja in stopnjo odkrivanja lezij. Visoko zadovoljstvo pacientov in upoštevanje navodil kažeta na to, da lahko vse tri režime enakovredno uporabljamo v vsakdanji klinični praksi.

Zaključek: Moviprep z Donat Mg, Plenvu in Plenvu z Donat Mg so učinkoviti, varni in dobro prenašani režimi priprave črevesja, primerni za rutinsko uporabo pri kolonoskopijah. Nadaljnje raziskave lahko razjasnijo vlogo dodatnih sredstev, kot je Donat Mg, pri izboljšanju rezultatov priprave.

INTRODUCTION

Colonoscopy is a cornerstone procedure in discovering colorectal diseases and plays a pivotal role in the early detection and prevention of colorectal cancer. The effectiveness of colonoscopy is heavily influenced by the quality of bowel preparation, which ensures adequate visualisation of the colonic mucosa, thereby enhancing the detection of pathological changes. Suboptimal bowel preparation not only impairs the detection of lesions but also prolongs the procedure time, potentially increasing patient discomfort and reducing adherence to recommended screening protocols (1).

Over the years, various bowel preparation regimens have been developed to optimise the balance between efficacy and patient acceptability. Polyethylene glycol (PEG) based regimens have been the most widely used due to their proven effectiveness and favourable safety profile. However, these regimens often require drinking a large volume of solution, which can be burdensome for patients, necessitating up to 4 litres of preparation fluid (1). In Slovenia, the standard preparation protocol for colonoscopy includes using Moviprep (2L PEG) in conjunction with Donat Mg, a magnesium sodium hydrogen carbonate mineral water (2).

The introduction of newer preparations, such as Plenvu (1L PEG), aimed to address the limitations correlated with large fluid volumes. Plenvu is a low-volume PEG solution enriched with ascorbic acid, designed to achieve high-quality bowel cleansing with a reduced total fluid intake. The efficacy and safety of Plenvu have been validated in multiple studies (3–6).

This study compares the efficacy and safety profiles of the three bowel preparation schemes: Moviprep combined with Donat Mg, Plenvu alone, and Plenvu combined with Donat Mg. By analysing these approaches, we seek to identify the optimal bowel preparation

method that maximises mucosal cleansing efficacy while minimising patient discomfort and procedural burden.

METHODS

This study included patients aged 18 years or older who underwent elective colonoscopy for diagnostic or surveillance purposes at the Clinical Department of Gastroenterology, University Medical Centre Ljubljana, between May 16, 2023, and August 31, 2023.

Patients were randomly assigned to one of three groups, with each group using a different bowel preparation regimen: Moviprep with Donat Mg, Plenvu, or Plenvu with Donat Mg. The preparation protocols were as follows:

- Patients in the Moviprep with Donat Mg group consumed 2 litres of Donat Mg mineral water and 2 litres of Moviprep solution.
- Patients in the Plenvu with Donat Mg group consumed 2 litres of Donat Mg mineral water, 1 litre of Plenvu solution, and 1 litre of plain water.
- Patients in the Plenvu without Donat Mg group consumed 1 litre of Plenvu solution and 1 litre of plain water.

All patients received an informational leaflet in preparation for the process, outlining the colonoscopy process and preparation instructions. During the bowel preparation patients completed a pre-distributed questionnaire. The questionnaire collected information on comorbidities, regular medication use, experiences with the bowel preparation process, and an evaluation of any adverse effects associated with the preparation.

The primary objective of the analysis was to assess bowel cleanliness using the Boston Bowel Preparation Scale (BBPS). Secondary objectives included determining the polyp detection rate (PDR) and adenoma detection rate (ADR), as well as evaluating the overall colonoscopy experience. This included assessing adverse effects, patient satisfaction with the preparation process, and whether they would be willing to undergo the same preparation regimen again in the future.

Statistical Analysis

Statistical analyses were performed using SPSS software. Patient characteristics were compared using the chi-square test, while differences in mean age were analysed with analysis of variance (ANOVA).

ANOVA was also employed to compare bowel cleanliness scores, measured by the Boston Bowel Preparation Scale (BBPS), and the mean number of polyps detected across groups. Polyp detection rates (PDR) and adenoma detection rates (ADR) between groups were compared using the chi-square test.

For pairwise comparisons between groups, pairwise t-tests were applied to assess differences in BBPS scores, and the chi-square test was used to compare PDR and ADR. Adverse effects were also analysed using the chi-square test.

RESULTS

Patient Characteristics

A total of 101 patients were included in the study, with 35 patients preparing for colonoscopy using Moviprep with Donat Mg, 32 using Plenvu, and 34 using Plenvu with Donat Mg. Among the participants, 60 were male, and 41 were female. There were no statistically significant differences in baseline characteristics among the groups, as detailed in Table 1.

Comorbidities were present in 68% of patients, with similar distribution across the three groups. The most frequently reported comorbidities with the potential to impact bowel motility and cleansing were diabetes mellitus (14 patients) and hypothyroidism (6 patients). Additionally, one patient had multiple sclerosis, and another had a history of ischemic cerebrovascular disease combined with hyperparathyroidism.

There were no statistically significant differences between the groups in the number of patients referred for an initial or follow-up colonoscopy. Patients were referred for both initial and follow-up colonoscopies for various reasons, such as chronic inflammatory bowel disease, anaemia, gastrointestinal bleeding, suspicion of malignant neoplasm, suspicion of benign neoplasm, diverticulosis, constipation, diarrhoea, abdominal pain and other unspecified reasons.

Boston Bowel Preparation Scale

BBPS total score was calculated in all cases. Adequate cleansing, as defined by a BBPS score of ≥ 6 with no

Table 1. Baseline Characteristics of Patients

Characteristics		Moviprep + Donat Mg (n=35)	Plenvu (n=32)	Plenvu + Donat Mg (n=34)	p-value
Gender	Male (n=60)	17	20	23	0.25
	Female (n=41)	18	12	11	
Ager	Mean (SD)	53.9 (15.7)	53.4 (15.0)	61.5 (16.8)	0.07
	≤ 65 years (n=70)	26	25	19	0.54
	> 65 years (n=31)	9	7	15	0.19
First/Follow-up Colonoscopy	First (n=37)	11	13	13	0.90
	Follow-up (n=64)	24	19	21	0.74
Comorbidities	None (n=32)	11	11	10	0.97
	Present (n=69)	24	21	24	0.88
	More than one condition (n=28)	10	8	10	0.87
Specific Comorbidities	Hypertension (n=16)	4	3	9	0.14
	Diabetes Mellitus (n=14)	4	6	4	0.75
	Hypothyroidism (n=6)	3	2	1	0.61

Table 2. Detailed Metrics of Results for Bowel Cleanliness Based on BBPS and Polyp Detection Across Groups

	Moviprep + Donat Mg (n=35)	Plenvu (n=32)	Plenvu + Donat Mg (n=34)	p-value
BBPS				
Right colon (mean, SD)	2.60 (0.64)	2.69 (0.46)	2.59 (0.69)	0.679
Transversum (mean, SD)	2.80 (0.40)	2.84 (0.44)	2.79 (0.47)	0.502
Left colon (mean, SD)	2.80 (0.47)	2.78 (0.60)	2.85 (0.35)	0.622
Total BBPS (mean, SD)	8.20 (1.17)	8.31 (1.13)	8.24 (1.37)	0.610
Polyp Detection				
Average of polyps per colonoscopy (SD)	1.06 (1.43)	1.10 (2.01)	1.12 (1.39)	0.988
PDR	51.4%	37.5%	52.9%	0.386
ADR	45.7%	37.5%	50.0%	0.585
PDR for right colon	37.1%	28.1%	44.1%	0.402
ADR for right colon	31.4%	28.1%	41.2%	0.502

ADR – adenoma detection rate; BBPS – Boston Bowel Preparation Scale; PDR – polyp detection rate; SD – standard deviation

segment less than 2, was overall very good and was achieved in 97.1% of cases in the Moviprep with Donat Mg, 96.9% of cases in Plenvu and 94.1% of cases Plenvu with Donat Mg group.

There were no statistically significant differences in bowel cleanliness scores (BBPS) across the three study groups (Table 2). This finding was consistent in both overall group comparisons and pairwise analyses.

Lesion Detection

Out of 101 patients, polyps were detected in 48 cases, and adenomas in 45, while one patient had a sessile serrated lesion in the right colon, one had pseudopolyps throughout the colon, and one had inflammatory polyps throughout the colon.

No significant differences in polyp detection rate (PDR) or adenoma detection rate (ADR) were found among the three groups (Table 2). Pairwise comparisons of PDR and ADR, both overall and specifically for the right colon, also showed no statistical significance (Table 3). Notably, for patients undergoing

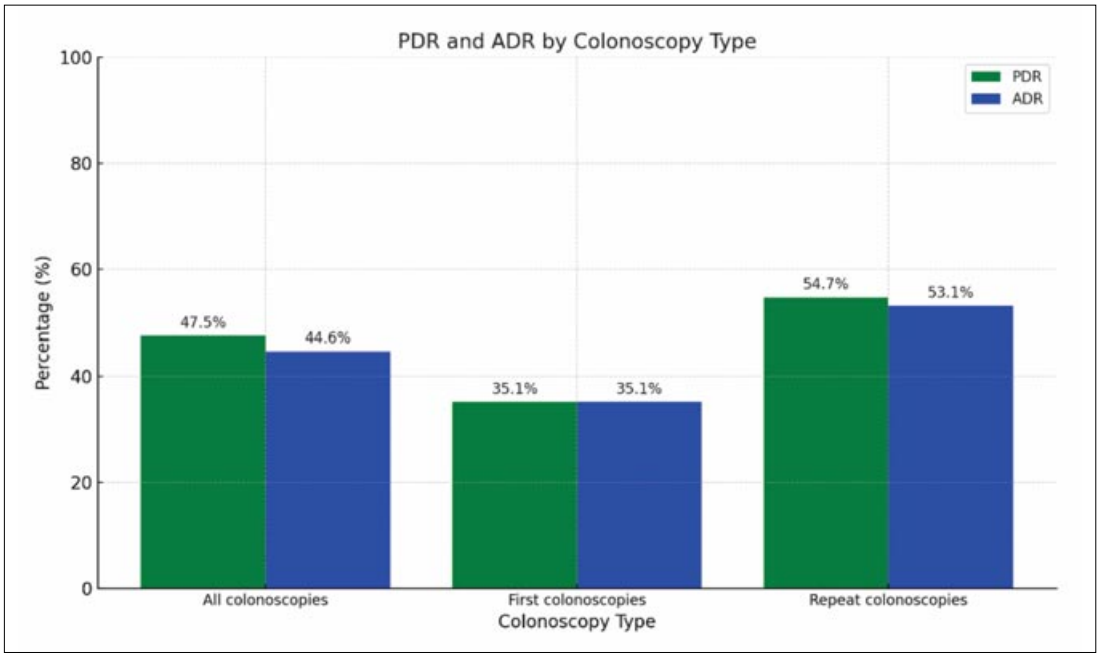

Figure 1. Overall PDR and ADR by Colonoscopy Type

Table 3. p-Values for Pairwise Comparison of BBPS and Polyp Detection

Outcome	Moviprep+Donat vs. Plenvu	Moviprep+Donat vs. Plenvu+Donat	Plenvu vs. Plenvu+Donat
BBPS			
Right colon	0.511	0.802	0.371
Transverse colon	0.355	0.741	0.255
Left colon	0.456	0.402	0.926
Total BBPS	0.289	0.982	0.377
Polyp Detection			
Average polyps per colonoscopy	p=0.99	p=0.98	p=0.99
PDR	0.250	0.956	0.207
ADR	0.498	0.730	0.301
PDR for right colon	0.427	0.562	0.177
ADR for right colon	0.781	0.400	0.262

colonoscopies for the first time, both PDR and ADR were identical, as all detected polyps in this subset were adenomas (Figure 1). Furthermore, in patients prepared with Plenvu, all polyps detected were adenomas, leading to identical PDR and ADR for this group.

No statistically significant differences in polyp detection rates (PDR) were found among the groups. Pairwise comparisons between groups for PDR and adenoma detection rates (ADR), both PDR and ADR specifically for the right colon, also showed no significant differences.

Colonoscopies for the first time, PDR and ADR were identical, as all patients with detected polyps had adenomas. Similarly, among patients prepared with Plenvu, all polyps detected were adenomas, resulting in identical PDR and ADR for this group.

Bowel Preparation Experience, Adherence and Tolerability

Patients rated their bowel preparation experience on a scale from 1 to 10. The average scores for the three regimens were 7.86 (±2.33) for Moviprep with Donat Mg, 8.34 (±2.07) for Plenvu, and 8.26 (±2.20) for Plenvu with Donat Mg (Figure 2). There were no statistically significant differences in mean ratings between the groups.

Patients were asked if they would be willing to repeat the same bowel preparation regimen in future. Results are summarized in Figure 3. Most patients expressed willingness to repeat their assigned preparation.

Adherence to the preparation protocol was 100% across all groups.

Patients were asked to report specific adverse effects experienced during bowel preparation via a standardised questionnaire. The most commonly reported

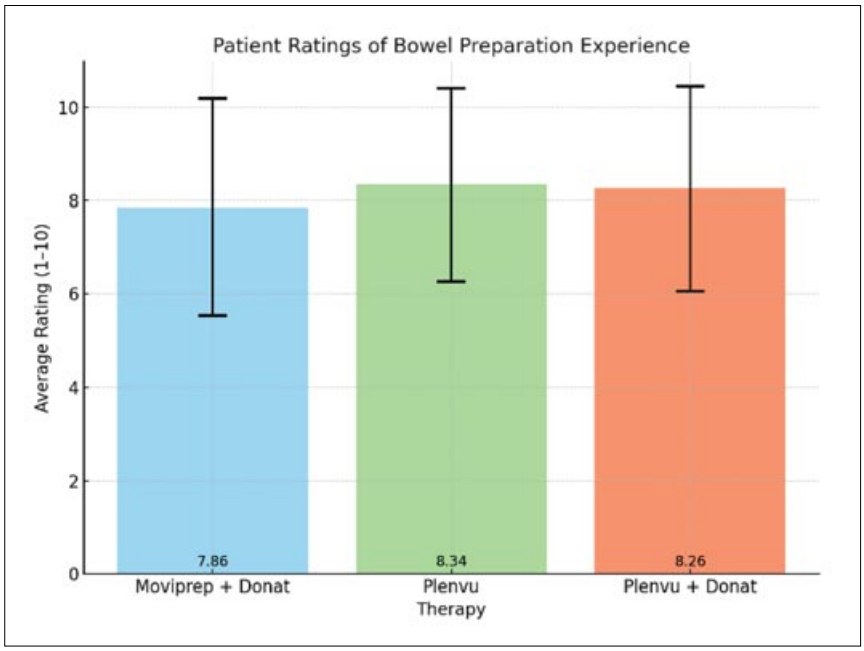

Figure 2. Patient Rating of Bowel Preparation Experience

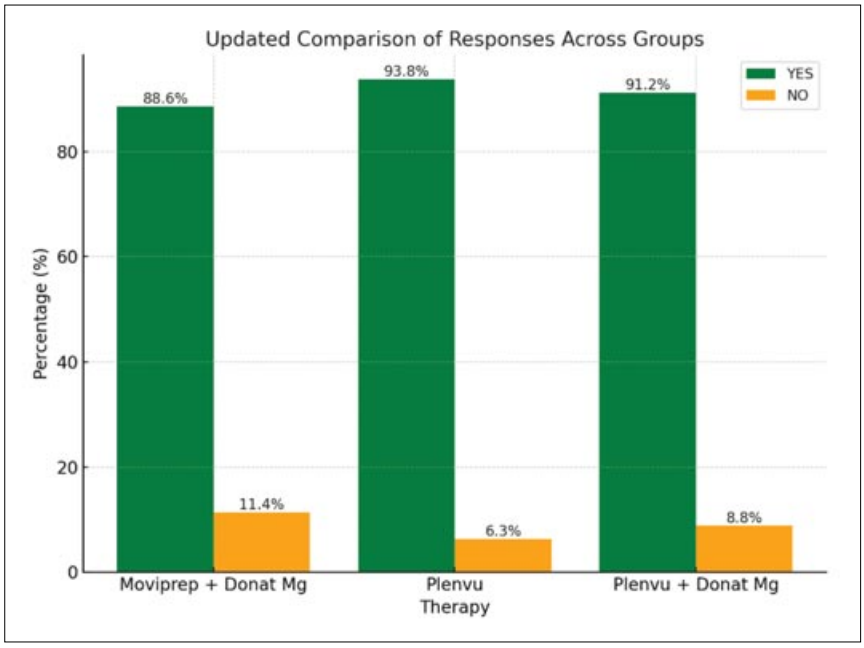

Figure 3. Would You Repeat Bowel Preparation with the Same Regimen?

adverse effects included thirst, bloating, and nausea. Thirst was the most frequently reported symptom, mentioned by 40.0% of patients in the Moviprep with Donat Mg group, 53.1% in the Plenvu group, and 55.9% in the Plenvu with Donat Mg group (p=0.37). Bloating was reported by 34.3%, 31.3%, and 32.4% of patients, respectively (p=0.964). Similarly, nausea was reported by 31.4% in the Moviprep with Donat Mg group, 34.4% in the Plenvu group, and 32.4% in the Plenvu with Donat Mg group (p=0.966). Less common adverse effects, such as dizziness and abdominal cramps, were reported at lower rates. The analysis revealed no statistically significant differences in the frequency of specific adverse effects among the three regimens.

Some patients perceived their adverse effects (thirst and nausea) as severe, but no medically significant adverse events were observed.

DISCUSSION

PEG-based regimens have been due to their proven effectiveness and favourable safety profile worldwide. We use 2L PEG (Moviprep) with 2L Donat Mg in Slovenia. Our study has assessed the efficacy, tolerability, and patient satisfaction associated with different bowel preparation regimens: Moviprep with Donat Mg, Plenvu, and Plenvu with Donat Mg.

Proper bowel preparation is essential for good visualisation of the intestinal mucosa and improved detection of lesions. All three groups achieved adequate bowel cleansing, exceeding the minimum standard of 90% set by ESGE (1).

Several studies have evaluated the efficacy of Plenvu in comparison to high-volume PEG preparations (5–9). All these studies demonstrated that Plenvu is non-inferior to 2L PEG. Furthermore, the results revealed a statistically significant improvement in overall bowel cleanliness, as assessed by the Boston Bowel Preparation Scale (BBPS), for the entire colon and specifically for the right colon in the Plenvu group compared to high-volume PEG preparations (5–9).

Arieira et al. demonstrated that overall bowel cleanliness, as evaluated by BBPS, was superior with Plenvu compared to 2L PEG. However, after excluding diabetic patients from the analysis, the statistically significant difference in overall cleanliness was no longer observed. Nevertheless, the Plenvu group consistently achieved better outcomes due to excellent bowel preparation, defined by a BBPS score of 9 (8).

Achieving optimal cleanliness of the right colon (BBPS score of 3) is particularly important for detecting flat lesions such as sessile serrated polyps (10). Improved excellent cleanliness of both the right colon and the entire colon in the Plenvu group compared to high-volume PEG preparations was also reported in a study by Bednarska et al. (11).

An additional method for assessing the efficacy of bowel preparation is through the detection rates of polyps (PDR) and adenomas (ADR), particularly in the right colon. The data in the literature regarding PDR and ADR across different bowel preparation methods are somewhat heterogeneous. Bisschops et al. demonstrated that ADR and PDR in the right colon and the entire colon in groups receiving Plenvu were not inferior to those receiving high-volume PEG. Furthermore, they reported a higher PDR in the right colon in the Plenvu group compared to the group receiving 2L PEG (6).

Hong et al. observed an improved PDR with Plenvu compared to 2L PEG, although no differences were noted in ADR. They attributed the discrepancy between the higher PDR and similar ADR to the small sample size and the inclusion of patients younger than 50 years, in whom fewer adenomas are expected (9). No differences were shown between the groups due to the number of polyps per colonoscopy, PDR, or ADR in the CLEANSE study (5).

In our study, overall bowel cleanliness as measured by BBPS and cleanliness of the right colon did not differ statistically significantly between the groups. We observed that PDR and ADR for the entire colon were somewhat higher in the groups receiving Donat

Mg (Moviprep with Donat Mg and Plenvu with Donat Mg). Additionally, we found that PDR and ADR in the right colon were highest in the group receiving Plenvu with Donat Mg. However, no significant differences in PDR or ADR were detected in statistical analysis, either for the entire colon or only the right colon.

Differences in findings, particularly regarding PDR and ADR among individual studies, may stem from the selection of patients, such as variations in age across groups and differing indications for colonoscopy. From this perspective, a larger multicentre study would be warranted, focusing on patients older than 50 years referred for colonoscopy under uniform indications, such as within screening programs like the Svit program.

As demonstrated by the study by Arieira et al., other factors, such as diabetes, may also influence the effectiveness of bowel preparation (8). In our study, the number of patients with comorbidities was relatively small, and their distribution across groups showed no statistically significant differences.

A limitation of the BBPS assessment is that it is evaluated after additional endoscopic cleaning (12). This introduces an additional human factor that may affect the validity of comparisons between the efficacy of different bowel preparation regimens. Therefore, we propose that studies evaluating bowel preparation agents utilise a validated scoring system where cleanliness is assessed before an additional endoscopic cleaning.

Other studies have attributed the differences between Plenvu and high-volume PEG preparations to better patient experience, tolerability, and adherence in the Plenvu groups (6, 7, 11, 13, 14). Conversely, some studies have reported poorer tolerability with Plenvu, yet still observed superior bowel cleanliness as assessed by BBPS in the Plenvu groups (5, 6, 9). The differences between these studies and ours may be explained by adding Donat Mg to Moviprep, which may have eliminated the difference in bowel preparation quality. This explanation is supported by studies showing that bowel cleanliness improves in groups receiving additional laxatives alongside high-volume PEG preparations (15–17).

Our study does not give a statistically significant difference in BBPS, PDR, or ADR between the group receiving Plenvu and the group receiving Plenvu with Donat Mg. Similarly, other studies have not demonstrated the superiority of regimens combining sodium picosulfate with magnesium citrate compared to Plenvu (3, 18). To confirm the clarification of whether the addition of Donat Mg and Moviprep was as effective as Plenvu and Plenvu with Donat Mg in our study, a control group where patients receive Moviprep without Donat Mg would be required.

In studies, patients reported experiencing side effects (such as nausea, vomiting, abdominal cramps, dizziness, and anal burning) in 16.8–59.37% of cases (5, 7, 9). Bisschop, Hong, Ahmad, and Arieira demonstrated significantly more adverse effects with Plenvu compared to 2L PEG in their studies (5, 6, 8, 9). Conversely, in the studies by Maida et al., no differences in adverse effects were observed between Plenvu and high-dose PEG (7). The most commonly reported adverse effects were nausea and vomiting, which were generally mild and rarely required intervention (6, 7, 9).

In our study, no differences were observed in patient experience or adherence. The frequency of reported side effects did not differ between the groups. Unlike other studies, where nausea and vomiting were identified as the most common adverse effects, thirst was the most frequently reported side effect among our patients, followed by bloating, with nausea being the third most common. Any adverse effects requiring specific medical intervention were observed.

CONCLUSION

The findings of this study confirm that Moviprep with Donat Mg, Plenvu, and Plenvu with Donat Mg are effective, safe, and patient-friendly options for

bowel preparation. These regimens achieve comparable outcomes in cleansing quality and lesion detection while maintaining a high amount of patient satisfaction and adherence. This supports their use in routine clinical practice and further underscores the value of low-volume preparations in enhancing patient experience and procedural outcomes.

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