

# Effects of oral sodium phosphate solution, as a colon preparation agent, on the serum potassium level in patients undergoing colonoscopy at a Secondary Care Community Hospital

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**Background** : *Colonoscopy is the gold standard investigation for assessing of the intra-luminal colorectal pathology. Effective bowel preparation contributed efficient visualizing of the colon. Osmotic laxatives such as sodium phosphate (NaP) are commonly used for colonic preparation for colonoscopy. A meta-analysis suggested that NaP offered a more effective and more readily completed preparation than PEG-based regimes. However, the use of sodium phosphate solution has been shown to significantly reduce the serum potassium level which is likely to affect cardiac rhythm in particular by prolonging the QT interval. But this affect was not clinically meaningful in most of patients. Sodium phosphate (NaP) are commonly used for colonic preparation for colonoscopy in Phukieo Rural Hospital a secondary care community hospital, the effect of oral sodium phosphate solution, as a colon preparation agent, on the serum potassium level in patients undergoing colonoscopy was evaluated.*

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- Objective** : *To determine the effect of oral sodium phosphate solution, as a colon preparation agent, on the serum potassium level in patients undergoing colonoscopy.*
- Design** : *Retrospective cohort study.*
- Setting** : *Phukieo Rural Hospital, Chaiyaphum Province*
- Material and Methods** : *From January 2010 to December 2013, medical charts of 88 patients who were admitted to Phukieo Rural Hospital for colonoscopy were retrospectively reviewed. All patients were given sodium phosphate solutions as colon preparation agents. Basic tests included serum electrolytes (pre- and post-preparation serum potassium levels) and creatinine determination, electrocardiography (EKG) and chest radiographs. Changes in oxygen saturation, blood pressure, EKG, and any adverse events occurring during colonoscopy were monitored in all patients. The differences between the levels of serum potassium levels before and after colon preparation were tested for statistical significance.*
- Result** : *There was a 0.17 mmol/L average reduction in the serum potassium level after colon preparation in 88 patients. No significant adverse events occurred during colonoscopy. No potential risk factors associated with reduced post-sodium phosphate serum potassium levels were identified on analysis of covariance. No systematic association between post-sodium phosphate potassium levels and any potential risk factors was seen.*
- Conclusion** : *There was a mild reduction in the level of serum potassium after colon preparation with oral sodium phosphate solution in patients who underwent colonoscopy. The reduction was not clinically significant.*
- Keywords** : *Serum potassium level, sodium phosphate, bowel preparation.*

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**เหตุผลของการทำวิจัย :** การส่องกล้องลำไส้ใหญ่ถือเป็น gold standard ในการตรวจวินิจฉัยโรคและพยาธิสภาพในลำไส้ใหญ่ การเตรียมลำไส้ใหญ่ก่อนการส่องกล้องจึงมีความสำคัญ และจากการศึกษาในอดีตพบว่าโซเดียมฟอสเฟตมีประสิทธิภาพในการเตรียมลำไส้ใหญ่ดีกว่าโพลีเอทรีลีนไกลคอล (polyethylene glycol: PEG) แต่มีข้อเสียคือทำให้ระดับโพแทสเซียมในเลือดของผู้ป่วยหลังการเตรียมลำไส้ใหญ่ลดลง ซึ่งมีผลต่อจังหวะการเต้นของหัวใจโดยเฉพาะการเกิด QT prolongation อย่างไรก็ตามผลกระทบดังกล่าวมีผลสำคัญทางคลินิกน้อยมาก ดังนั้นการวิจัยครั้งนี้จึงได้มุ่งศึกษาถึงระดับโพแทสเซียมในเลือด และผลทางในทางคลินิกของผู้ป่วยหลังการเตรียมลำไส้ใหญ่ด้วยยาโซเดียมฟอสเฟตก่อนการส่องกล้องลำไส้ใหญ่ภายใต้การระงับความรู้สึกด้วยยาสลบทางหลอดเลือดดำ รวมถึงปัจจัยที่มีผลต่อระดับโพแทสเซียมในเลือดของผู้ป่วยกลุ่มนี้

**วัตถุประสงค์ :** เพื่อศึกษาระดับโพแทสเซียมในเลือดของผู้ป่วยหลังการเตรียมลำไส้ใหญ่ด้วยยาโซเดียมฟอสเฟต และภาวะแทรกซ้อนทางระบบหลอดเลือดและหัวใจที่เกิดจากการเปลี่ยนแปลงระดับโพแทสเซียมในเลือดของผู้ป่วยก่อนการส่องกล้องลำไส้ใหญ่

**รูปแบบการวิจัย :** การศึกษาย้อนหลังเชิงพรรณนา (Retrospective Clinical Study)

**สถานที่ทำการศึกษา :** โรงพยาบาลภูเขียว จังหวัดชัยภูมิ

**ตัวอย่างที่ทำการศึกษา :** ผู้ป่วยอายุตั้งแต่อายุ 18 ปีขึ้นไป ที่มีข้อบ่งชี้ในการส่องกล้องลำไส้ใหญ่ด้วยโรคหรือภาวะ ต่าง ๆ ได้แก่ เลือดออกในทางเดินอาหารส่วนปลาย อากาที่สงสัยว่าเป็นโรคมะเร็งลำไส้ใหญ่ หรือมีประวัติมะเร็งลำไส้ใหญ่ และทวารหนักในครอบครัว จำนวน 88 คน ที่เข้ารับการรักษาที่หอผู้ป่วยศัลยกรรม โรงพยาบาลภูเขียว จังหวัดชัยภูมิ ระหว่างเดือนมกราคม 2553 ถึง ธันวาคม 2556 ทำการเก็บข้อมูลลักษณะพื้นฐานของผู้ป่วย ได้แก่ อายุ เพศ ข้อมูลทางคลินิก ได้แก่ โรคร่วมหรือโรคเดิม ผลการตรวจทางห้องปฏิบัติการ ได้แก่ อิเล็กโทรไลต์ ซีรัมครีเอตินิน ผลการตรวจคลื่นไฟฟ้าหัวใจ ภาพถ่ายรังสีทรวงอก และข้อมูลการติดตาม

ผลการศึกษา	<p>การเปลี่ยนแปลงของสัญญาณชีพ ระดับออกซิเจนอิ่มตัวในเลือด คลื่นไฟฟ้าหัวใจ ตลอดจนภาวะแทรกซ้อนต่าง ๆ ที่เกิดขึ้นในระหว่างการส่องกล้องลำไส้ใหญ่ โดยค่าความแตกต่างของระดับโพแทสเซียมในเลือดของผู้ป่วยก่อนและหลังการเตรียมลำไส้ใหญ่ด้วยยาโซเดียมฟอสเฟตได้รับการวิเคราะห์ทางสถิติ</p> <p>ระดับโพแทสเซียมในเลือดของผู้ป่วยหลังการเตรียมลำไส้ใหญ่ด้วยยาโซเดียมฟอสเฟตจำนวน 88 ราย ลดลงเฉลี่ย 0.17 มิลลิโมล/ลิตร ซึ่งนับว่าน้อยมาก ไม่พบว่ามีปัจจัยใดที่มีผลต่อการเปลี่ยนแปลงระดับโพแทสเซียมในเลือดของผู้ป่วยอย่างมีนัยสำคัญ และไม่พบภาวะแทรกซ้อนที่รุนแรงหรือมีนัยสำคัญ รวมทั้งไม่พบว่ามีความสัมพันธ์ของระดับโพแทสเซียมในเลือดที่ลดลงกับภาวะแทรกซ้อนที่เกิดขึ้น</p>
สรุป	<p>ระดับโพแทสเซียมในเลือดของผู้ป่วยหลังการเตรียมลำไส้ใหญ่ด้วยยาโซเดียมฟอสเฟตก่อนการส่องกล้องลำไส้ใหญ่ภายใต้การระงับความรู้สึกด้วยยาสลบทางหลอดเลือดดำลดลงน้อยมากและไม่มีนัยสำคัญทางสถิติและในทางคลินิก</p>
คำสำคัญ	<p>ระดับโพแทสเซียมในเลือด, โซเดียมฟอสเฟต, การเตรียมลำไส้ใหญ่.</p>

Colonoscopy is the gold standard investigation for assessing intra-luminal colorectal pathology, because of its ability to view the entire colon and to both detect and remove abnormal lesions during the same procedure.<sup>(1,2-3)</sup> Bowel cleansing prior to colonoscopy is essential for adequate visualization of the colon. Adequate bowel preparation, either by purge with a laxative or by lavage, is important in assuring the quality and accuracy of the colonoscopy.

Colon cleansing preparations can be broadly classified into three groups ; The first group, osmotic laxatives are most commonly used and include agents such as sodium phosphate (NaP), magnesium citrate and mannitol. These increase intraluminal water by promoting the passage of extracellular fluid across the bowel wall. The second group, polyethylene glycol (PEG)-based solutions, consist of high-molecular-weight non-absorbable molecules in a dilute electrolyte solution and designed to be osmotically balanced. Lastly, the third group which includes stimulant laxatives such as senna, sodium picosulphate and bisacodyl, which work principally by enhancing bowel wall smooth muscle activity and may also increase bowel water content.<sup>(3)</sup>

Oral NaP solutions are preferred by clinicians because of the small volume required for effective use, and their previously documented superior efficacy over PEG-based and stimulant laxatives preparations.<sup>(4 - 7)</sup> However, sodium phosphate solutions have been shown to significantly reduce the serum potassium level resulting in polymorphic ventricular tachycardia from severe hypokalemia and hypomagnesemia, especially in older patient or in patients who are taking diuretics or digitalis.<sup>(3, 8 - 11)</sup> Oral potassium replacement and post procedural potassium level assessment, at least for the elderly

or for certain groups of high risk patients were recommended in some studies.<sup>(12 - 13)</sup> However, in another previous study, prophylactic potassium supplement or routine serum potassium monitoring after oral sodium phosphate colon preparation did not seem to be necessary.<sup>(14)</sup>

Hypokalemia might be more important and potassium supplementation or close monitoring might be required in patients undergoing colonoscopy under intravenous (IV) anesthesia. The primary objective of this study was to determine the difference in serum potassium levels before and after colonic preparation for colonoscopy under IV anesthesia. The occurrence of cardiovascular events such as arrhythmia during colonoscopy was also recorded as a secondary outcome.

## Materials and Methods

Medical charts of patients who were admitted to Phukieo Rural Hospital, and who underwent colonoscopy under IV anesthesia with the primary diagnosis of lower gastrointestinal tract hemorrhage (LGIH), colorectal cancer, and other colorectal disorders, during January 2010 to December 2013 were retrospectively reviewed. A few basic tests, which included serum electrolytes, creatinine determination, electrocardiography (EKG) and chest radiographs, were done to assess the fitness to undergo general or intravenous anesthesia. Baseline data including age, gender, underlying medical illnesses, indications for colonoscopy, concurrent medications, serum blood urea nitrogen (BUN) and creatinine level were recorded. Additional laboratory tests such as the liver function test, fasting blood sugar level, or coagulation profile were also done if indicated.

Intravenous or oral potassium supplementation was given to the patient if pre-procedure serum potassium level was less than the lower normal limit. Concurrent medications possibly affecting the serum potassium level such as diuretics, ACEI or NSAIDs<sup>(15-16)</sup> were generally not suspended prior to the procedure if the serum potassium level was normal or could be normalized. Sodium phosphate (Swiff®; Berlin Pharma, Thailand) was given to the patient in two divided doses of 45 ml each, for colonic preparation, starting at 11.00 am on the day before the procedure (scheduled for morning). Post preparation serum potassium level was determined from a venous blood sample drawn at night (7.00 to 8.00 pm) prior to IV anesthesia, and it was repeat on the day of colonoscopy if serum potassium level still abnormal. The patient underwent intravenous anesthesia with Propofol 1 mg/kg bolus followed by 50 gm/kg/min infusion, titrated according to clinical status and hemodynamics until colonoscopy was completed. All patients were monitored for changes in oxygen saturation, blood pressure, EKG, and any adverse events occurring during colonoscopy. The quality of colon preparation and the duration of colonoscopy were also recorded according to the Boston bowel preparation scale.

Quantitative variables were summarized as mean (SD) or median (range) as appropriate. Categorical data were expressed as counts and percentages. The differences between the serum potassium levels before and after colon preparation were tested for statistical significance by using paired t-test. Significant risk factors influencing the serum potassium level after colon preparation were determined using multiple linear regression models

with the baseline potassium level as a covariate. *P*-values less than 0.05 were considered statistically significant. All statistical analyses were performed using Stata version 12 (Stata Corp, College Station, TX USA).

## Result

There were 88 patients in the present study. The baseline data, details of underlying diseases, concurrent medications, pre- and post- sodium phosphate serum potassium levels and their differences are given in Table 1. Indications for colonoscopy included colorectal cancer screening in 52 patients (59%), and lower gastrointestinal bleeding in 35 (40%) (Table 2). Some patients may harbor several illnesses and may be taking several concurrent medications. The quality of bowel preparation in most patients was excellent (84%).

There was a small drop in serum potassium level of 0.17 mmol/L, on average, after sodium phosphate use. The range of change was from an increase of 1.4 mmol/L to a decrease of 1.1 mmol/L (Table 1). Largest decreases occurred in patients with relatively high pre-preparation serum potassium levels.

Intra-operative outcomes and complications are given in Table 2. There were six patients (7%) with intra-operative cardiovascular events. Two patients (2%) had intra-operative hypotension easily corrected by saline infusion. Four patients (5%) developed intra-operative arrhythmia with otherwise normal hemodynamics. Post-sodium phosphate serum potassium levels were normal in almost all patients who developed intra-operative adverse events (3.5 to 4.1 mmol/L). Only one patient who

developed intraoperative arrhythmia had a potassium level of 3.2 mmol/L. No risk factor could be identified which was significantly associated with reduced

serum potassium level after colonic preparation by sodium phosphate, on multivariable analysis with the baseline potassium level as a covariate (Table 3).

**Table 1.** Baseline data.

Characteristic	Summary (n = 88)
Age, years: mean (sd)	60.8 (12.4)
Gender, male: number (%)	47 (53)
Cerebrovascular disease, yes: number (%)	3 (3)
Chronic kidney disease, yes: number (%)	16 (18)
DM, yes: number (%)	16 (18)
HT, yes: number (%)	16 (18)
Cirrhosis, yes: number (%)	3 (3)
COPD, yes: number (%)	7 (8)
Malignant disease, yes: number (%)	24 (27)
Diuretic use, yes: number (%)	7 (8)
Ventolin use, yes: number (%)	3 (3)
Insulin use, yes: number (%)	4 (5)
Statin use, yes: number (%)	4 (5)
ACE inhibitor use, yes: number (%)	6 (7)
Beta-blocker use, yes: number (%)	8 (9)
Calcium channel blocker use, yes: number (%)	10 (11)
Oral hypoglycemic use, yes: number (%)	8 (9)
Use of any drug, yes: number (%)	24 (27)
BUN, mg/mL: median (range)	12 (4 to 55)
Serum creatinine, mg/mL: median (range)	1.07 (0.49 to 3.36)
Pre-sodium phosphate, serum potassium, mmol/L:	
median (range)	3.85 (2.5 to 5.4)
mean (sd)	3.84 (0.54)
Post-sodium phosphate, serum potassium, mmol/L:	
median (range)	3.70 (2.80 to 4.80)
mean (sd)	3.66 (0.39)
Difference*, pre-post sodium phosphate, mmol/L:	
median (range)	-0.2 (-1.1 to 1.4)
mean (sd)	-0.17 (0.52)

\*Negative number refers to decrease after sodium phosphate use; the largest decrease of 1.1 mmol/L occurred in a patient with pre-sodium phosphate potassium level of 4.8 mmol/L

**Table 2.** Intraoperative outcomes and complications.

Outcomes and complications	Summary (n = 88)
Indications for colonoscopy	
LGIH	35 (40)
Surveillance	1 (1)
Screening	52 (59)
Bowel preparation assessment	
Good	14 (16)
Excellent	74 (84)
Cardiac arrest, yes: number	0
Intraoperative hypotension <sup>a</sup> , yes: number (%)	2 (2)
Intraoperative arrhythmia <sup>b</sup> , yes: number (%)	4 (5)
Hospital stay, days: median (range)	3.5 (2 to 90)

<sup>a</sup>Serum potassium levels (post-sodium phosphate) in patients with intraoperative hypotension: 3.6, 4.1 mmol/L

<sup>b</sup>Serum potassium levels (post-sodium phosphate) in patients with intraoperative arrhythmia: 3.2, 3.5, 3.9, 4.1 mmol/L

**Table 3.** Analysis of covariance (adjusted for pre-sodium phosphate serum potassium level) of factors potentially associated with reduced post-sodium phosphate serum potassium level.

Factor	Change (95% CI)	p-value
Age, per year increase	-0.0027 (-0.0088 to 0.0035)	0.393
Gender, male vs. female	-0.10 (-0.26 to 0.05)	0.174
Cerebrovascular disease, yes vs. no	0.15 (-0.27 to 0.57)	0.470
Chronic kidney disease, yes vs. no	0.15 (-0.05 to 0.35)	0.141
DM, yes vs. no	0.11 (-0.09 to 0.31)	0.269
HT, yes vs. no	-0.05 (-0.25 to 0.15)	0.606
Cirrhosis, yes vs. no	-0.06 (-0.47 to 0.36)	0.794
COPD, yes vs. no	-0.03 (-0.31 to 0.25)	0.832
Malignant disease, yes vs. no	0.02 (-0.15 to 0.19)	0.810
Diuretic use, yes vs. no	0.03 (-0.26 to 0.32)	0.846
Ventolin use, yes vs. no	0.06 (-0.36 to 0.48)	0.781
Insulin use, yes vs. no	-0.09 (-0.47 to 0.28)	0.615
Statin use, yes vs. no	0.30 (-0.07 to 0.66)	0.107
ACE inhibitor use, yes vs. no	0.08 (-0.23 to 0.38)	0.624
Beta-blocker use, yes vs. no	-0.07 (-0.35 to 0.21)	0.600
Calcium channel blocker use, yes vs. no	-0.08 (-0.33 to 0.16)	0.493
Oral hypoglycemic use, yes vs. no	0.21 (-0.06 to 0.47)	0.120
Use of any drug, yes vs. no	0.02 (-0.15 to 0.19)	0.817
BUN, per mg/mL increase	0.0001 (-0.0084 to 0.0087)	0.978
Serum creatinine, per mg/mL increase	0.11 (-0.07 to 0.28)	0.243



## Discussion

A recent meta-analysis suggested that sodium phosphate offered a more effective and easily administered preparation than PEG-based regimen and advocated its use as a bowel preparation of choice in patients without co-morbidities.<sup>(17)</sup> However, the use of sodium phosphate solution has been shown in some studies to significantly reduce the serum potassium level.<sup>(18)</sup>

In the present study, patients who took sodium phosphate for colonic preparation before undergoing colonoscopy under intravenous anesthesia, showed only a small reduction in the potassium level and appeared to be asymptomatic. Moreover, there were few and minor intra-operative adverse cardiovascular events, all of which were unlikely to be related to the reduction in the serum potassium level. After adjusting the baseline serum potassium levels, there were no significant risk factors associated with the reduction in post-preparation potassium levels, including age, gender, co-morbid disease, concurrent medications and baseline creatinine levels. This could be due to the small sample size and lack of statistical power.

Despite of a considerable number of patients in the present study with underlying medical illnesses and taking concurrent potassium-losing medications, the reduction in the serum potassium level after sodium phosphate-based colon preparation was relatively minor and was well tolerated by all patients. The present study confirmed similar findings in many previous studies.<sup>(3, 8 - 9,14,18 - 19)</sup> The benign nature of the reduction in post sodium phosphate preparation potassium levels was shown by the lack of any significant intra-operative adverse events, a finding

comparable to previous studies as well.<sup>(3,14,18 - 20)</sup> All intra-operative events were probably due to relative hypovolemia, which was a laxative-associated complication.<sup>(8 - 9,13)</sup> The effectiveness of bowel preparation by NaP in the present study can be seen in the high rate (84%) of satisfactory preparation.

Weaknesses of the present study included the retrospective design and the small number of patients, possibly not sufficient to demonstrate rare but serious adverse events, and was also not powerful enough to show statistical significance of risk factors determining low serum potassium levels. However, the documentation of the occurrence of adverse events during colonoscopy, and the attempt to address risk factors influencing serum potassium levels after colonic preparation with sodium phosphate were among the strengths of the present study.

## Conclusion

Colonic preparation by sodium phosphate in patient undergoing colonoscopy under intravenous anesthesia was safe and effective. The reduction in serum potassium level after sodium phosphate colon was mild and not clinically significant.

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