Comparative Study Between Polyethylene Glycol and Sodium Phosphate Solution in Elective Colorectal Surgery†

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Abstract

Objective : The aim of this study was to compare the pre-operative-post-operative complications and patients' tolerance between sodium phosphate solution (NaP) and polyethylene glycol-electrolyte solution (PEG-ES) for elective colorectal surgery.

Material and Method : All colorectal cancer patients treated between August 2000 and May 2001 (NaP group) who received two doses of 45 ml NaP solution with a glass of water were compared to all colorectal cancer patients between July 1997 and July 2000 (PEG group) who received 3 liters of PEG-ES. Patient tolerance, post-operative septic complications, and serum sodium and potassium before and after bowel preparation were assessed.

Results : Twenty five patients in the NaP group and eighty six patients in the PEG group were included in the study. Age, gender and surgical procedure were well matched. Patient tolerance to NaP was superior to PEG-ES (p=0.044). There was a significant increase in serum sodium levels (p=0.022) and a significant decrease in serum potassium levels in NaP group (p=0.018) without any clinical sequelae. 35 per cent of the patients in the PEG group had wound infection *versus* only 10 per cent of patients in the NaP group (p=0.021).

Conclusion : Sodium phosphate solution was safe, rapid, well-tolerated and could be the standard pre-operative mechanical bowel preparation for elective colorectal surgery.

Key word : Bowel Preparation, Polyethylene Glycol, Sodium Phosphate, Surgery

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J Med Assoc Thai 2002; 85: 92-96

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† Presented at the Joint Scientific Conference, Royal College of Surgeons of Thailand and Royal College of Surgeons of Edinburgh, Pattaya, Cholburi, Thailand, 6 July 2001.

Pre-operative bowel preparation has been the standard procedure for elective colorectal surgery for over 50 years with the aim to reduce the risk of septic complications, to reduce anastomotic disruption, and to improve operative handling of the bowel (1,2). Mechanical cleansing is the mainstay of bowel preparation which has ideal characteristics of safe, rapid, good-cleansing, little or no discomfort, simple to use, and not expensive.

Before 1980, mechanical bowel preparation used a large volume of solutions that caused fluid and electrolyte imbalance, caused poor tolerance for patients in ingesting the large volume of solutions up to 10 liters which patients could not ingest completely, and took many days of preparation. In 1980, Davis et al(3) developed a polyethylene glycol-electrolyte solution that caused no fluid and electrolyte imbalance, and took only one day for preparation, but used 3-4 liters of solution that 20-35 per cent of patients could not ingest completely(4,5).

Sodium phosphate has been used for bowel preparation since 1969 but took 3-4 days of preparation(6,7). In 1990, Vanner et al(8) used 90 ml of sodium phosphate solution for one day preparation with good quality of cleansing and found that all patients could tolerate it very well(9). But sodium phosphate solution caused minor intravascular volume depletion, hyperphosphatemia, hypocalcemia, hypernatremia, hypokalemia, but no clinical sequele (8). Adequate fluid intake after completion of bowel preparation was used for correcting intravascular volume depletion(5), but it might create poor tolerance for patients.

The aim of this study was to compare the pre-operative-post-operative complications and patients' tolerance between sodium phosphate solution (NaP) and polyethylene glycol-electrolyte solution (PEG-ES) for elective colorectal surgery.

MATERIAL AND METHOD

All colorectal cancer patients treated between August 2000 and May 2001 (NaP group) were prospectively instructed to take a clear liquid diet from 2.00 pm on the day before operation until midnight and received 45 ml of sodium phosphate preparation (Swiff®, Berlin Pharmaceutical Industry Co. Ltd., Bangkok, Thailand) in a glass of water at 2.00 pm and again at 6.00 pm, followed by no additional water and no enema. Each 5 ml of sodium phosphate solution contained monobasic sodium phosphate 2.4 g and dibasic sodium phosphate 0.9 g.

All colorectal cancer patients treated between July 1997 and July 2000 (PEG group) were instructed to take a clear liquid diet from 2.00 pm on the day before operation until midnight, and received 3 liters of a polyethylene glycol-electrolyte solution (Phramongkutklao hospital, Bangkok, Thailand) between 5.00-8.00 pm. One liter of PEG-ES contained polyethylene glycol 60 g, sodium chloride 1.459 g, potassium chloride 0.744 g, sodium bicarbonate 1.68 g and sodium sulphate 5.68 g. Both groups received pre-operative intravenous antibiotics but no pre-operative oral antibiotics.

Blood for electrolytes was collected before the bowel preparation procedure and again at 10.00 pm after completion of the bowel preparation. Patients who had renal failure, heart failure, ascites, complete bowel obstruction, previous colostomy and patients who had abdominal distension before or after bowel preparation, and patients who received antibiotics administration in the previous two weeks were excluded from the study. Patients were asked about the percentage of the solution ingested. Any sign and symptoms of wound infection and anastomotic leakage were recorded.

A written informed consent was obtained from all patients. Data was computed with SPSS 9.0 Chi-square and Fisher's exact tests were used to evaluate dichotomous data. Paired-sample *t*-tests and independent-sample *t*-tests were used to evaluate continuous data.

RESULTS

Twenty five patients in the NaP group and eighty six patients in the PEG group were included in the study. Age, gender and surgical procedure were well matched (p=0.306, 0.894, 0.153, respectively). All patients in the NaP group ingested all of the NaP solution, but 18 per cent of patients in the PEG group could not ingest all of the PEG-ES solution (p=0.044).

Serum sodium and potassium levels before administration of the PEG-ES or NaP solution between the two groups was not different (p=0.534, 0.502, respectively). There was a significant increase in serum sodium levels (p=0.022) and a significant decrease in serum potassium levels (p=0.018) in the NaP group without any clinical sequelae.

Table 1. Procedure and wound infection.

Procedure	PEG-ES		NaP	
	No.	Wound infection	No.	Wound infection
Rt. hemicolectomy	8	1	2	1
Lt. hemicolectomy	2	0	2	0
Ant. resection	21	8	8	2
Low ant. resection	29	13	2	0
AP-Resection	24	6	9	0
Hartmann's op.	2	2	2	0
Total	86	30	25	3

Serum sodium and serum potassium levels in the PEG group were not different before and after administration of PEG-ES (p=0.998, 0.141, respectively).

Thirty five per cent of the patients in the PEG group had wound infection *versus* only 10 per cent of patients, in the NaP group (p=0.021) (Table 1). Anastomotic leakage occurred in 2 patients in the PEG group, but none in the NaP group. All patients in both groups were operated on by qualified colorectal surgeons.

DISCUSSION

Hypernatremia and hypokalemia from the NaP solution were not different from the study of Oleveira et al[10] and Cohen et al[4]. Hypokalemia had to be corrected before general anesthesia because it might have caused prolonged relaxation of the respiratory muscles. During correction of hypokalemia with intravenous fluid replacement, volume depletion caused by the osmotic properties of the NaP solution[8] was corrected simultaneously. Therefore, water ingestion immediately after the NaP solution ingestion may not be necessary.

The low rate of wound infection and anastomotic leakage indicated that the NaP solution was safe for elective colorectal surgery. But other factors participated in the reduction of septic complications such as appropriate antibiotics, intraoperative surgical technique, and increased use of outpatient bowel preparation[11,12]. Surgeons must be strict on these factors, especially the surgical technique.

The small volume of the NaP solution helped the patients to ingest all of the solution. This caused one hundred per cent effectiveness of bowel cleansing, which was superior to previous mechanical cleansing preparations that used a large volume of solution up to 10 liters[4,9,10,13-16] with or without the use of an N-G tube that caused intolerance to the patients and failure to complete the mechanical bowel preparation.

SUMMARY

Sodium phosphate solution with a glass of water could be the standard pre-operative mechanical bowel preparation for elective colorectal surgery. Sodium phosphate solution had better patient tolerance, caused fewer septic complications, and caused hypernatremia and hypokalemia which might cause complications when patients are under general anesthesia.

(Received for publication on July 12, 2001)

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การศึกษาเปรียบเทียบระหว่างโพลีเอธีลีนกลัยคอลและสารละลายโซเดียมฟอสเฟต ในการผ่าตัดลำไส้ใหญ่โดยการนัดหมาย

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วัตถุประสงค์ : เพื่อศึกษาเปรียบเทียบผลแทรกซ้อนทั้งก่อนและหลังการผ่าตัดและความทนต่อการให้สารละลายระหว่างโพลีเอธีลีนกลัยคอลและสารละลายโซเดียมฟอสเฟตในการผ่าตัดลำไส้ใหญ่โดยการนัดหมาย

วิธีการศึกษา : ได้รวบรวมผู้ป่วยทำการผ่าตัดลำไส้ใหญ่โดยการนัดหมายระหว่างเดือนกรกฎาคม 2540 ถึงเดือนกรกฎาคม 2544 โดยกลุ่มที่ได้รับสารละลายโซเดียมฟอสเฟตจะได้รับสารละลายโซเดียมฟอสเฟต 45 มล.ในน้ำหนึ่งแก้ว จำนวนสองครั้ง เปรียบเทียบกับกลุ่มที่ได้รับสารละลายโพลีเอธีลีนกลัยคอล 3 ลิตร บันทึกการทนได้ของผู้ป่วย ภาวะการติดเชื้อของแผลผ่าตัดและระดับโซเดียมและโปแตสเซียมในเลือดทั้งก่อนและหลังให้สารละลาย

ผลการศึกษา : กลุ่มที่ได้รับสารละลายโซเดียมฟอสเฟตมีจำนวน 25 รายเปรียบเทียบกับกลุ่มที่ได้รับสารละลายโพลีเอธีลีนกลัยคอลจำนวน 86 ราย ทั้งสองกลุ่มมีการกระจายของเพศ อายุ และชนิดของการผ่าตัดเหมือนกัน พบว่าผู้ป่วยทนต่อการให้สารละลายโซเดียมฟอสเฟตได้ดีกว่าโพลีเอธีลีนกลัยคอล ($p=0.044$) ผู้ป่วยในกลุ่มที่ได้รับสารละลายโซเดียมฟอสเฟตมีการเพิ่มขึ้นของระดับโซเดียมในเลือด ($p=0.022$) และการลดลงของระดับโปแตสเซียมในเลือด ($p=0.018$) อย่างมีนัยสำคัญแต่ไม่ทำให้เกิดอาการผิดปกติใด ๆ นอกจากนี้ผู้ป่วยในกลุ่มที่ได้รับโพลีเอธีลีนกลัยคอลมีการติดเชื้อของแผลผ่าตัดสูงกว่ากลุ่มที่ได้รับสารละลายโซเดียมฟอสเฟต ($p=0.021$)

สรุป : สารละลายโซเดียมฟอสเฟตมีความปลอดภัย ผู้ป่วยสามารถทนได้ดี สามารถนำไปใช้สำหรับการเตรียมลำไส้ใหญ่สำหรับการผ่าตัดได้

คำสำคัญ : การเตรียมลำไส้, โพลีเอธีลีนกลัยคอล, สารละลายโซเดียมฟอสเฟต, การผ่าตัด

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จดหมายเหตุทางแพทย์ ฯ 2545; 85: 92-96

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