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RESEARCH ARTICLE
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COMPARISON OF MEAN BOWEL PREPARATION IN PATIENTS UNDERGOING COLONOSCOPY PREPARED BY SODIUM PHOSPHATE VERSUS POLYETHYLENE USING BOSTON BOWEL PREPARATION SCORE

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Abstract

Introduction: Colonic preparation plays a crucial role in colonoscopy, as it affects the chances and success of identifying the lesion and other related results. Sodium Phosphate (NaP) and Polyethylene Glycol (PEG) are two types of bowel preparation agents, comparison between them reveals that they have a propensity to cause side effects, complications, and patient compliance. The Bowel preparation score of Boston thus makes it easier to compare the efficacy of the various regimens because it has a touch of bias-free, objectivity in the process of assessment.

Objectives: The current study aimed to compare the mean bowel preparation quality of NaP and PEG in patients undergoing colonoscopy with the help of BBPS to check its effectiveness, safety, and compliance.

Materials and Methods: A cross-sectional study was done at Department of Gastroenterology & Hepatology, Nishtar Medical University Hospital, Multan, Pakistan from January 2024 to June 2024, with 200 patients randomly placed in NaP or PEG. Descriptive statistics on BBPS, compliance level, and AEs on the patient samples were conducted.

Results: In this study, NaP was found to have overall better BBPS scores of 7.2 ± 1.4 than PEG of 6.5 ± 1.6, p = 0.03. However, NaP was significantly associated with a higher risk of dehydration compared to saline which was only 18% against 8% With PEG, more patients reported cases of nausea and bloating.

Conclusion: NaP is more effective as a bowel preparation though it poses more risks of dehydration than the other preparations. Besides, it was demonstrated that the mentioned PEG is safer for high-risk patients even if it harms lower compliance of the patient. Thus, the strategy of risk adjustment can be applied to bowel preparation outcomes, as it is with other similar procedures.

Keywords: Bowel Cleaning, Polyethylene Glycol, Boston Bowel Preparation Score, Colonoscopy, and Sodium Phosphate.

INTRODUCTION

Colonic preparation is an essential element in colonoscopy because it influences the degree of colon cleansing, detection of lesions, and in general, examiner outcomes. Mandatory requirements for a successful bowel cleanse procedure include successful colonic preparation to avoid missed lesions and repeated procedures. These bowel preparations include sodium phosphate (NaP) polyethylene glycol (PEG) each having different mechanisms and side effects (1). The indication between these two agents continues to be controversial among clinicians because of questions about their effectiveness, side effects, and patient acceptance. The Boston Bowel Preparation Score (BBPS) is a widely accepted qualitative scoring system that can be used for evaluating the quality of bowel preparation and provides comparable grounds for comparing different regimens (2). The objectives of this research are as follows to determine the difference between the introduced bowel preparation quality average in patients treated with NaP and PEG based on the BBPS checklist.

Sodium phosphate works by acting as an osmotic laxative, namely by increasing the amount of water in the colon. It is formulated in tablet or solution for reconstitution and is usually chosen over PEG because of its lower volume and taste (3). Research has found that NaP can provide superior cleansing of the bowel, especially in the distal colon to increase lesion detection rates (4). However, NaP has been reported to cause electrolyte imbalance, dehydration, and nephrotoxicity and for this reason, its safety in elderly and renal impaired patients has been questioned (5). Alas, such strengths put NaP on the favorable side for many patients because of its simplicity and higher patient satisfaction (6).

Polyethylene glycol is an iso-osmotic solution that is mainly used because it increases the volume of stool by using water to soften the stool without the addition of electrolytes. It is assumed to be less hazardous compared to NaP, especially for patients with other medical conditions but is used in relatively large volumes thus inducing poor patient compliance (7). This family of PEGs has been in the past associated with poor tolerance due to their volume and taste. Consequently, several low-volume PEG-based formulations have been prepared for such solutions that are used in combination with ascorbic acid or bisacodyl to improve compliance but not at the cost of efficacy (8). There is evidence suggestive that NaP can be effectively replaced by these modified PPEG regimens for bowel cleansing, although the acceptability score is suboptimal (9). One of the decisive aspects that affect the results of this question is the readiness of the patient to strictly follow the instructions. According to some research, low-volume preparations are less likely to be rejected by patients as compared to high-volume preparations due to the nausea and bloating effects (10). In this respect, NaP has an obvious benefit over PEG, because the latter requires more volume of liquid. However, the side effect of its use is a concern to its use, especially in patients with conditions that might affect the electrolyte levels in the body (11). Contrarily, PEG since it is less convenient is preferred in higher-risk populations owing to its safety profile (12).

The Boston Bowel Preparation Score has now become more popular in rating the effectiveness of bowel preparation. The BBPS divides the colon into the right, transverse, and left colons, and each segment is scored from 0 to 3, for a maximum total of 9. Additionally, a higher score on the scale suggests better bowel preparation, which helps to increase the rates of detecting lesions and decrease the rates of repeat colonoscopy (13). Research has shown that both NaP and PEG can provide acceptable bowel preparation, the observed BBPS scores are influenced by factors including the patient's characteristics and compliance with this regimen (14). NaP is anticipated to produce higher scores in BBPS due to the better cleansing of the distal colon as compared to the proximal colon by PEG (15).

Considering the importance of bowel preparation in determining the outcome of colonoscopy, it is essential to identify the best regimen of preparation that would be safe, effective, and acceptable to the patient. Although NaP has some merits concerning palatability and the number of patients, its disadvantages should not be dismissed, especially when it comes to patients' sensitivity. On the other

hand, PEG is still relished by many physicians because of its safety issues, although patients' acceptability of this method is still a matter of concern. The purpose of this study lies in comparing the mean bowel preparation scores which can be obtained by means of NaP and PEG using the BBPS as an assessment tool. More specifically, this study will help add to the understanding of the efficiency of these two regimens in a hospital environment in Pakistan, and hence contribute to the database for betterment of the operations of colonoscopic procedures.

Objective: In order to ensure the best possible clinical results, the aim of this study is to compare the mean bowel preparation quality in individuals undergoing colonoscopy using sodium phosphate versus polyethylene glycol, as assessed by the Boston Bowel Preparation Score.

MATERIALS AND METHODS

Study Design: Comparative, observational study.

Study setting: The study was carried out at Department of Gastroenterology & Hepatology, Nishtar Medical University Hospital, Multan, Pakistan.

Duration of the study: The study will run from January 2024 to June 2024 a period of six months.

Inclusion Criteria:

The participants are patients who are 18 years or older and require an elective outpatient colonoscopy. Patients' willingness is presumed to follow the assigned bowel preparation regimen as well as the pre-procedure diet restrictions. Individuals with no history of severe diseases in the gastrointestinal tract including Crohn's Disease and ulcerative colitis will be included. Patients colonoscopes for clinically indicated colonoscopy, including CRC screening, evaluation of gastrointestinal symptoms (e.g. rectal bleeding, chronic diarrhea, unexplained anemia), or surveillance for polyps, will be included. They should have normal renal function (serum creatinine within normal range) and no contradictions to either bowel preparation regimen.

Exclusion Criteria

Those patients who have renal disease of Screen III, congestive heart failure, or electrolyte imbalance will be excluded from the study because of the side effects related to Sodium Phosphate. The subjects with a history of hypersensitivity to any ingredient in PEG or NaP will not comprise part of the study. Those who are suffering from gastrointestinal motility problems like gastroparesis or intestinal obstruction will also not be allowed as they will not be able to prepare themselves properly. Pregnant and lactating women will not be included because of safety issues that concern the fetus or the baby. Patients with a history of recent major abdominal surgery such as colectomy, or patients who failed the bowel preparations on account of cognitive dysfunction or other medical reasons will also not be considered for the study.

Methods

Two groups of patients under elective colonoscopy will be involved in the study which include Sodium Phosphate (NaP) and Polyethylene Glycol (PEG). Which bowel preparation to use will depend on the hospital's general policy or guideline to meet the ethical issues and the safety of the patient. Verbal and written instructions concerning down diets and bowel preparations shall also be given to all participants. Colon cleanliness on the day of colonoscopy will be measured using the Boston Bowel Preparation Score (BBPS) which involves rating three areas of the colon namely the right, transverse, and left colon, and the scores range from 0-3 for each region. The total BBPS score ranging from 0 to 9 will be documented by the endoscopists who would not be aware of the preparation regimen of the patient. The rates of tolerability, side effects, and patients' outcomes of complete treatment will also be collected. Descriptive statistics will be used to compare the two groups in terms of their mean BBPS scores and case of equal variance Student t-tests or non-parametric equivalent tests will be carried out. $P < 0.05$ will be the cut-off point significance level.

RESULTS

The study involved **200 patients in total, 100** of those were given to the **Polyethylene Glycol (PEG)** group and **100 to the Sodium Phosphate (NaP**) group. Age, gender, and the reasons for the colonoscopy were among the participant demographics that were similar between the two groups.

Patient Demographics and Baseline Characteristics

Characteristic	Sodium Phosphate (n=100)	Polyethylene Glycol (n=100)	p-value
Mean Age (years)	52.4 ± 10.2	53.1 ± 9.8	0.62
Male (%)	58 (58%)	55 (55%)	0.74
Female (%)	42 (42%)	45 (45%)	0.68
Indication for Colonoscopy			
Screening Colonoscopy	40 (40%)	38 (38%)	0.81
GI Symptoms	45 (45%)	47 (47%)	0.79
Polyp Follow-up	15 (15%)	15 (15%)	1.00

Participants in both groups had similar mean ages **(p = 0.62)**, and the distribution of genders did not differ significantly. With similar percentages in both groups, screening, gastrointestinal symptom assessment, and polyp follow-up were the main reasons for colonoscopies.

Boston Bowel Preparation Scores (BBPS) Comparison

BBPS Score Range	Sodium Phosphate (n=100)	Polyethylene Glycol (n=100)	p-value
Poor (0–3)	10 (10%)	15 (15%)	0.37
Fair (4–6)	28 (28%)	36 (36%)	0.21
Good (7–9)	62 (62%)	49 (49%)	0.08
Mean BBPS Score	**7.2 ± 1.4**	**6.5 ± 1.6**	**0.03**

Superior bowel cleanliness was demonstrated by the Sodium Phosphate group's mean **BBPS score (7.2 ± 1.4)**, which was substantially greater than that of the **PEG group (6.5 ± 1.6, p = 0.03)**. While a larger percentage of **PEG** users fell into the fair and bad categories, **62% of patients in the NaP group** obtained a good preparation score **(BBPS 7-9) as opposed to 49% in the PEG group.**

Patient Tolerance and Adverse Effects.

Adverse Effects	Sodium Phosphate (n=100)	Polyethylene Glycol (n=100)	p-value
Nausea (%)	28 (28%)	42 (42%)	0.04
Vomiting (%)	10 (10%)	15 (15%)	0.37
Bloating (%)	20 (20%)	30 (30%)	0.12
Dehydration (%)	18 (18%)	8 (8%)	0.04
Overall Compliance (%)	89 (89%)	82 (82%)	0.21

While dehydration was more prevalent in the **Sodium Phosphate group (18% vs. 8%, p = 0.04)**, patients in the PEG group reported higher rates of bloating and nausea **(42% vs. 28%, p = 0.04)**. Although the difference was not statistically significant, the NaP group had higher overall compliance with the preparation regimen **(89% vs. 82%, p = 0.21)**. Last but not least, sodium phosphate maintained comparable patient compliance while improving bowel **cleanliness as shown by higher BBPS ratings**. Nevertheless, it was linked to an increased risk of dehydration, while Polyethylene Glycol resulted in increased bloating and nausea. **According to these results, NaP might be a better choice for bowel preparation** in people who don't have any contraindications, but any possible negative effects should be properly controlled..

DISCUSSION

Therefore, it is extremely important to improve the quality of bowel preparation, since poor cleansing may result in lesion miss, longer time of examination, and the need for redemption. This study aims to evaluate between Sodium Phosphate (NaP) and Polyethylene Glycol (PEG) in terms of bowel preparation among patients, where the outcome assessment with the Boston Bowel Preparation Score (BBPS). The study established that NaP was more effective in attaining higher bowel cleanliness compared to PEG on an average BBPS whilst PEG had a high prevalence of GI discomfort including nausea and bloating. Nevertheless, NaP was associated with an increased risk of dehydration which should be considered an indication for patient selection and safety while choosing an appropriate BPR.

The findings also support other studies that have looked at the efficacy of NaP and PEG for colon emptying. Tariq et al. (2022) further observed that NaP was superior to PEG in terms of bowel cleansing mainly at the distal colon which attributed to a better lesion detection rate (1). This supports our study since a higher percentage of patients in the NaP group attained a "good" BBPS value essential for bowel preparation. The ability of the NaP to cause an osmotic effect that allows water to be drawn into the intestinal lumen probably makes it more effective in cleansing. On the same note, the same mechanism poses dangers related to fluid dispensing and electrolyte imbalances, a peril to sensitive patients including elderly or renal patients (Page 2). Patient compliance is very important for bowel preparation because failure to do so results in poor bowel preparation. This study's findings revealed that NaP conformed marginally much better compared to the PEG group albeit non-significant difference. Gravina et al (2023) noted that non-compliance is common with PEG because of its large volume to be ingested and foul taste, thus leading to incomplete evacuation and poor cleansing results (3). Lower-volume PEG-based formulations have been prepared subsequently, to decrease the degree of irritation, but these also need extra additives such as ascorbic acid or bisacodyl to name but a few to be effective (4). However, these modifications have enhanced the acceptability among the patients and NaP has been considered convenient due to small volumes and better taste.

However, the major controversy associated with NaP use is the development of dehydration as well as electrolyte imbalance. In the present investigation, 18 of the patients group in the NaP group suffered from dehydration, while a similar condition was recorded in only 8 of the PEG group. Such a result is also in accord with the current literature which indicates that NaP is related to a higher risk of renal complications especially those with renal dysfunction or receiving diuretic medications (5). Similarly, Othman et al. (2023) also made some important suggestions while administrating the NaP this is because of the life-threatening effects of the dehydration and the electrolyte imbalances that are known to cause acute phosphate nephropathy (6). To minimize these risks, it is advisable to drink sufficient fluids before and after taking NaP and renal function should be evaluated in high-risk patients before the prescription of NaP.

On the other hand, PEG is less invasive than NGT in fluid and electrolyte imbalance, complication rate, and mortality, causing more nausea and bloating. According to Kim et al. (2022), the side effects mentioned earlier that was mentioned which range from 20%–40% of patients who go through PEG reported gastrointestinal symptoms that instigate low compliance and reduced satisfaction in the preparation process (7). It should also be noted that the amount of PEG that needs to be ingested daily may be a problem for certain patients with delayed gastric emptying or motor problems. Jeon et al. (2023) described that a split-dose PEG regimen and/or using adjunctive agents to reduce the bloating could be helpful to overcome this barrier (8).

The BBPS is considered a valuable assessment tool for determining the cleanliness of the colon as it is used as a standardized scale for comparison of various bowel preparation regimens. In this study, our BBPS was significantly higher in the NaP group compared to the PEG group for better cleansing efficacy. The same observation was made by Ali et al. (2022) whereby NaP always had better BBPS than other groups of patients (9). It should be noted that the quality of bowel preparation can vary depending on the patient's dietary regimen, the time of consumption of the preparation solution, as well as patient-related factors such as bowel movement and hydration level. Thus, patients with

chronic constipation, diabetes Mellitus, or a history of poor bowel preparation should be provided with special regimens of preparation. According to Shahini et al. (2023), factors that contribute to bowel preparation success include education of a patient, compliance with dietary measures, and the use of additional laxatives (11). In our study, NaP and PEG work well in most patients, however, some patients had inadequate bowel purge suggesting the importance of tailoring bath preparation.

It is important to consider safety measures when choosing the regimen that will be used for the preparation of the bowel. Although NaP is more effective about cleansing and its acceptability by patients the use of NaP bears with it the risk of nephrotoxicity and electrolyte imbalance. According to Arieira et al., (2021), NaP should not be prescribed to patients with chronic kidney disease, chronic congestive heart failure, or patients under standard medications like NSAIDs or ACE inhibitors. On the other hand, PEG even though is less effective in cleansing, is safer for high-risk patients so due to its iso-osmotic nature, does not cause shifts in electrolyte balance (13). Bowel preparation has been subjected to related changes in prior studies to evaluate changes in efficacy and tolerability. Sirinawasatien et al. (2022) conducted a systematic review and meta-analysis to establish the impact of adding lubiprostone, a chloride channel activator, to PEG with the study proving effective in enhancing bowel cleansing with minimal patient discomfort (14). Similarly, Park et al. (2024) conducted a study that compared the use of low-volume PEG plus ascorbic acid to sodium sulfate tablets orally and they posited that there was no significant difference between the two as to the cleansing effect as well as the satisfaction level of the patients. These findings indicate that more research should be carried out to achieve effective cleansing to enhance the results and reduce side effects.

Finally, it was established that Sodium Phosphate resulted in more effective bowel cleaning than Polyethylene Glycol as suggested by the BBPS scores. However, NaP was associated with a higher risk of dehydration and other side effects of PEG include symptoms of nausea and bloating. However, since NaP may be safer for patients without contraindications, proper patient selection could help prevent adverse outcomes. Also, its lower tolerability does not deny the essential safety of PEG over individuals with renal impairment or electrolyte abnormalities. The subsequent investigations need to identify new approaches to bowel preparation that can effectively work and are more acceptable among patients so that colonoscopy outcomes can be improved.

CONCLUSION

This study aims to look at the efficiency of Sodium Phosphate (NaP) and Polyethylene Glycol (PEG) as the pre-colonoscopy bowel preparation by utilizing the Boston Bowel Preparation score as a parameter. CHO comparing NaP to PEG showed that NaP was more effective in obtaining better bowel cleanliness with higher BBPS scores. However, the results showed that NaP had slightly better adherence with the patients primarily because of its lower volume and taste less bitter. However, NaP was found to increase the rate of dehydration while PEG led to many cases of nausea and bloating hence causing a pose to patient tolerance. Based on such outcomes, NaP might be more advantageous than the other options appointed for patients with no contraindications while PEG is safer for the high-risk groups including those with impaired renal function or electrolyte disturbances. Therefore, bowel preparation should be continued and further research should be conducted on how to improve the compliance of bowel preparation regimen while maintaining high efficacy. The use of patients' characteristics in addressing the problem will produce positive trends in the outcomes of colonoscopy and increase the chances of success.

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