Effect of Bowel Preparation with Oral Sodium Phosphate on Serum Potassium Level in Patients Undergoing Colonoscopy under IV Anesthesia

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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 under IV anesthesia.*
Material and Method: *Patients set to undergo elective colonoscopy under IV anesthesia (propofol infusion) were recruited to participate in the present study during the period between October 2008 and January 2009. All patients had normal serum potassium level prior to colon preparation, and all ingested 90 ml of sodium phosphate solution one day before colonoscopy. Blood samples for post preparation potassium level determination were taken immediately before administering IV propofol. Baseline data including age, gender, diagnosis, indication for colonoscopy, underlying illness, concurrent medications and serum potassium and creatinine levels were recorded. The serum potassium levels were compared before and after colon preparation, and potentially important baseline risk factors for low potassium levels after colon preparation were determined.*
Results: *In 48 patients, there was a 0.57 mmol/L (from 4.11 to 3.54 mmol/L) average reduction in the serum potassium level after colon preparation. There were no significant adverse events during colonoscopy. No significant risk factors were identified on multivariable linear regression analysis.*
Conclusion: *There was a mild reduction in serum potassium level after colon preparation with oral sodium phosphate solution, which was probably not clinically significant. Prophylactic potassium supplement or routine serum potassium monitoring after oral sodium phosphate colon preparation did not seem to be necessary for this group of patients.*

Keywords: *Sodium phosphate, Bowel preparation, Serum potassium level*

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Sodium phosphate solution is an effective and tolerable oral hyperosmotic laxative for the preparation of the large bowel for colonoscopy or surgery[1-3]. However, the use of sodium phosphate solution has been shown to significantly reduce the serum potassium level[1-3]. Some studies recommend oral potassium replacement[4,5] and post procedural potassium level assessment, at least for the elderly or certain groups of high risk patients[1,5,6]. In Ramathibodi Hospital, the majority of patients are given sodium phosphate solution as colon preparation agents for day-case, elective colonoscopy or computerized tomographic (CT) colonography. These patients are not routinely given potassium supplements prior to, or close potassium monitoring after, the procedures, unless potassium levels prior to the procedure were lower than normal. For patients undergoing colonoscopy under intravenous (IV) anesthesia the issue of

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hypokalemia might be more important and potassium supplementation or close monitoring might be required. The primary objective of the present study was to compare the serum potassium levels before and after colonic preparation for elective colonoscopy under IV anesthesia in a group of patients deemed fit to undergo IV anesthesia. The occurrence of cardiovascular events during colonoscopy was also recorded as a secondary outcome.

Material and Method

During the period between October 2008 and January 2009, patients who underwent elective colonoscopy under IV anesthesia at the Department of Surgery were invited to participate in the present study. The Hospital's research ethics committee approved the present study. Patients undergoing colonoscopy at the Department routinely required a few basic tests for the fitness to undergo general anesthesia, which included serum electrolytes and creatinine determination, electrocardiography (EKG) and chest radiographs. Patients were approached for informed consent at the Outpatient Department. If the patient's pre-procedure serum potassium level was less than the lower normal limit, he or she was given oral potassium supplementation, with a further determination of the potassium level one week later. Concurrent medications possibly affecting the serum potassium level were generally not suspended prior to the procedure if the serum potassium level was normal or could be normalized. Baseline data including age, gender, underlying medical illnesses, indications for colonoscopy, concurrent medications, serum blood urea nitrogen (BUN) and creatinine were recorded.

The colon was prepared with 90 ml of sodium phosphate solution (Swiff®; Berlin Pharma, Thailand) in one or two divided doses, starting at 16.00 o'clock on the day before the procedure (scheduled for morning). Post preparation serum potassium level was determined from a venous blood sample drawn immediately prior to IV anesthesia (proprofol 1 mg/kg bolus followed by 50 μgm/kg/min infusion, titrated according to clinical status and hemodynamics). By taking blood samples prior to and not after the procedure, the authors could eliminate the confounding effects of anesthetic agents on the serum potassium level.

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.

Continuous data were summarized as mean (SD) or median (range) as appropriate. Categorical data were summarized 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 9 (Stata Corp, College Station, TX USA).

Results

There were 51 patients who consented to participate in the present study. The baseline data are given in Table 1. Details of underlying diseases and concurrent medications are given in Table 2. Note that a given patient may harbor several illnesses and may be taking several concurrent medications.

Of the 51 patients, 3 were excluded from the final analysis due to hemolysis of the blood sample taken in the operating room. Summary of the baseline and post preparation potassium values are given in Table 3. The average potassium level was 0.57 mmol/L (SE, 0.05) lower after colon preparation (p-value < 0.001, paired t-test).

On multivariable analysis with the baseline potassium level as a covariate, no risk factors were significantly associated with the serum potassium level after colon preparation (Table 4).

There were three patients with intra-operative adverse events (3/51, 6%), which were all minor hypotensive episodes easily corrected by saline infusion.

Discussion

In patients undergoing colonoscopy under IV anesthesia (propofol infusion), who had normal serum potassium levels prior to taking sodium phosphate as an hyperosmotic laxative, there was a statistically significant but small reduction in the potassium level which appeared to be asymptomatic. Moreover, there were few and minor intra-operative adverse events, all of which were unlikely to be related to the reduction in the serum potassium level. After adjusting for baseline serum potassium levels, there were no significant risk factors associated with the reduction in post-preparation potassium levels,

Table 1. Demographic and clinical characteristics of patients (n = 51 unless stated otherwise)

Characteristics	Summary
Age (years): mean (SD)	56.8 (13.4)
Sex (male/female)	17/34 (33%/67%)
Underlying medical & surgical illnesses	25 (49%)
Concurrent medications	17 (33%)
Indications for colonoscopy	
Lower GI hemorrhage	17 (33%)
Surveillance & constipation	34 (67%)
Serum creatinine (mg/dL): median (range); n = 49	0.8 (0.4 to 1.6)
BUN (mg/dL): median (range); n = 49	12 (4 to 29)
Baseline serum potassium (mmol/L): median (range)	4.11 (3.46 to 4.77)

Table 2. Underlying diseases and concurrent medications (n = 51)

Underlying diseases and medications	Number (%)
Underlying diseases	
Hypertension	16 (31)
Dyslipidemia	11 (21)
Malignancy	5 (10)
Diabetes mellitus	3 (6)
Valvular heart disease	2 (4)
Gout	2 (4)
Cardiac arrhythmia	1 (2)
Ischemic heart disease	1 (2)
Epilepsy	1 (2)
Concurrent medications	
Statins	7 (14)
Calcium channel blockers	7 (14)
Beta blockers	7 (14)
Angiotensin receptor blockers	4 (8)
Diuretics	3 (6)
Angiotensin converting enzyme inhibitors	2 (4)
Oral hypoglycemic agents	2 (4)
Antiplatelet drugs	2 (4)
Allopurinol	2 (4)
Anticonvulsants	1 (2)

including age, gender, indications for colonoscopy, underlying illnesses, concurrent medications and baseline creatinine levels. The most likely explanation for the last finding was that the size of the present study was too small and was not sensitive in detecting important risk factors.

The present study confirmed previous findings that the reduction in the serum potassium level after sodium phosphate-based colon preparation was relatively minor and was well tolerated by patients, if the laxative was given in the appropriate amount[1-5]. This was so despite a considerable number of patients in the present study with underlying medical illnesses and taking concurrent potassium-losing medications. A lack of any significant intra-operative adverse events attributable to the reduction in serum potassium levels seemed to confirm the benign nature of the problem. All intra-operative events were due to relative hypovolemia, possibly a laxative-associated complication[1,2,6]. It seems that oral potassium supplement as a prophylactic measure or serum potassium level monitoring after colonoscopy are not recommended for these patients, but adequate pre- or intra-operative hydration must be assured.

The effectiveness of oral sodium phosphate for the preparation of the colon, using the conventional dose, was once again confirmed in the present study, with a high rate (96%) of satisfactory preparation (Table 3).

One weakness of the present study was due to selection bias-that is, most patients were relatively healthy, or they would not have been candidates for IV anesthesia. The number of subjects in the present study was small and would not be sufficient to demonstrate rare but serious adverse events. Also, the present study was not powerful enough to show statistical significance of risk factors determining low serum potassium levels. However, the strength of the present study included the measurements of serum potassium without the confounding effects of anesthesia[7], 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.

Table 3. Post-preparation potassium level and quality of bowel preparation (n = 51 unless stated otherwise)

Variable	Summary
Baseline potassium level (mmol/L)	
Mean (SD)	4.11 (0.31)
Median (range)	4.11 (3.46 to 4.77)
Post-prep potassium level (mmol/L); n = 48*	
Mean (SD)	3.54 (0.26)
Median (range)	3.53 (2.9 to 4.12)
Pre- and post-prep potassium difference; n = 48*	
Mean (SD)	-0.57 (0.34)
Median (range)	-0.54 (-1.34 to 0.53)
Quality of bowel preparation	
Good	42 (82%)
Fair	7 (14%)
Poor	2 (4%)

* 3 patients were excluded because of hemolysis in the blood samples

Table 4. Effects of potential risk factors on post preparation serum potassium level, adjusted for baseline potassium level (n = 48 unless stated otherwise)

Factor	Effect on serum level (mEq/L change)	95% CI	p-value
Age	-0.003 per year increase	-0.009 to 0.002	0.235
Sex	0.0751 male vs. female	-0.076 to 0.226	0.322
Use of drugs	-0.064 use vs. no use	-0.217 to 0.090	0.407
Underlying disease	-0.046 disease vs. no disease	-0.194 to 0.101	0.531
Indication for colonoscopy	0.025 LGIH vs. other indications	-0.131 to 0.181	0.746
Quality of preparation			
Good	0 (reference group)	NA	NA
Fair	0.148	-0.262 to 0.558	0.472
Poor	0.073	-0.296 to 0.441	0.692
Serum creatinine level; n = 46	0.086 per mg/dL increase	-0.193 to 0.364	0.539
Serum BUN; n = 46	-0.003 per mg/dL increase	-0.021 to 0.014	0.697

Conclusion

In patients undergoing elective colonoscopy, who had normal serum potassium levels prior to colon preparation, and who were sufficiently fit to undergo IV anesthesia, the reduction in serum potassium level after sodium phosphate colon preparation was mild and not clinically significant. Prophylactic oral potassium supplement and serum potassium level monitoring after colonoscopy did not seem to be necessary in these patients.

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ผลของการเตรียมลำไส้ด้วยการกินโซเดียมฟอสเฟตต่อระดับโพแทสเซียมในเลือดในผู้ป่วยที่มารับการส่องกล้องตรวจลำไส้ใหญ่ภายใต้การฉีดยาสลบ

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วัตถุประสงค์*: เพื่อศึกษาผลของการเตรียมลำไส้ด้วยการกิน sodium phosphate solution ต่อการเปลี่ยนแปลงของระดับโพแทสเซียมในเลือดในผู้ป่วยที่มารับการส่องกล้องตรวจลำไส้ใหญ่ภายใต้การฉีดยาสลบ*

วัสดุและวิธีการ*: ขอความยินยอมผู้ป่วยที่มารับการส่องกล้องตรวจลำไส้ใหญ่ภายใต้การฉีดยาสลบ ในช่วงเวลาระหว่าง ตุลาคม พ.ศ. 2551 ถึงมกราคม พ.ศ. 2552 ผู้ป่วยทุกคนมีระดับโพแทสเซียมในเลือดอยู่ในเกณฑ์ปกติ ก่อนการเตรียมลำไส้ต้องกิน sodium phosphate solution ปริมาณ 90 มล. หนึ่งวันก่อนการตรวจลำไส้เจาะเลือดเพื่อตรวจ ระดับโพแทสเซียมในเลือดหลังการเตรียมลำไส้แต่ก่อนฉีดยาสลบ มีการเก็บข้อมูลพื้นฐาน รวมถึง อายุ เพศ การวินิจฉัยโรค ข้อบ่งชี้ในการตรวจลำไส้ โรคที่พบร่วม ยาที่กินเป็นประจำ ระดับโพแทสเซียมและระดับ ครีอาตินีนก่อนเตรียมลำไส้ ทำการเปรียบเทียบระดับโพแทสเซียมในเลือดก่อนและหลังเตรียมลำไส้ และหาปัจจัยเสี่ยงที่ทำให้ระดับโพแทสเซียมลดลงหลังเตรียมลำใส้*

ผลการศึกษา*: พบระดับโปแตสเซี่ยมลดลง 0.57 mmol/L โดยเฉลี่ย (จาก 4.11 เหลือ 3.54 mmol/L) หลังการเตรียมลำไส้ในผู้ป่วย 48 คน ไม่พบมีเหตุการณ์ข้างเคียงที่สำคัญระหว่างการส่องกล้องไม่พบปัจจัยเสี่ยงที่มีนัยสำคัญต่อการลดลงของระดับโพแทสเซียม*

สรุป*: ระดับโพแทสเซียมในเลือดลดลงเล็กน้อยหลังการเตรียมลำไส้ด้วย sodium phosphate solution โดยอาจไม่มีความสำคัญทางคลินิก การให้โพแทสเซียมกินเพื่อป้องกันการลดลงของโพแทสเซียมมากเกินไป หรือ การเฝ้าระวังตรวจระดับโพแทสเซียมในเลือดอย่างใกล้ชิดหลังการเตรียมลำไส้ อาจไม่จำเป็นในผู้ป่วยกลุ่มนี้*