

# USEFULNESS OF SERUM ELECTROLYTE EXAMINATION AFTER MECHANICAL BOWEL PREPARATION

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## Abstract

**Background and objectives:** Quality of colonic preparation is a crucial part for accuracy and safety of colonoscopy that should be effective, safe, and well-tolerated by patients. Polyethylene glycol (PEG) and sodium phosphate (NaP) solutions are the most regularly used preparation and might lead to adverse events. There was no consensus about usefulness of serum electrolyte examination after bowel preparation. **Aim of this study** to determine the usefulness of serum electrolyte examination after bowel preparation. **Methods:** From July 2017 to December 2017, patients who underwent mechanical bowel preparation for elective colonoscopy were enrolled. Patient demographic data and serum electrolyte levels were recorded and evaluated. **Results:** 100 patients were included in this study. Of these, 15 patients had hypokalemia after bowel preparation. 14 patients developed mild hypokalemia and only 1 patient developed moderate hypokalemia. There were no adverse event during the operation and no significant risk factors were identified on multivariate analysis. **Conclusions:** In patients who undergo elective colonoscopy, are given the appropriate bowel preparation agent the changing of the serum electrolyte level after bowel preparation are mild and not clinically significant. Routine testing for serum electrolyte after bowel preparation seem to not necessary in these patient.

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

## Introduction

Colorectal cancer is one of the most common malignancies in Thailand. It is also the third most frequent cause of mortality in Thailand. (Virani *et al.*, 2017) Colonoscopy is the standard procedure for colorectal cancer surveillance and diagnosis of the colonic disease by direct examination and intervention in the same time. Colonoscopy demand is increasing significantly in Thailand over the few years because of colorectal cancer

screening campaigns that supported by the National health security office (NHSO). Colonic preparation is an important part of quality for colonoscopy that provides the endoscopist to get a good view of the colonic mucosa, to identify colonic polyp or others lesion and do an additional intervention such as polypectomy or endoscopic mucosal resection (EMR) safely. (Kastenberg *et al.*, 2018) Inadequate bowel preparation prolongs the

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procedural time, reduce the completion rate, increase the risk of complication and increase likelihood missing lesions. (Komeda *et al.*, 2013) Several new innovations have been applied to colonoscopy for colorectal cancer surveillance, including chromoendoscopy, narrow-band imaging, and endocytoscopy. These novel techniques require excellent bowel preparation. (Cheon *et al.*, 2007) Despite advances in endoscopic technique, instrument and anesthesia that improved tolerability of the colonoscopy, bowel cleansing remains an unpleasant part for colonoscopy. (Lee *et al.*, 2014) That may effect in diminish patient acceptance of colorectal cancer screening program especially in elderly patients, who have a higher risk of colorectal cancer. (DeCosse *et al.*, 1994)

The ideal preparation for colonoscopy has also be acceptable for patients to take, in term of flavor and amount and should also not cause in fluid and electrolyte disturbance. There are two colonic preparation agents of widespread usage, including sodium phosphate (NaP) and polyethylene glycol (PEG). (Committee *et al.*, 2015) Sodium phosphate (NaP) formulations are low volume hyperosmotic solutions that draw water from intestinal wall into the bowel lumen, that also induce significantly fluid and electrolyte disturbance. NaP formulations should not be administered to elderly patients, patients with congestive heart failure, cirrhosis, renal insufficiency and taking diuretics such as ACE inhibitors, angiotensin II receptor blockers. PEG is a non-absorbable agent that pass throughout the bowel without absorption that not inducing electrolyte and fluid disturbance. However, a large amount of patients are intolerant of unpleasant ingestion of large volume of fluid that leads to poor compliance.

There are different practices about serum electrolyte measurement after bowel preparation. Some of studies have concluded that serum electrolyte examination should be done routinely and nowadays there are no consensus about this practice. (Ainley *et al.*, 2005) Following this recommendation, routine serum electrolyte examination after bowel preparation was adopted in our hospital and this review was undertaken of 100 patients and is report in this study. The purpose of our study to compare the outcome and safety of both bowel preparation regimen in patients who fit for undergoing colonoscopy. The second aim to determining the necessary of the routine measurement of electrolytes in these patients was recorded as the secondary outcome.

## Materials and Methods

We collected a retrospective analysis of medical records of patients who underwent bowel preparation for colonoscopy at Suranaree University of Technology hospital from July 2017 to December 2017. All adult patients (>18 years of age) who underwent colonoscopy in the hospital during the study period were included in this study. All patients required basic evaluation to undergo intravenous anesthesia, which included complete blood count (CBC) , serum creatinine, serum electrolyte, electrocardiography (EKG) and chest radiographs. The patients demographic data, bowel preparation regimen, results of measurement of serum electrolyte and peri-operative clinical events were recorded. Informed consent was obtained from each patient at the outpatient department. Electrolyte supplementation was given in the patient's pre-procedure serum electrolyte level was less than the lower normal limit and a further measurement of the serum electrolyte was performed one week later. Exclusion criteria in this study was incomplete medical record. The investigation protocol was reviewed and approved by the institutional review committee of Suranaree university of Technology (EC-60-58). The study was conducted with strict adherence to the Helsinki Declaration.

All patients were suggest to take clear liquid diet the day before colonoscopy that improve quality of bowel preparation. (Reilly *et al.*, 2004) The choice of bowel preparation regimen was assigned by the endoscopist. The high risk patients for electrolyte imbalance such as age>60 years, congestive heart failure, liver or renal insufficiency and taking ACE inhibitor, were received polyethylene glycol for bowel preparation. All patients were given metoclopramide intravenously 30 minutes prior bowel preparation. In the patients who receive sodium phosphate for bowel preparation, were prepared by two doses of 45 ml each three hours apart. In the patients who prepare by polyethylene glycol were received the 2 L of low volume Polyethylene glycol. Blood test for electrolyte measurement was taken before and after bowel preparation. Patients with abnormal serum level were corrected by the endoscopist and repeated serum electrolyte level after correction. Post preparation serum electrolyte was determined at 2 h prior intravenous anesthesia (propofol 1mg/kg bolus followed by 50 µgm/kg/min infusion, titrated according to clinical status and hemodynamics).

The results of the blood tests were compared in each group before and after bowel preparation. All patients were monitored for vital signs, oxygen saturation, ECG and any adverse events during the procedure.

Prevalence of electrolyte disorders were defined as the prevalence of hypokalemia (serum potassium <3.5 mEq/L). Moderate hypokalemia was defined as potassium level of 2.5 to 3.0 mEq/L. Severe hypokalemia was defined as potassium level <2.5 mEq/L. Patients with moderate hypokalemia received oral potassium supplement and cases of severe hypokalemia was necessary to intravenous administer potassium chloride. Hyponatremia is a low serum sodium concentration <135 mEq/L. In patient with moderate and severe hyponatremia (serum sodium <130 mEq/L) was postponed for colonoscopy. Severity of hypernatremia was classified as follows: mild hypernatremia (serum sodium 146-150 mEq/L, moderate hypernatremia (serum sodium 151-155 mEq/L and severe hypernatremia (serum sodium >155 mEq/L). In patient who had serum sodium greater than 151 mEq/L was postponed for the operation.

Continuous data were presented as means ± standard deviations and categorical data were described as number and percentages. To compare demographic data between both groups, continuous variables were analyzed by the independent t-test and Fisher's probability test was applied for categorical variables. The paired t-test was applied to evaluated the differences in serum electrolyte level between baseline (before bowel preparation) and post bowel cleansing in each group. Any  $p$ -value ≤ 0.05 were considered statistically significant. All statistical analyses were conducted with STATA (Stata Corp, College Station, TX USA).

## Results and Discussion

A total of one hundred patients attending for colonoscopy were included in this study. A enrolled patients were divided into 2 group according to bowel preparation regimen (NaP group = 49 patients and PEG group = 51 patients). Both groups were comparable with demographic data including age, gender and purpose of bowel preparation were similar between the two groups. The demographic data, indication for colonoscopy and details of diuretic use are showed in Table 1. There was no difference in age, gender, and purpose for colonoscopy between the two groups. All patients were tolerated for bowel preparation agents. Summary of the pre-preparation and post-preparation serum electrolyte are showed in Table 2. Average age of PEG group (61.46 years) was greater than NaP group (50.5 years) but there was no significant difference. The small size of this study reduces the power of the study.

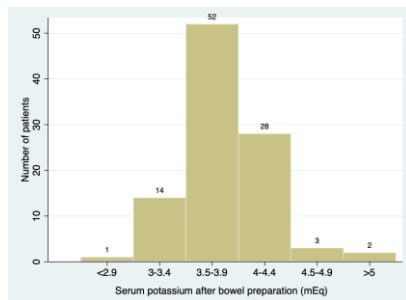
After bowel preparation, all but twelve patients had normal serum sodium level. In those with serum sodium level was no significant change: 139.8 mEq/L before bowel preparation and 141.1 mEq/L after bowel preparation. All of twelve patients had mild hypernatremia that not necessary for sodium correction. Five patients had a potassium level below the lower limit of reference at 3.5 mEq/L. Four of five patients had mild hypokalemia (Figure 1). Only one patient had moderate hypokalemia who need potassium supplement. All patients with previous potassium level showed a mean change of -0.34 mEq/L (mean, 4.14 before and 3.82 after bowel preparation. There was no significant relationship between post bowel preparation electrolyte level and gender, age,

**Table 1. Shows patients' demographic data, indication for colonoscopy and details of diuretic use**

|                                      | NaP         | PEG          | P value                    |
|--------------------------------------|-------------|--------------|----------------------------|
| Number                               | 49          | 51           |                            |
| Mean age (years) (SD)                | 50.5 (10.1) | 61.46 (11.9) | NS                         |
| Male : Female                        | 27:22:00    | 24:27:00     | 0.43                       |
| Purpose                              |             |              |                            |
| Screening and surveillance of cancer | 16          | 18           | 0.13 (Fisher's exact test) |
| GI bleeding                          | 18          | 10           |                            |
| Bowel habit change                   | 15          | 23           |                            |
| Diuretics use                        | 0           | 2            | 0.23 (Fisher's exact test) |

**Table 2. Show summary of the pre-preparation and post-preparation serum electrolyte**

| Laboratory variables | Baseline   |            |         | Post bowel preparation |            |         |
|----------------------|------------|------------|---------|------------------------|------------|---------|
|                      | NaP (SD)   | PEG (SD)   | P value | NaP (SD)               | PEG (SD)   | P value |
| Sodium               | 138.7(3.5) | 140.8(2.5) | NS      | 140(3)                 | 141.1(3.1) | NS      |
| Potassium            | 4.18(0.5)  | 4.09(0.37) | NS      | 3.9(0.4)               | 3.7(0.3)   | NS      |
| Chloride             | 101.9(4.7) | 102.7(2.9) | NS      | 105.6(4.1)             | 107.8(2.3) | NS      |
| TCO3                 | 26.1(2.8)  | 27.2(2.1)  | NS      | 23.6(4)                | 23.6(1.9)  | NS      |



**Figure 1. Shows distribution of serum potassium level after bowel preparation**

diuretics use, underlying disease and bowel preparation agents (Tables 3 and 4). There was no adverse event requiring medical intervention in this study.

For endoscopists, colonoscopy has become a standard procedure for assessing disorder of the colon. Excellent bowel preparation is needed for good quality of colonoscopy. Bowel preparations agents include sodium phosphate or polyethylene glycol were used widely due to their safety, efficacy and compliance. Clinical experience indicates that patient may respond unfavorably to the taste and a large volume of bowel preparation agents that may lead to low compliance and acceptance. (Kumagai *et al.*, 2014) PEG has often used as an bowel preparation agent due to its safety for patients who has risk for electrolyte imbalance. (Lee *et al.*, 2015) However, many patients are not able to complete the PEG due to its taste and the large volume. NaP as an alternative bowel preparation agent was used due to its small volume and ease to take.

Sodium phosphate offered a better tolerated by patients than polyethylene glycol due to its small volume. Previous studies showed more frequent occurrence of electrolyte disturbance after sodium

phosphate preparation compare to polyethylene glycol preparation especially in high risk patients for electrolyte disturbance. (Beloosesky *et al.*, 2003) In our hospital, the selected agent for bowel preparations were depended on the patients conditions. We used PEG in patient with serum electrolyte imbalance, kidney or liver insufficiency, congestive heart failure and taking ACE inhibitors.

There are no consensus about the essential of serum electrolyte examination after bowel preparation. In our hospital, there are different practices about the measurement of serum electrolyte after bowel preparation. We decided to study the metabolic effects of these preparation in a retrospective study. To assess the safety of PEG and NaP compound, the serum electrolyte level evaluated two times, before and after colonic preparation. After bowel preparation, there were slightly decrease of serum potassium level in both groups. Our result in this study were similar to previously studies. (Cohen *et al.*, 1994; Kan *et al.*, 2012) From other clinical trials, changing in serum electrolyte concentration were more usual in the NaP group than the PEG group. (Lee *et al.*, 2014, 2015) Serum phosphate level in the NaP group was significantly change compared to the PEG group. Hyperphosphatemia symptoms are often induced by hypocalcemia that may include tetany, muscle spasm or alteration of mental status. Due to incomplete data, we did not include serum phosphate level in our study but there are no complication from hyperphosphatemia.

Our study confirmed previous studies that the changing of the serum electrolyte after bowel preparation was relatively minor and without adverse clinical effects, if the appropriate bowel preparation agent was given in the patient. A lack of any significant intra-operative adverse events seemed to confirm our hypothesis. It seems that oral

**Table 3. Clinical characteristics of subjects after bowel preparation by serum sodium condition**

|                            | Hypernatremia<br>N = 12 | No hypernatremia<br>N = 88 | OR (95% CI)      | P value |
|----------------------------|-------------------------|----------------------------|------------------|---------|
| Age                        | 54.16(9.4)              | 56.1(12.6)                 |                  | 0.6     |
| Gender (male)              | 6                       | 45                         | 1.04 (0.25-4.24) | 0.59    |
| Diuretics                  | 0                       | 2                          | 0 (0-14.9)       | 0.77    |
| Indication (symptom)       | 7                       | 59                         | 1.45 (0.33-5.83) | 0.38    |
| Bowel cleansing agent(NaP) | 9                       | 40                         | 0.27 (0.04-1.22) | 0.05    |

**Table 4. Clinical characteristics of subjects after bowel preparation by serum potassium condition**

|                           | Hypokalemia<br>N = 15 | No hypokalemia<br>N = 85 | OR(95% CI)       | P value |
|---------------------------|-----------------------|--------------------------|------------------|---------|
| Age                       | 59.3(9.9)             | 55.2(12.6)               |                  | 0.24    |
| Gender (male)             | 5                     | 46                       | 0.42 (0.10-1.51) | 0.11    |
| Diuretics                 | 1                     | 1                        | 0.16 (0.00-14)   | 0.27    |
| Indication (symptom)      | 12                    | 54                       | 2.29 (0.55-13.5) | 0.17    |
| Bowel cleaning agent(NaP) | 6                     | 49                       | 0.65 (0.17-2.26) | 0.31    |

potassium supplement as a prophylactic agent are not recommended for these patients.

There are some limitations in our study. First, this study was a retrospective single center study. Hence, they may be unexpected confounding factors that may effect patients in our data. The second weakness of our study was selection bias-that is, the patients who relatively healthy were assigned for sodium phosphate but it reflects to routine practice. Third, we only included patients who fit for elective colonoscopy. So our results may not be adopted in emergency conditions. Fourth, the population of our study was rather small and thus this study may not have sufficient power to detect adverse events and unforeseen complications. Thus, further large scale, multicenter and randomized control studies are needed to confirm our results. Despite these limitations, the strength of our study included the measurement of serum electrolyte without the confounding effects of anesthesia, the documentation of the adverse events during the procedure, and the attempt to identify risk factors influencing serum electrolyte after bowel preparation. We believe that our study may productive to develop the colonoscopic guideline and clinical epidemiologist who plan to do further large scale studies.

## Conclusions

In patients who undergo elective colonoscopy, who had normal serum electrolyte level prior to bowel preparation, fit to undergo intravenous anesthesia and are given the appropriate bowel preparation agent, the changing of the serum electrolyte level after bowel preparation are mild and not clinically significant. Routine testing for serum electrolyte after bowel preparation seem to not necessary in these patients.

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