Efficacy and Adverse Effects of Sodium Phosphate and Polyethylene Glycol When Used in Bowel Preparation prior to Colonoscopy among Patients Admitted at Vajira Hospital

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Vajira Med J. 2022; 66(2): 115-24
http://dx.doi.org/10.14456/vmj.2022.xx

Abstract

Objective: Bowel preparation is an important process before colonoscopy. Sodium phosphate (NaP) and polyethylene glycol (PEG) are the drugs mainly used in bowel preparation at Vajira Hospital. Since NaP is an osmotic laxative, it may cause dehydration and electrolyte imbalance. Hence, PEG is commonly utilized in patients admitted to the hospital. The fragile patients need to admitted for bowel preparation for colonoscopy. Thus, the current study aimed to compare the efficacy of NaP and PEG and their effect on electrolyte levels in these patients.

Methods: Datas were collected from admitted patients who received either NaP or PEG for bowel preparation at Vajira Hospital from January 1, 2016, to December 31, 2016.

Results: NaP and PEG did not significantly differ in terms of efficacy. However, compared with PEG, NaP significantly increased serum Na levels (+1.737 mmol/L) and decreased serum K levels (-0.517 mmol/L). Nevertheless, there was no remarkable difference in the changes in serum Na and K levels based on clinical data.

Conclusion: Thus, NaP can be used with caution in bowel preparation among admitted patients as it has minimal side effects on electrolyte levels.

Keywords: bowel preparation, colonoscopy, electrolyte, polyethylene glycol, sodium phosphate

Received: 15 June 2021, **Revised:** 6 April 2022, **Accepted:** 6 April 2022

ความสะอาดของลำไส้และผลข้างเคียงของการใช้ Sodium Phosphate และ Polyethylene Glycol สำหรับเตรียมลำไส้ในผู้ป่วยที่ได้รับการเตรียมลำไส้ใหญ่แบบนอนในวชิรพยาบาล

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Vajira Med J. 2022; 66(2): 115-24

http://dx.doi.org/10.14456/vmj.2022.xx

บทคัดย่อ

บทนำ: การเตรียมลำไส้ใหญ่มีความสำคัญต่อการส่องกล้องลำไส้ใหญ่ ยาที่ใช้เป็นหลักในวชิรพยาบาลคือ โซเดียมฟอสเฟต (NaP) และ โพลีเอทธิลีน ไกลคอล (PEG) ซึ่งยา NaP เป็นยากลุ่ม osmotic laxative มีผลข้างเคียงทำให้มีการสูญเสียน้ำและเกลือแร่ จึงมีการใช้ PEG ในโรงพยาบาลเป็นส่วนใหญ่ อย่างไรก็ตามยังไม่มีการศึกษาถึงผลข้างเคียงของ NaP ในผู้ป่วยที่ต้องมีการเตรียมลำไส้ใหญ่ในโรงพยาบาล การศึกษานี้มีจุดประสงค์เพื่อเปรียบเทียบความสะอาดของลำไส้ และผลข้างเคียงจากการเตรียมลำไส้ด้วยตัวยาสองชนิดนี้ในผู้ป่วยที่ต้องอยู่ในโรงพยาบาล

แนวทางวิจัย: การศึกษาย้อนหลังเชิงพรรณนาในผู้ป่วยที่ต้องนอนในวชิรพยาบาลเพื่อเตรียมลำไส้ใหญ่สำหรับการส่องกล้องลำไส้ใหญ่ตั้งแต่วันที่ 1 มกราคม ถึงวันที่ 31 ธันวาคม 2559

ผลของงานวิจัย: ความสะอาดของการเตรียมลำไส้ใหญ่ด้วยยาทั้งสองชนิดไม่แตกต่างกัน แต่ผลข้างเคียงจากการเตรียมลำไส้ใหญ่ด้วย NaP ทำให้มีค่าของโซเดียมและโพแทสเซียมเพิ่มขึ้นและลดลงอย่างมีนัยสำคัญ (+1.737 มิลลิโมล/ลิตร - 0.517 มิลลิโมล/ลิตร) อย่างไรก็ตาม พบว่าค่าผลเลือดที่เพิ่มหรือลดลงจนผิดปกติของทั้งโซเดียมและโพแทสเซียมไม่มีความแตกต่างอย่างมีนัยสำคัญเมื่อเปรียบการเตรียมลำไส้ด้วยยาทั้งสองชนิด

สรุป: การเตรียมลำไส้ด้วย NaP ส่งผลต่อค่าเกลือแร่ในร่างกายเพียงเล็กน้อย และสามารถใช้ได้อย่างปลอดภัยสำหรับผู้ป่วยที่นอนในโรงพยาบาลเพื่อเตรียมลำไส้ใหญ่สำหรับส่องกล้องลำไส้ใหญ่ แต่ควรใช้ด้วยความระมัดระวัง

คำสำคัญ : การเตรียมลำไส้ใหญ่, การส่องกล้องลำไส้ใหญ่, อิเล็กโทรไลท์, โพลีเอทธิลีนไกลคอล, โซเดียมฟอสเฟต

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Introduction

Colonoscopy is a diagnostic and therapeutic procedure used to detect colonic lesions such as abnormal vasculature, polyps, and mass. Moreover, polypectomy, biopsy, dilatation, clipping, and electro-cauterization can be conducted via colonoscopy. The American College of Gastroenterology and the Canadian Association of Gastroenterology recommend the use of colonoscopy for screening colonic cancer in normal (age ≥ 50 years old) and high-risk (with first-degree relative with colonic cancer) patients[1]. Since colorectal cancer caused 880,792 deaths in 2018 (9.2% of all cancer-related deaths worldwide)[2], the National Health and Medical Research Council showed that this number can be reduced by 15% with the screening program[3]. Zauber AG revealed that the mortality rate of colorectal cancer decreased by 14% with proper screening and 3% with reduction of risk factors[4].

Nusko et al. showed that if a colonoscopist identifies polyps of the same size, those on the right side of the colon have a higher risk of malignancy than those on the left[5]. Hence, complete colonoscopy is recommended during the screening program. However, a complete colonoscopy cannot be performed in 20%–25% of patients due to inadequate bowel preparation[6-7] owing to bowel habit, drug tolerance, or timing of colonoscopy. People with a history of constipation require a strict dietary program with adequate hydration or adjunct laxative agent. The volume and flavor of drugs may affect patient tolerance. Further, some regimens require a volume intake of up to 4 L, which is sometimes difficult for patients to tolerate. Split-dose regimen on the same day of colonoscopy has better outcomes than that on the day before[7-8]. Thus, adequate bowel preparation has an important role in improving polyp detection rate.

Bowel preparation is composed of dietary program and medications. Patients are advised to take low-residue diet at least 2 days before the procedure date and clear liquid diet 1 day before. By contrast, medications for cleansing the bowel can be divided into four groups, which are as follows: isosmotic, hypoosmotic, hyperosmotic, and combined agents. Isosmotic agent is a non-absorbable solution that contains nonfermentable electrolyte that passes through the bowel without absorption or secretion. Therefore, it is associated with a lower risk of electrolyte imbalance after bowel preparation. Hyposomotic agent is not approved by the Food and Drug Administration for colonoscopy preparation because it has a low adenoma detection rate, and it can cause hyponatremia. Hyperosmotic agent is poorly absorbed, and it is more effective when used for bowel preparation. However, data on its safety are inconclusive. Meanwhile, combined agent is less effective in bowel preparation than isosmotic agent, and it affects the gastrointestinal tract[9].

Two drugs are commonly used for bowel preparation in Vajira Hospital. First is sodium phosphate (NaP), a hyperosmotic agent that may cause dehydration and electrolyte abnormalities or even nephropathy based on several studies[10-11]. However, this agent can be easily used as it can be administered at a low volume. Patients who utilize NaP as a bowel preparation regimen should drink 90 mL of drug in split doses (45 mL each time within a period 4–5 h). The second is polyethylene glycol (PEG), which is an isosmotic agent that has a lesser effect on intravascular fluid and electrolytes[9]. However, patients who take this drug must drink 4 L of water within 2 h as part of the preparation. The use of these drugs is based on the colonoscopist.

Several studies have shown that PEG is safe, and NaP is better for bowel cleansing. However, there is no standard criteria for determining which type of drug should be used particularly in elderly patients and those with several underlying diseases who require close monitoring after fluid loss from diarrhea due to the use of bowel preparation drug. Thus, this study aimed to compare the efficacy of NaP and PEG and their adverse effect on electrolyte levels among admitted patients. Moreover, the most suitable drug for these patients was determined.

Methods

Data were collected from the medical records of patients who were admitted to Vajira Hospital and who underwent colonoscopy from January 1, 2016, to December 31, 2016. Patients who received other laxative drugs and those who had incomplete records were excluded. Demographic data (such as sex, age, weight, height, BMI, duration for complete colonoscopy, current intake of medicine, underlying disease, bowel habit, and indication for colonoscopy) were collected. The Vajira bowel preparation score was used to assess the efficacy of bowel preparation. Vajira bowel preparation is classified into four grades, which were as follows: grade 1, solid feces with bowel wall poorly visualized; grade 2, feces with thick viscosity with bowel wall occasionally seen; grade 3, clear liquid feces with most parts of the bowel wall identified; and grade 4, minimal feces with bowel wall clearly observed. These grades were obtained by the colonoscopist at the time of endoscopy. In terms of serum electrolyte levels, patients who received drugs and 48 hours after received drugs experienced changes in serum sodium (normal range: 135–145 mmol/L) and potassium (normal level: 3.5–5 mmol/L) levels.

Demographic data were presented as percentage, mean, and SD. The Statistical Package for the Social Sciences software version 22.0 (IBM Inc.) was used to compare the efficacy of these drugs and their effect on serum electrolyte levels using the chi-square test and the independent *t*-test. Hazard ratios and 95% confidence intervals were calculated. A P value of <0.05 was considered statistically significant.

Results

Of 214 patients, 95 were included in this study. In total, 61 (64.21%) received NaP for bowel preparation. In the NaP group, 20 (32%) were men. The mean age of the participants was 60.13 (40–85) years; mean BMI, 23.51 (16.23–39.31) kg/m^2; and mean time to finish the procedure, 27.10 (9–45) minutes. About 50% of patients had coronary artery disease. Nearly 15% used nonsteroidal anti-inflammatory drugs or angiotensin-converting-enzyme inhibitors (ACEI)/angiotensin II receptor blockers (ARB). Approximately 30% had constipation and were treated with laxative drugs. However, the most common reason of colonoscopy was the presence of abnormal clinical sign. In about 70% of patients, the scope was passed to the caecum. Then, there were 12 (35%) men in the PEG group. The mean age of the participants was 74.12 (47–94) years; mean BMI, 22.87 (13.67–35.46) kg/m^2; and mean time to finish the procedure, 30.44 (10–60) minutes. Results showed significant differences in terms of age and time to finish the procedure in the NaP group. Moreover, approximately 80% of patients in the PEG group had coronary artery disease. About 25% received ACEI/ARB or diuretic drug. The bowel habit was similar between the PEG and NaP groups. However, the most common cause of colonoscopy was the presence of abnormal clinical signs. The rate of passing the scope to the caecum did not significantly differ between the PEG and NaP groups. One patient in the PEG group presented with bowel perforation (Tables 1A, 1B). Perforated bowel occurred from electrocautery in 79 year old female which underlying hypertension, hyperlipidemia and chronic kidney disease stage III, the cleanliness bowel preparation was good, she had done polypectomy for splenic flexure pedunculated polyp and present clinical abdominal pain 12 hours after intervention. Emergency exploratory and primary repair was done and she was discharged 5 days after operation without any complications. NaP and PEG did not significantly differ in terms of efficacy (Table 2).

NaP increased serum Na levels up to 1.737 mmol/L, which is statistically significant (Figure1, Table 3). Only 11 patients received NaP, and they had high serum Na levels. However, the result did not significantly differ from that of patients who received PEG (Table 4). The maximal level of potassium decreased by NaP was 0.511 mmol/L, which is statistically significant (Figure 2, Table 5). Only 22 patients had low serum K level, and the result did not significantly differ (Table 6).

Table 1:

Demographic data of the patients which bowel preparation prior to colonoscopy in patients admitted at Vajira Hospital

A

Characteristic	NaP Mean (Min–Max, SD)	PEG Mean (Min-Max, SD)	P
Age (y)	60.13 (40-85, 11.40)	74.12 (47-94, 10.08)	.000
BMI (kg/m^2)	23.51 (16.23-39.31, 4.69)	22.87 (13.67-35.46, 5.10)	.543
Duration (min)	27.10 (9-45, 5.91)	30.44 (10-60, 8.45)	.028

B

Characteristic		NaP N = 61 (64.21%)	PEG N = 34 (35.79%)	P
Gender	Male	20 (32.79%)	12 (35.29%)	.807
Current drug	NSAID	8 (13.11%)	2 (5.88%)	.230
	ACEI/ARB	9 (14.75%)	9 (26.47%)	.195
	Diuretic	1 (1.64%)	9 (26.47%)	.003
Underlying	CVS	30 (49.18%)	29 (85.29%)	.000
	Endocrine	14 (22.95%)	10 (29.41%)	.492
	Renal	3 (4.92%)	9 (26.47%)	.012
	GI	2 (3.28%)	0 (0.00%)	.159
Bowel habit	Constipation	21 (34.43%)	11 (32.35%)	.840
	Laxative	19 (31.15%)	10 (29.41%)	.862
Indication	surveillance	31 (50.82%)	7 (20.59%)	.002
	screening	5 (8.21%)	7 (20.59%)	.122
	clinical	25 (40.98%)	20 (58.82%)	.097
Completion		43 (70.49%)	26 (76.47%)	.536
Complication		0 (0.00%)	1 (2.94%)	.325

Table 2:

Efficacy of NaP and PEG for bowel preparation in colonoscopy in admitted patients at Vajira Hospital

Cleanliness	NaP	PEG	Pearson Chi-Square	P
Good (score 4)	44 (72.13%)	29 (85.29%)	2.126	.145
Poor (score 1-3)	17 (27.87%)	5 (14.71%)		

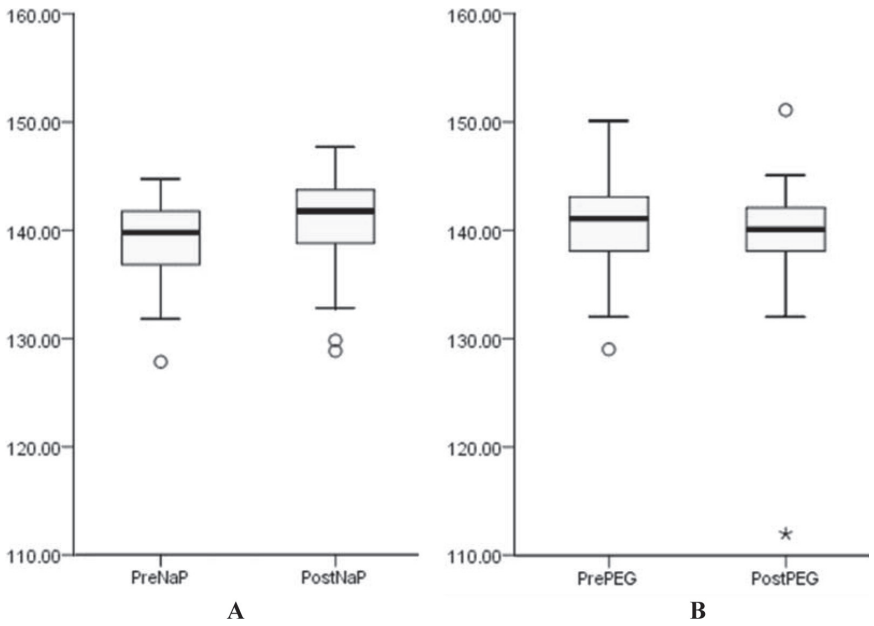

Figure 1: Difference ranges of serum Na levels for pre-bowel preparation with NaP and PEG

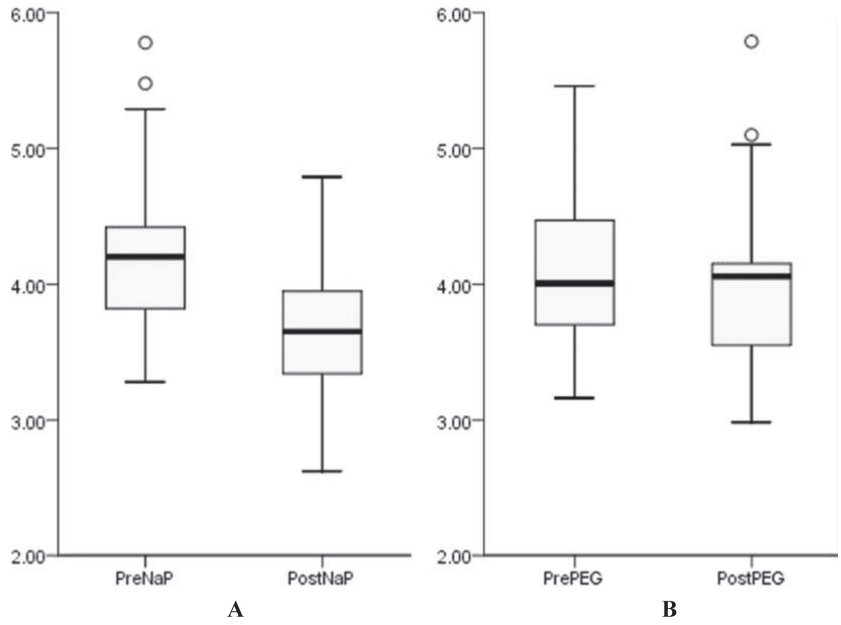

Figure 2: Difference ranges of serum K levels for pre-bowel preparation with and PEG

Table 3:
Number of patients and level change of serum Na

ΔNa	N	Mean	SD	t	Sig
NaP	61	1.737	3.999	2.651	.009
PEG	34	-0.882	5.569		

Table 4:
Number of patients which abnormal change serum Na

ΔNaClinic	N	Mean	SD	t	Sig
NaP	11	2.3636	7.47359	1.382	.190
PEG	4	-5.0000	13.21615		

Table 5:
Number of patients and level change of serum K

ΔK	N	Mean	SD	t	Sig
NaP	61	-0.511	0.536	-3.275	.001
PEG	34	-0.114	0.615		

Table 6:
Number of patients which abnormal change serum K

ΔKClinic	N	Mean	SD	t	Sig
NaP	23	-.7565	.49414	-1.943	.061
PEG	11	-.3373	.75591		

Discussion

Several retrospective studies have shown that NaP has a high efficacy when used in bowel preparation[12–18]. Meanwhile, this research revealed NaP and PEG did not significantly differ in terms of efficacy. Most endoscopist preferred do bowel preparation for fragile patients which inpatients type, for the purpose of early detection and replaced of early rehydration and abnormal electrolyte correction. No standard definition for fragile patients but in practice usually mean old age, multiple comorbidities, impaired kidney function, and the patients who were more likely loss of fluid and abnormality of electrolytes. Our study showed there were statistic significant in term of mean age which higher age and there was statistic significant have cardiovascular disease and renal disease in PEG group which may from individual endoscopist preferred PEG preparation for old age fragile admitted patients which high risk prone to have many complications for bowel preparation.

The recommendation from Kossi et al. showed that the procedure time was shorter in patients who received NaP[17], as shown in this study. Because of the they found statistic significant in term of efficacy bowel preparation in two group that may cause effect for duration colonoscopy. However, the duration for complete colonoscopy was still insignificant for our study.

Several studies have shown that NaP may cause asymptomatic hyperphosphatemia[12,15] and changes in serum electrolyte levels and kidney function without symptom[19]. However NaP associated with symptomatic hyponatremia[20] and nephropathy based on some studies[11,21]. Florentin M et al. revealed that elderly women with metabolic diseases and poor bowel absorption have a higher risk of kidney injuries and hyperphosphatemia[19]. NaP can cause hypocalemia, hypokalemia, hypernatremia, or even hyponatremia caused by dehydration after diarrhea[19]. Moreover, it has a more evident effect on increasing serum Na levels and decreasing serum K levels than PEG. However, the changes did not significantly affect the patients. Nevertheless, changes in serum phosphate levels and kidney function were not assessed in these studies. Thus, clinicians must cautiously consider the risk and benefits of NaP among admitted patients.

This study had several limitations. That is only the bowel cleanliness score in Vajira Hospital was used. Moreover, it has a retrospective design, and most patient data were incomplete, thus we did not collect the changed of other electrolytes such as phosphorous, calcium. Finally, NaP affected to kidney function then monitoring creatinine and kidney function test are important in every status patient especially fragile bowel preparation patients. Another limitation that impact to the adverse effect are age group and the severity of fragile patients, more in PEG group, may be from the bias of endoscopist usually preferred PEG due to less likely have complication in old age and fragile patients. If possible to compare in the likely same characteristic in both group.

Conclusion

The effect of NaP and PEG, which are used in bowel preparation, did not significantly differ in term bowel cleanliness. Compared with PEG, NaP significantly increased serum Na levels and decreased serum K levels. However, based on clinical data, there were no remarkable differences in the changes in serum Na and K levels in selected patients. Thus, NaP can be used for bowel preparation with caution in admitted patients as it has minimal effects on electrolyte levels. The early closed monitoring, rehydration and corrected abnormal electrolytes from timing bowel preparation is important.

Ethical Approval

Committee on Human Rights Related to Research Involving Human Subjects, Faculty of Medicine, Vajira Hospital, Navamindradhiraj University. Protocol Number: ID 036/60 COA 83/ 2560.

Acknowledgements

This study was supported by Navamindrahiraj University Research Fund.

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