

PREOPERATIVE ELECTIVE BOWEL PREPARATION IN CHILDREN WITH POLYETHYLENE GLYCOL VERSUS POLYETHYLENE GLYCOL AND MANNITOL - A COMPARATIVE STUDY

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Abstract

Background: Oral mechanical bowel preparation (MBP) is a routine practice prior to colorectal surgery in many centers. Virtually all colorectal surgeons consider a mechanically cleansed and empty bowel as one of the prerequisites for a safe colonic resection and anastomosis. Various agents had been used in different centers in mechanical bowel preparation.

Methods: A comparative prospective interventional analysis of preoperative elective bowel preparation in children with polyethylene glycol (PEG) versus polyethylene glycol and mannitol was conducted on 60 children underwent elective GIT surgery between July 2014 and June 2016. The patients were allocated into 2 groups by simple random sampling, 30 in each group. Children of 6 months to 14 years were selected as study population. In group I, PEG was given per orally or through nasogastric tube at the rate of 1.5 gm powder/kg/dose, in group II, PEG & Mannitol were given orally or via nasogastric tube. PEG was administered as same dose of group I and mannitol 20% at a dose of 10 ml/kg/dose. All patients received prophylactic intravenous antibiotics (ceftriaxone + metronidazole) preoperatively as well as in postoperative period. All children were investigated preoperatively and post operative follow up was recorded. Structured questionnaire was used to collect information regarding preoperative status and post operative follow up. Statistical assessments were done by SPSS version 21. An Ethical clearance had been sought.

Results: Sixty children underwent mechanical bowel preparation prior to GIT surgery. 30 with PEG (group I) and 30 with PEG and Mannitol (group II). Our outcome variables were wound infection, anastomotic leakage, and Electrolyte balance. Demographic pattern also evaluated. The age range of both groups was 6-68 months, p value 0.987. In both group male and female were same in number, 16 male and 14 female each in both groups. Wound infection occurred 3 cases (10%) in PEG group and 2 cases in PEG and Mannitol group, p value 0.64. No anastomotic leakage in PEG and Mannitol group and only 1 leakage in PEG group. No Electrolyte imbalance was found in both groups. No mortality was recorded in this study.

Conclusions: No significant difference was found between the two study groups in respect of wound infection, anastomotic leakage and electrolyte balance. Ingestion of two drugs did not have any better outcome. So, mannitol can be omitted in MBP in children

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Introduction

Oral mechanical bowel preparation (OMBP), defined as the use of an oral preparation given prior to surgery to cleanse fecal material from the bowel lumen, is often prescribed preoperatively for patients undergoing elective colorectal surgery.¹

Virtually all colorectal surgeons consider a mechanically cleansed and empty bowel as one of the prerequisites for a safe colonic resection and anastomosis. In many surgical centers the bowel is thoroughly cleansed before colorectal surgery with the aim to prevent wound infection and anastomotic leakage.²

From the very beginning several methods of MBP were used. There was the traditional preparation which was a time-consuming procedure usually consisting of a period of starvation for five days before surgery. The patient was encouraged to drink only a liquid diet followed by purgation with magnesium sulphate, magnesium citrate or sennasides, followed by an enema and rectal washout. The second method introduced³ was whole bowel irrigation with an electrolyte solution through a nasogastric tube. The technique was subsequently modified for use as bowel preparation. The procedure involved administration of a 10–12-liter electrolyte solution originally with normal saline. At last oral bowel preparation was introduced with hypertonic solutions consisting of 4 liters of polyethylene glycol (PEG) or mannitol. Patients were able to drink this the day before surgery and acceptability improved as flavoring was added. It soon became clear that polyethylene glycol-electrolyte had several advantages over the other cleansing regimens.

The importance of efficient mechanical bowel preparation preventing infectious complications and anastomotic dehiscence after colorectal surgery has been a dogma among surgeons for more than a century.⁴ Clinical experiences and observational studies have shown that mechanical removal of gross fecal matter from the colon has been associated with decreased morbidity and mortality in patients undergoing operation of the colon.⁵

The ideal cleansing agent should be well tolerated by the patient, produce adequate

cleansing without the formation of explosive gases, as well as be easily administered and have a low cost. Some preparations require the oral ingestion of great quantities (between 2 to 4 L) in short time which is the case with hyperosmotic electrolyte solutions, iso-osmotic solutions, and a polyethylene glycol solution.⁶

In mechanical bowel preparation Mannitol and Polyethylene Glycol are most utilized, both are equally effective and safe for bowel cleansing⁷ Polyethylene glycol (PEG) is the non absorbable osmotic agent most widely commercially available.

PEG is a balanced solution that is not absorbed, it is safe for patients with electrolyte imbalances (i.e., renal failure patients) or patients who may not be able to tolerate fluid shifts (i.e., congestive heart failure patients, patients with ascites from liver disease). In addition, PEG solution is the method of choice for bowel cleansing in infants and children⁸. Mannitol is an osmotic laxative, derivative of mannose that when administered orally in a hypertonic solution 20% is not absorbed by gastrointestinal tract. It has a sweet taste to it. It draws fluid into the lumen of the bowel by osmotic action. Mannitol, however, is fermented by enteric organisms and thus resulted in an increased post-operative rate of septic complications and risk of bowel explosions.⁹ Dose of Mannitol in children is 10 ml/kg.¹⁰

In present study, preoperative bowel preparation with PEG versus PEG and Mannitol in children was assessed and compared

Materials and Methods

It is a Prospective, comparative, and interventional study. The study was conducted in the Department of Pediatric Surgery, Dhaka Medical College, and Hospital. Study period was 02 years (From July 2014 to June 2016). The children who underwent bowel preparation for various GIT surgery were selected for the study. 60 patients were taken for this study-30 in each group. Sample was taken randomly.

Pre-operative Preparation: In group I, PEG was given per orally or through naso-gastric tube. PEG was administered at the rate of 1.5 gm powder/kg/dose (17 gm powder dissolved in 240 ml of fluid).

In group II, PEG and Mannitol were given orally or via naso-gastric tube. PEG was administered as same dose of group I and mannitol 20% at a dose of 10 ml/kg/dose.

In both group preparation started 18-24 h before surgery. Only clear fluid (plain water, juice, ORS) was allowed in this period. In this study drugs were given 3 times among each group as per schedule. 1st dose at 10 am, 2nd dose at 3 pm and 3rd dose at 10 pm. After the 2nd dose if effluents become clear and watery 3rd dose was omitted. S. Electrolytes were assessed before starting of preparation and at 7 pm (after receiving 2 dose of drugs) in each patient. After completion of the 2nd dose of preparation, patients were kept in fasting condition and nutrition maintained on intravenous (I/V) fluids (maintenance fluids and cholera saline) based on their body weight. Serum electrolyte level was assessed at night and if needed electrolyte supplements were given accordingly. All patients received prophylactic intravenous antibiotics (Ceftriaxone + Metronidazole) preoperatively as well as in postoperative period (up to 7th POD). In case of stoma closure patients, distal loop irrigation with normal saline and enema were also given for distal clearance.

Postoperative evaluation of the outcome variables: Surgical Site Infection (SSI) – evaluated by ASEPSIS Score on 3rd, 5th and 7th POD. Fever on 5th POD and 7th POD. Check dressing done at 3rd POD and transparent dressing (Tegaderm) was given. ASEPSIS wound scoring was done at the time of dressing on 3rd, 5th and 7th POD.

In case of wound infection daily dressing and scoring was done. Patients with post-operative surgical site infection had purulent discharge from the wound. In case of purulent discharge pus was sent for culture sensitivity test. Culture sensitivity test revealed growth of Escherichia coli in 3 cases and Staphylococcus aureus in 2 cases. All the cases were sensitive to ceftriaxone. So, no additional antibiotic was given, only regular dressing was done.

Postoperative pyrexia before the 5th POD is usually due to conditions like atelectasis, stress etc. So, fever appearing after the 5th POD was considered significant. Total WBC count, differential count of neutrophil and fever was recorded to evaluate the postoperative inflammatory response.

Follow up visits: Patients were followed up at 15th POD and 30th POD.

Result

This is a prospective comparative interventional study conducted from July 2014 to June 2016 (02 years) in Department of Pediatric Surgery, DMCH on 60 patients, 30 in each group. In the present study age range was 6 months to 168 months in both groups. Mean age of PEG and PEG & Mannitol group was 46 ± 49.084 months and 46 ± 42.643 months respectively. No significant age difference was seen between the groups as p value was > 0.05 . In this study out of 60 patients, 32 (53.33%) were male and 28 (46.67%) were female. In both groups male were 16 and female were 14. Out of 60 patients, 83% of the patients in PEG group and 66.67% in PEG and Mannitol group underwent closure of enterostomies (colostomy, ileostomy and ileocolostomy). Two patients (6.67%) in the PEG group and 3 patients (16.67%) in the PEG and Mannitol group had trans-anal pull through. Two patients (10%) in the PEG group and 6 patients (20%) in PEG and Mannitol group had ASARP. Only a single patient in the PEG and Mannitol group had Hepatico-duodenostomy.

In group I wound infection occurred in 1 case (3.33%) of small gut surgery patients and in 2 cases (6.66%) of large gut surgery patients. Proportion Z test revealed p value 0.29 which was non-significant.

In group II wound infection occurred in 2 cases (6.66%) of large gut surgery patients but no infection occurred in small gut surgery patients. Proportion Z test revealed p value 0.20 which was non-significant.

S. Electrolyte level of both groups were assessed in Pre and post preparation (after 2nd dose) state. No significant difference was found between Na^+ , K^+ & Cl^- level.

Though there was no significant difference between pre and post preparation K^+ level, it was observed that potassium level and Cl^- was low in PEG and mannitol group at post preparation (after 2nd dose) state.

Post operative fever developed in 3 cases of group I and 6 cases of group II on 5th POD with a p value of 0.378, which was not significant and 2 cases of Group I and 3 cases of Group II developed fever on 7th POD which was not significant as p value 0.64.

Table I
Age distribution of children (months)

Age (months)	PEG Group (n=30)	PEG and Mannitol Group (n=30)	P value
Range	6 - 168	6 - 168	0.987 ^{ns}
Mean \pm SD	46 \pm 49.084	46 \pm 42.643	

Table II
Types of operation done

Type of operation	Group I (PEG) (n=30)		Group II (PEG and Mannitol) (n=30)	
	No.	%	No.	%
Ileostomy Closure	13	43.33	5	16.67
Transverse Colostomy Closure	5	16.67	5	16.67
Pelvic Colostomy closure	7	23.33	10	33.33
Anterior sagittal ano rectoplasty	3	10	6	20
Trans-anal pull through	2	6.67	3	10
Excision of Choledochal cyst(Hepatico-doudenostomy)	0	0	1	3.33

Table III
Comparison of Surgical Site Infection (wound infection) between the

Wound infection	Study groups				P value
	Group I(n=30)		Group II(n=30)		
	No.	%	No.	%	
	3	10	2	6.67	0.640 ^{ns}

Table IV
Comparison of wound infection between the Study groups (According to type of surgery)

Type of operation	Group I(PEG) (n=30)			Group II(PEG and Mannitol) (n=30)		
	No.	Wound infection %		No.	Wound infection %	
Small gut surgery (Ileostomy Closure)	13	1	3.33	5	0	
Large gut surgery	17	2	6.66	25	2	6.66

Table V
Comparison of post preparation (after 2 dose) S. Electrolyte level Between the study Groups

	Group I (PEG) (n=30)	Group II (PEG and Mannitol) (n=30)	P value
(Na ⁺) Mean \pm SD	140.20 \pm 4.366	140.73 \pm 4.118	0.628 ^{ns}
(K ⁺) Mean \pm SD	4.313 \pm 0.457	4.217 \pm 0.524	0.45 ^{ns}
(Cl ⁻) Mean \pm SD	106.63 \pm 1.671	98.70 \pm 24.24	0.079 ^{ns}

Table VI

Comparison between pre and post preparation (after 2nd dose) S. Electrolytes level in Group II (PEG and Mannitol)

	Group II (PEG and Mannitol) (n=30)		P value
	Pre preparation	Post preparation (After 2 dose)	
(Na ⁺) Mean ±SD	140.233 ±3.811	140.733±4.118	0.603 ^{ns}
(K ⁺) Mean ±SD	4.392 ±0.396	4.216±0.323	0.086 ^{ns}
(Cl ⁻) Mean ±SD	107.66 ±3.844	98.70±24.24	0.057 ^{ns}

Table VII

Comparison of post-operative fever between the study groups

Fever	Group (PEG) (n=30)		Group (PEG and Mannitol) (n=30)		P value
	No.	%	No.	%	
5 th POD					
Present	3	10	6	20	0.278 ^{ns}
Absent	27	90	24	80	
7 th POD					
Present	2	6.67	3	10	0.64 ^{ns}
Absent	28	93.33	27	90	

Discussion

Mechanical bowel preparation is a routine practice prior to colorectal surgery. In this study, the outcome of MBP in children with PEG versus PEG & mannitol was assessed and evaluated. Our outcome variables were wound infection, anastomotic leakage and electrolyte balance. Along with these variables, the demographic pattern of study population and review of different literature on MBP would be discussed.

In the present study the age range was 6 months to 168 months in both groups. Mean age of PEG and PEG & Mannitol group was 46 ± 49.084 months and 46 ± 42.643 months respectively. No significant age difference was seen between the groups as p value was > 0.05. In this study out of 60 patients, 32 (53.33%) were male and 28 (46.67%) were female. In both groups male were 16 and female were 14. The difference in sex distribution between the study groups was statistically insignificant (P value – 1.00).

In the present study wound infection was an important outcome variable. In PEG group 3 patients had wound infection. One patient had purulent collection under the wound which was drained by slight splitting of the surgical wound under local anesthesia (ASEPSIS score –38). The other 2 patients had serous discharge, erythema and mild separation of deep tissue at the wound site (ASEPSIS score was 26 and 28).

In PEG and Mannitol group 2 patients developed wound infection, among them 1 patient had purulent discharge from the wound on 5th POD which was drained by spontaneous separation of about 30% of the wound length, no debridement was needed (ASEPSIS score – 30). Another patient had serous discharge, erythema of the wound and separation of wound margin (<30%) with an ASEPSIS score of 25 detected on 5th POD. In every cases discharge of the wound sent for culture and sensitivity (C/S) test and wound infection confirmed with

microbiological evidence. Among the 5 cases, 3 cases were *Escherichia coli* positive, and 2 cases were *Staphylococcus aureus* positive. All the cases were Ceftriaxone sensitive. In present study wound infection occurred 3 cases in PEG group and 2 cases in PEG and Mannitol group, P value 0.64, which was not significant.

In this study comparison of wound infection rate between small gut surgery and large gut surgery was evaluated. Among 13 small gut surgery patients of group I, 1 patient (3.33%) developed wound infection on the other hand among 17 large gut surgery patients, 2 patients developed wound infection with the p value of 0.29 which was non-significant. In group II among 5 patients of small gut surgery patients, no wound infection occurred and among 25 patients of large gut surgery patients, 2 patients developed wound infection with p value 0.2, which was non-significant.

A study¹¹ on “Updated systemic review and meta-analysis of randomized clinical trials on the role of mechanical bowel preparation before colorectal surgery” demonstrated no difference between PEG and Sodium Phosphate regarding wound infection. A study⁷ on effect of MBP with PEG and Normal saline in children. Out of 30 children, 15 in each group, only 1 wound infection occurred in group II, p value 1, so there was no significant difference in the two groups. A multicenter randomized study¹² at 13 hospitals among 1431 patients who were going to have elective colorectal surgery to either receive mechanical bowel preparation or not. In MBP group wound infection occurred in 90 cases and in no MBP group wound infection occurred in 96 cases, p value 0.82 which was insignificant. A multicenter evaluation of the ‘Role of MBP in pediatric colostomy take down’ done¹³ among 272 children in 3 large children’s Hospital. PEG was given to 187 children and no preparation given to 85 children. Higher incidence of wound infection (P= 0.04) occurred in PEG group. From the evaluation of this study and compared with above mentioned studies, it may be said that mechanical bowel preparation has no significant role in wound infection.

In this study no anastomotic leakage occurred in PEG and Mannitol group and only 1

anastomotic leakage occurred in PEG group. Leakage occurred in a case of closure of loop ileostomy. Ileostomy was constructed for protection of ileo-anal anastomosis in a case of Total colonic ganglionitis (HPD). Though 1 leakage happened in PEG group it was statistically insignificant, p value 0.313.

In the present study, the comparison between small gut surgery and large gut surgery on the effect of MBP in respect of anastomotic leakage or disruption was done. No anastomotic leakage occurred in group I (PEG). In group II five patients underwent small gut surgery, 1 anastomotic leakage developed; p value 0.313 which was non-significant. On the other hand, 25 patients underwent large gut surgery, no anastomotic leakage developed; p value 1; which was also non-significant.

A randomized clinical trials done¹⁵ on “Mechanical bowel preparation for elective colorectal surgery - comparing sodium phosphate and polyethylene glycol based oral lavage solution”. Total case was 200, 100 in each. This study demonstrated that anastomotic leakage occurred 4% in NaP group and 1% in PEG group which was statistically not significant. A meta-analysis of randomized clinical trials done¹¹ on the role of mechanical bowel preparation before colorectal surgery demonstrated no difference between PEG and Sodium Phosphate regarding anastomotic leakage. A multicenter randomized trial done¹² on Mechanical bowel preparation for elective colorectal surgery. Total patients were 1340 among them 670 got MBP and 670 got no preparation. 32 cases in MBP group and 37 cases in no MBP group developed anastomotic leakage which was statistically insignificant. In a multicenter randomized clinical trial¹⁷ of mechanical bowel preparation in elective colonic surgery, 686 patients got MBP, and 657 patients got no MBP. On that study anastomotic dehiscence occurred 13 cases (1.89%) in MBP group and 17 cases (2.58%) in no MBP group. No significant difference was found between the two groups. With the comparison of different studies and evaluation of present study it was observed that mechanical bowel preparation has no significant effect on anastomotic leakage.

In the present study pre preparation and post preparation (after 2 dose) level of S. Electrolytes (Na⁺, K⁺ and Cl⁻) were assessed and compared between two study groups. No significant difference of S. Electrolytes level between the two study groups was found. Though there were no significant differences between pre and post preparation (after 2 dose) K⁺ level, it was observed that potassium level was low in PEG and mannitol group at post preparation state. It was also found that chloride level in post preparation (after 2 dose) state was low (lower limit of normal value) than pre preparation state. A study¹⁸ on "Comparison of oral lavage methods for preoperative colonic cleansing" among 80 patients, 40 in each group. Group I got Mannitol and group II got PEG. There was a significant difference in Na⁺ level, p value 0.05. But there are no significant differences in K⁺ and Cl⁻ level. In that study hyponatremia occurred due to Mannitol. A randomized control study¹¹ on effect of MBP with PEG and Normal saline in children. Out of 30 children, 15 children got PEG and 15 children got N/S. Electrolyte imbalance occurred in 5 cases of PEG group and 7 cases in N/S group, p value 0.7104, the difference was insignificant. In a study¹⁰ outcome of mechanical bowel preparation with or without Mannitol was assessed. The study was done among 60 patients, 30 patients in each group. In that study the mean level of Na⁺ was 141.13±4.41 in mannitol group and 139.73±2.55 in without mannitol group p value was 0.002 so there was significant difference between two groups regarding Na⁺ level though both were within normal limit. Mean K⁺ level was 3.7±0.32 in mannitol group and 4.39±0.45 in without mannitol group, p value was 0.006, that difference was significant. Though both were within normal limit, mannitol causes hypokalemia. From the evaluation of above-mentioned studies, it was clear that Mannitol causes electrolyte imbalance but in the current study no significant difference was found between the two study groups regarding electrolyte balance.

In this study both the groups were compared for the presence of postoperative pyrexia on 5th and 7th POD. Fever was present in 10% patients

(3cases) of PEG group and 20% patients (6 cases) of the PEG and Mannitol group on 5th POD. Though PEG and Mannitol group had higher incidence of fever, comparison between the groups by chi-square test revealed a p value of 0.278 which was insignificant. Evaluation on 7th POD revealed that fever was present in lesser percentage in both the groups, 6.67% in PEG group & 10% in PEG and Mannitol group. P-value on 7th POD was also insignificant (0.674). So, it was seen that there was no difference in incidence of post-operative pyrexia among the groups. Though statistically insignificant, on 5th POD 6 patients in PEG and Mannitol group developed fever and only 3 patients in PEG group developed fever, almost double than group I, this fever might be due to Mannitol.

Few patients in different study groups suffered from postoperative fever other than infective causes which was statistically insignificant. A study⁴ on Mechanical bowel preparation or not in elective colonic surgery, 686 cases got MBP, and 657 cases got no MBP. Postoperative fever of unknown origin occurred in 10 patients in each group, which was not significant. In a study¹³ on "Bowel preparation for colorectal surgery: with and without mannitol", 30 patients were allocated in each group. Fourteen patients of the mannitol group developed mild fever (mean 38.1°C), 3 subjects had postsurgical fever within 48 h of surgery. In group II, postoperative fever was found in 2 subjects. Significant changes in two groups and postoperative fever occurred due to Mannitol. From above discussion it might be said that Mannitol causes postoperative fever.

Conclusion

In this study no significant difference was found between the study groups in respect of wound infection, anastomotic leakage, and electrolyte balance. Patients of both the groups had fever but more in case of group II which might be due to mannitol. So, mannitol can be omitted in MBP in children.

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