Oral Potassium Chloride and Oral Rehydration Solution Supplement to Prevent Hypokalemia in Sodium Phosphate Regimen for Bowel Preparation Prior to Gynecological Laparoscopic Surgery

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Objective: *To evaluate the efficacy of oral potassium chloride and oral rehydration solution (ORS) supplement for hypokalemia prevention after sodium phosphate (NaP) bowel preparation.*
Material and Method: *A comparative historical study of patients who underwent gynecological laparoscopic surgery between June 2005 and December 2007 and received NaP for bowel preparation prior to surgery. In the experiment group, a 10% Potassium chloride (KCl) elixir and ORS supplement was introduced to 47 of the patients. The control group of 42 patients received only pure water. Age, body mass index, and time of defecation after NaP bowel preparation were recorded. Serum potassium level before NaP (K0), 4 hours (K4), and 10 hours (K10) after last dose of NaP were measured in both groups.*
Results: *It was found that the experiment group could maintain serum potassium level well. The mean $\pm$ SD of serum potassium level before NaP (K0), at 4 hours after NaP (K4) and at 10 hours after NaP (K10) were 3.99 $\pm$ 0.35, 4.09 $\pm$ 0.43, 4.03 $\pm$ 0.63, respectively. In the control group, the K0 was similar to that in the experiment group but the K4 decreased to 3.50 $\pm$ 0.35 and K10 was 3.76 $\pm$ 0.40, which had a significant difference ($p = 0.011$). Serum hypokalemia ($K < 3.5$mmol/L) was found in 22 patients (52.38%) of the control group.*
Conclusion: *Oral KCl elixir and ORS supplement for sodium phosphate bowel preparation regimen can prevent hypokalemia prior to surgery.*

Keywords: *Sodium phosphate, Oral potassium chloride, Hypokalemia, Oral rehydration solution, Bowel preparation*

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There are many regimens of bowel preparation for patients who undergo colonoscopy, colorectal surgery, or for surgery that has a risk of colorectal injury. There are many gynecologic surgeries that patients have a high risk of bowel injury, such as previous several times of pelvic surgery, severe endometriosis, rectovaginal endometriosis, etc. Bowel preparation prior to surgery is important to reduce the rate of serious complications, such as colostomy. Polyethylene glycol, sodium phosphate, sodium picosulphate, bisacodyl, etc. can be used to clean the intralumen of the bowel. Adequacy, time consuming, inconvenience, discomfort, and compliance of the patient should be considered. A comprehensive systematic review showed that polyethylene glycol and sodium phosphate (NaP) were the most frequently investigated bowel preparations. There was no significant difference between the two agents, but NaP was better tolerated[1-3]. However, electrolyte disturbance was one of the problems for NaP, especially hypokalemia[4].

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Accordingly, the present study was undertaken to evaluate efficacy of oral potassium chloride (KCl) and oral rehydration solution (ORS) supplement for hypokalemia prevention after sodium phosphate (NaP) bowel preparation.

Material and Method

All patients were obtained from the Department of Obstetrics and Gynecology, Rajavithi Hospital. Data of 89 women who underwent laparoscopic surgery were collected. Forty-two cases of the control group were collected between June 2005 and December 2006. The 47 cases of the treatment group who received potassium chloride and oral rehydration solution supplement were all cases of gynecologic laparoscopy who needed bowel preparation and were collected in 2007.

Patients that were at risk of bowel injury in both groups used oral NaP to clean the bowel before surgery. All patients had normal value of complete blood count, BUN, Cr, serum electrolytes, chest x-ray and EKG. Sodium phosphate (Swiff) was taken 30-45 ml in two divided doses, 4 hours apart. Four hours after taking the last dose of sodium phosphate, serum potassium level was evaluated, then reevaluated again 6 hours later. In the control group, pure water was given during preparation. In the treatment group, the patients had to drink 10% potassium chloride elixir 30 ml (40mEq) 2 hours after each dose of sodium phosphate and they had to drink oral rehydration solution 1-2 liter (at least 1 liter) during bowel preparation. ORS consists of sodium chloride 60 mmol/l, trisodium citrate dihydrate 10 mmol/l, potassium chloride 20 mmol/l and glucose 111mmol/l that are equal to Na^+ 90mEq/l, K^+ 20 mEq/l, Cl^- 80 mEq/l, $Citrate^-$ 10 mEq/l and glucose 111 mEq/l.

Age, body mass index (BMI), times of defecation since the starting of bowel preparation, serum potassium level before NaP (K0), 4 hours (K4), and 10 hours (K10) after last dose of NaP were recorded. Serum sodium, chloride, and bicarbonate levels were recorded before NaP (0), 4 hours (4), and 10 hours (10) after the last dose of NaP in the experiment group.

A pilot study in the experiment group of potassium chloride and ORS supplement and the control group was done in 10 cases in each group. The serum electrolyte level in the experiment group was within normal range. No severe adverse effects such as vomiting or severe nausea were detected in the experiment group of the pilot study. Comparison of two means was used to calculate for sample size. Minimal sample size from calculation was eight. All 42 patients in the control group were recruited in 2005-2006 while the 47 patients in the experiment group were recruited in 2007. All patients gave informed consent.

Statistical analysis

Mean, standard deviation, and percent were used for descriptive statistics. Independent t-test and repeated measure were used for analytic statistics of normal distribution data. Mann-Whitney U test and Wilcoxon Signed Ranks test were used for analytic statistics of non-normal distribution data. Repeated measure and adjusted covariate of age, BMI, times of defecation were used to compare serum potassium at K0, K4 and K10 between both groups. SPSS11.5 program was used for analysis. A p-value of less than 0.05 was considered statistically significant.

Results

General data in the experiment and the control group were significantly different. Mean age $\pm$ SD in the experiment group was 34.07 $\pm$ 6.21, which was significantly lower than that in the control group, which was 49.36 $\pm$ 14.63 ($p < 0.001$). Mean BMI $\pm$ SD in the experiment group was 20.93 $\pm$ 2.69 Kg/m^2, which was significantly lower than that in the control group, which was 24.95 $\pm$ 4.63 Kg/m^2 ($p < 0.001$). Mean time of defecation $\pm$ SD in the experiment group was 7.82 $\pm$ 3.34, which was significantly lower than that in the control group, which was 10.24 $\pm$ 5.41($p = 0.002$). Twenty-two cases in the control group needed to be treated with intravenous KCl after K4 due to hypokalemia ($K < 3.5$ mmol/l).

Patients in the experiment group could maintain serum potassium level at K0, K4, and K10 well. Mean serum potassium levels $\pm$ SD at K0, K4, and K10 were 3.99 $\pm$ 0.35, 4.09 $\pm$ 0.43, and 4.03 $\pm$ 0.63, respectively. While in the control group it was found that K0 was similar to the experiment group but K4 and K10 decreased significantly to 3.50 $\pm$ 0.35 and 3.76 $\pm$ 0.40, respectively ($p = 0.011$) (as shown in Table 1).

Table 1. Serum potassium level before NaP (K0), 4 hours after NaP (K4) and 10 hours after NaP (K10)

Serum potassium	Experiment		Control		p-value
	Mean	SD	Mean	SD	
K0 (before NaP)	3.99	0.35	4.07	0.33	0.011
K4 (4 Hr after NaP)	4.09	0.43	3.50	0.35	
K10 (10Hr after NaP)	4.03	0.36	3.76	0.40	

Repeated measure adjusted covariate: Age, BMI and time of defecation

Serum sodium and chloride level of patients in the experiment group increased significantly while serum bicarbonate level decreased significantly ($p < 0.001$). Mean serum sodium level $\pm$ SD at Na 0, Na 4, and Na10 were 139.23 $\pm$ 2.45, 144.36 $\pm$ 3.19, and 141.49 $\pm$ 2.06, respectively. Mean serum chloride levels $\pm$ SD at Cl 0, Cl 4, and Cl 10 were 105.66 $\pm$ 2.90, 111.85 $\pm$ 3.50, and 112.62 $\pm$ 3.87, respectively. Mean serum bicarbonate levels $\pm$ SD at HCO3-0, HCO3-4, and HCO3-10 were 26.89 $\pm$ 2.56, 24.85 $\pm$ 2.60, and 24.08 $\pm$ 3.87, respectively.

Discussion

Sodium phosphate (NaP) is a low-volume, hyperosmolar laxative that is an effective bowel-cleansing agent in humans. The oral NaP preparation was less expensive, better tolerated, and more likely to be completed than polyethylene glycol preparation[5]. NaP was more effective in bowel cleansing than polyethylene glycol (PEG) or sodium picosulphate (SPS) and was comparable in terms of adverse events[6].But some studies showed that NaP was better tolerated and more acceptable[1-3] while the efficacy was not different compared to PEG[1,2].

It was found that single-day, divided-dose 4 hours apart, oral NaP has good efficacy, patient tolerance, and is less time consuming[7]. In patients with normal serum creatinine levels, significant changes in serum potassium occurred after NaP bowel preparation[1,4-6,8]. Electrolyte solution supplement and adequate hydration seem to affect a lesser degree of hypovolemia and could protect against hypokalemia in patients who took NaP for bowel preparation[9,10]. Diarrhea produced by sodium phosphate was watery and voluminous, with stool weights averaging 1078 g/day (range 601-1713 g/day)[11]. Fluid replacement in the present study was 1-2 liter (at least 1 liter). The maximum rate of potassium urinary excretion was 2.2 hr from the first elixir dose[12]. KCl elixir was given twice (2 hours after each dose of NaP). Potassium lost in the stool was about 15 mEq/l so KCl elixir 40mEq (30ml) was given in the present study.

Because of this, the authors introduced a divided-dose 4 hours apart of oral NaP, supplement with oral rehydration solution(ORS) 1-2 liter (at least 1 liter) and10% potassium chloride (KCl) elixir 40mEq (given 2 hours after each dose of NaP) to prevent hypokalemia in patients who took NaP for bowel preparation.

From the results, both groups had no significant difference in serum potassium level before NaP intake (K0). After NaP intake, the serum potassium level was significantly different between both groups, and significantly decreased in the control group. Some cases in the control group needed to be treated with intravenous KCl after K4 due to hypokalemia ($K < 3.5$ mmol/l). Hypokalemia can be the cause of arrhythmia, bowel ileus or metabolic alkalosis that are dangerous conditions for preoperative patients. It was found that significant changes between K0 and K4 were noted in the treatment and the control group. Supplement of KCl elixir and ORS in the experiment group had a significant difference in serum potassium from the control group. However, the control and the treatment groups were not studied at the same time and some data such as age, time of defecation and BMI had significant differences. Even the statistics repeated measure for adjusted covariate age, BMI, times of defecation were used and showed significant difference of the serum potassium level in both groups.

The other serum electrolytes after NaP receiving were recorded only in the experiment group. Serum sodium and chloride levels increased significantly due to NaP and ORS receiving. However, there was no data from the control group to compare with them. Some patients had hypernatremia or hyperchloremia but they had no symptoms. All of them turned to normal level after intravenous fluid replacement prior to operation.

In summary, oral KCl elixir and ORS supplement for NaP can prevent hypokalemia in patients receiving NaP regimen for bowel preparation prior to gynecological laparoscopic surgery. Serum potassium level evaluation after oral NaP for bowel preparation may not be necessary in the future. This protocol will obtain better compliance for the patients and will save costs from medical services. Adjusting dosage of KCl or ORS may have a role to achieve better control of body electrolytes and safer for the patients. However, a double-blinded randomized control trial should be conducted to confirm the advantages of this intervention.

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การให้สารละลายโปแตสเซียมคลอไรด์และสารละลายเกลือแร่ ระหว่างการเตรียมลำไส้ด้วยโซเดียมฟอสเฟต เพื่อป้องกันภาวะโปแตสเซียมในเลือดต่ำก่อนการผ่าตัดผ่านกล้องทางนรีเวช

วิบูลย์ กมลพรวิจิตร, วรพงศ์ ภู่พงศ์

วัตถุประสงค์*: เพื่อศึกษาถึงประสิทธิภาพในการป้องกันภาวะโปแตสเซียมต่ำ โดยให้สารละลายโปแตสเซียมคลอไรด์และสารละลายเกลือแร่ในผู้ป่วยผ่าตัดผ่านกล้องทางนรีเวชที่เตรียมลำไส้โดยใช้โซเดียมฟอสเฟต*

วัสดุและวิธีการ*: ศึกษาเปรียบเทียบผู้ป่วยผ่าตัดผ่านกล้องทางนรีเวชตั้งแต่ มิถุนายน พ.ศ. 2548 - ธันวาคม พ.ศ. 2550 จำนวน 2 กลุ่ม ที่ได้รับการเตรียมลำไส้ด้วยโซเดียมฟอสเฟต กลุ่มแรก 47 คน (กลุ่มทดลอง) ได้รับ 10% สารละลายโปแตสเซียมคลอไรด์และสารละลายเกลือแร่ระหว่างการเตรียมลำไส้ กลุ่มที่สอง 42 คน (เป็นกลุ่มควบคุม) ได้รับน้ำดื่มปกติ วิเคราะห์เปรียบเทียบดัชนีมวลกาย อายุ จำนวนครั้งที่ถ่ายอุจจาระ ระดับโปแตสเซียมในเลือด ก่อนการได้รับโซเดียมฟอสเฟต (K0) หลังได้รับโซเดียมฟอสเฟต 4 ชั่วโมง (K4) และ 10 ชั่วโมง หลังได้รับโซเดียมฟอสเฟต (K10)*

ผลการศึกษา*: ค่าเฉลี่ย ± ส่วนเบี่ยงเบนมาตรฐาน ของ ระดับโปแตสเซียมในเลือดในกลุ่มทดลองมีค่าไม่เปลี่ยนแปลงคือ ก่อนการได้รับโซเดียมฟอสเฟต (K0) หลังได้รับครั้งสุดท้าย 4 ชั่วโมง (K4) และ 10 ชั่วโมง (K10), มีค่า = 3.99 ± 0.35, 4.09 ± 0.43, 4.03 ± 0.63 ตามลำดับ ส่วนในกลุ่มควบคุมไม่พบความแตกต่างใน K0 เมื่อเปรียบเทียบเทียบกับกลุ่มทดลอง แต่ K4 และ K10 ลดลงเป็น 3.50 ± 0.35 และ 3.76 ± 0.40 ตามลำดับ ซึ่งมีนัยสำคัญทางสถิติ (p = 0.011) พบภาวะโปแตสเซียมในเลือดต่ำ (K < 3.5mmol/L) จำนวน 22 รายในกลุ่มควบคุมซึ่งเท่ากับ 52.38%*

สรุป*: การให้สารละลายโปแตสเซียมคลอไรด์ และสารละลายเกลือแร่ ระหว่างการเตรียมลำไส้ด้วยโซเดียมฟอสเฟต สามารถป้องกันภาวะโปแตสเซียมในเลือดต่ำก่อนการผ่าตัดผ่านกล้องทางนรีเวชได้*