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Original Research Article

Comparison of surgical outcome of patients in whom bowel is prepared with intravenous fluid replacement with those who are not given intravenous fluid replacement

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ABSTRACT

Background: Adequate cleansing is essential for reliable diagnostic and surgical colon procedures. Accuracy and safety depend on good preparation. Patient compliance is enhanced by simplicity and well-tolerated method. About mechanical bowel preparation with PEG and Nap, it is noted that PEG is more effective and better tolerated than the diet combined with cathartic regimens that were used before 1980. PEG also is safer and more effective than high-volume balanced electrolyte solutions. The aim of this prospective study is to assess whether perioperative outcome is affected by administrating a calculated amount of intravenous fluid during bowel preparation as compared to subjects who do not get I V fluids during bowel preparation.
Methods: This is randomized prospective case control study, carried out government general hospital and teaching tertiary care institute located in Mumbai. Total 86 patients were included in this and randomly allocated to case or control group after applying inclusion and exclusion criteria.
Results: More and more studies then compared the quality of preparation of bowel during colonoscopy with PEG and NaP and superiority of one over other was discovered. Also, this led to development of low dose 2 lit regimen of PEG and flavoring agents. Studies then were more inquisitive regarding the side effect of bowel preparation in regard to healing of anastomosis, chances of leak and effects of dehydration postoperatively. Present study is for same purpose
Conclusions: In present study it is observed that there is increase in I V fluid requirement in the patients in whom mechanical bowel preparation is given without I V fluid rehydration and the post-operative outcome in view of returning of bowel activity was unaltered.

Keywords: Bowel preparation, Polyethylene glycol, Colonoscopy

INTRODUCTION

Colorectal surgery performed prior to 1970 was fraught with postoperative infectious complications which occurred in more than 30-50% of all operations.

Diversion of the fecal stream appeared mandatory when operating on an urgent or emergent basis, thereby requiring the performance of multiple, staged operations instead of a single surgery encompassing resection and primary anastomosis as is performed commonly today.

Multiple studies conducted in the early 1970s determined that anaerobic colonic micro flora were causative agents in postoperative infections in colon and rectal surgery, and these studies initiated the development of effective oral preoperative antibiotic prophylaxis in combination

with preoperative mechanical bowel preparation. This dual-tier regimen significantly reduced the incidence of postoperative infectious complications, thus allowing most uncomplicated colon and rectal surgeries to be performed in a single stage without the need for the diversion of the fecal stream and multiple operations.

Also, mechanical bowel preparation has been considered an efficient agent against leakage and infectious complications. This dogma is not based on solid evidence, but on observational data and expert's opinions.[1] Therefore, a preoperative mechanical and antibacterial bowel regimen serves as the cornerstone of modern elective colorectal surgery.[2]

Bowel preparation includes

- Mechanical bowel preparation (MBP)
- Administration of antibiotics to decrease antibiotic load.

It is also observed that the colonocytes receive nutrition from intraluminal free fatty acids produced by fermentation by colonic bacteria so there are concerns that bowel preparation may actually be detrimental to the healing of colonic anastomosis.[3] However, in India at the present time, the colon is generally cleansed in the preparation of colonic and intestinal operations.

Mechanical bowel preparation

The ideal preparation for bowel would reliably empty the bowel of all fecal material in a rapid fashion with no gross or histologic alteration of the mucosa. The preparation also would not cause any patient discomfort or shifts in fluids or electrolytes and would be inexpensive4. Unfortunately, none of the preparations currently available meet all of these requirements.[4,5]

Bowel preparations evolved from radiologic and surgical preparations.[6] Early preparations used dietary limitations, cathartics, and enemas. Although these preparations cleansed the Bowel, they were time consuming (48-72 hours), uncomfortable for the patient, and associated with fluid and electrolyte disturbances.[7] A rapid preparation used high-volume (7-12 liters) per oral gut lavage with saline/electrolyte solution.

This also was associated with severe fluid and electrolyte shifts and poor patient tolerance. In 1980, Davis et al formulated polyethylene glycol (PEG), an osmotically balanced electrolyte lavage solution.[8] The standard 4-liter dosing regimen given the day before the procedure was established as safe and effective.[9-10] PEG quickly became the ‘‘gold standard’’ for bowel preparation.

However, poor compliance related to the salty taste, the smell from the sulfates, and the large volume of fluids required led to modifications of the PEG solutions and their dosing recommendations and re-evaluations of other osmotic laxatives (e.g., sodium phosphate [NaP]).[12-19] Chang et al developed a method of pulsed rectal irrigation combined with magnesium citrate. These regimens and their use continue to evolve.[20,21] More recent studies have focused on identifying the ‘‘ideal’’ preparation including parameters such as taste, electrolyte supplementation, and the timing and division of doses.

Regimens for mechanical bowel preparation

The various regimens are as follows

- Diet
- Enemas
- High volume gut lavage
- Rectal pulsed irrigation
- PEG (polyethylene Glycol)
  a) Standard 4-liter regimen
  b) Sulphate free PEG
  c) Low volume PEG with or without bisacodyl
- Sodium Phosphate in aqueous form (Fleet Phosphosoda)
- Tablet sodium phosphate

The aim of this prospective study is to assess whether perioperative outcome is affected by administrating a calculated amount of intravenous fluid during bowel preparation as compared to subjects who do not get I V fluids during bowel preparation. It is to test the hypothesis that the iso osmotic and isotonic fluid composition of PEG does not get absorbed through intestinal mucosa and acts just like a cleansing fluid and the IV fluid given does not affect the perioperative outcome and may be unnecessary.

METHODS

Setting

One of the government general hospital and teaching tertiary care institute located in Mumbai.

Design

This is randomized prospective case control study.

Inclusion criteria

- Patients of age 18 to 65 yrs were selected
- Patients who received bowel preparation and proceeded to surgery were included.

Exclusion criteria

- Those people with high ASA grade of 4 and above which are prone to adverse effects of dehydration were excluded.
- Those people who are taken to surgery and not prepared for bowel were excluded.

- Patients undergoing bowel preparation but not proceeding to surgery were excluded.
- Patients with high risk cardiopulmonary risk were excluded.
- Pregnant and lactating women were excluded.

After applying inclusion and exclusion criteria patients were blinded and were divided into groups of those who get IV fluids and those who do not get IV fluids and proceeded to operation. Patient were given PEG with oral fluids (clear fluids such as water, coconut water, oral rehydration solution, such as WHO ORS) before he/she starts starvation and other group will be of patients who will receive PEG, oral fluids and I V fluids when he/she starts starvation A = Test; B = control.

RESULTS

Total 86 patients were included in this prospective randomized controlled study and randomly allocated to case or control group after applying inclusion and exclusion criteria.

Table 1: Sex distribution of study.

				Count
Group	Case	sex	Male	9
			Female	20
	Control	sex	Male	33
			Female	24

The case group included those in whom bowel was prepared with peglec with oral rehydration. We got 29 patients in this group.

The control group included those patients in whom bowel was prepared with peglec and given calculated amount of I V fluid to counteract dehydration.

Table 2: Paired samples statistics.

group			Mean	N	Std. Deviation	Std. Error Mean
1.00 case	Pair 1	pre Hemoglobin concentration	10.6310	29	1.38024	.25630
		post op Hemoglobin concentration	10.0207	29	1.23675	.22966
	Pair 2	pre PCV	30.4931	29	1.28867	.23930
		post op PCV	29.9241	29	1.64917	.30624
	Pair 3	pre-Na pre-Na+	138.6207	29	3.16695	.58809
		post op Na+ post op Na++	138.5172	29	4.86695	.90377
	Pair 4	pre-k pre k+	4.2034	29	.61788	.11474
		post op k post op k+	3.9310	29	.51762	.09612
	Pair 5	pre hco3	21.3586	29	1.33350	.24763
		post op hco3	21.8793	29	2.72651	.50630
2.00 control	Pair 1	pre Hemoglobin concentration	10.3193	57	.92068	.12195
		post op Hemoglobin concentration	10.0772	57	.98580	.13057
	Pair 2	pre PCV	30.0053	57	.99129	.13130
		post op PCV	29.5947	57	.84609	.11207
	Pair 3	pre-Na pre-Na+	139.1754	57	3.72790	.49377
		post op Na+ post op Na++	140.3158	57	4.84826	.64217
	Pair 4	pre-k pre-k+	4.2351	57	.57833	.07660
		post op k post op k+	3.9754	57	.43148	.05715
	Pair 5	pre hco3	21.8965	57	1.46787	.19442
		post op hco3	21.6263	57	1.84289	.24410

All the patients were of age range 18 to 65. The sex distribution was as follows in case and in control group. The data was analyzed at Tata institute of social sciences by applying appropriate statistical tests. The paired samples like pre and post-operative values of Hemoglobin, PCV, Na+, k+ and HCO3- were analyzed by using paired t test.

The unpaired statistics like blood transfusion requirement, I V fluid requirement, urine output on day one and day two, pass of flatus, pass of motion and time taken for taking full diet was analyzed using t test for equality of means.

The results are as follows

The above table describes the statistics of the paired variables. The pre and post values in both case and control groups. It should be noted that all the values of means of all pairs are within normal range of our physiological values. This means that though there may be differences in the values of pre and post op values and

which may be significant, the values are within normal range. The fact to be noted. After applying the paired t test, the values along with the p values are given in below table.

Table 3: Paired samples test.

Group			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
1.00 case	Pair 1	pre Hemoglobin concentration- post op Hemoglobin concentration	.61034	1.52089	.28242	.03183	1.18886	2.161	28	.039
	Pair 2	pre PCV - post op PCV	.56897	1.53834	.28566	-.01619	1.15412	1.992	28	.056
	Pair 3	pre-Na pre Na+ - post op Na+ post op Na++	.10345	5.73426	1.06483	-2.07775	2.28465	.097	28	.923
	Pair 4	pre k pre k+ - post op k post op k+	.27241	1.01274	.18806	-.11281	.65764	1.449	28	.159
	Pair 5	pre hco3 - post op hco3	-.52069	3.02411	.56156	-1.67100	.62962	-.927	28	.362
2.00 control	Pair 1	pre Hemoglobin concentration- post op Hemoglobin concentration	.24211	.98252	.13014	-.01859	.50280	1.860	56	.068
	Pair 2	pre PCV - post op PCV	.41053	.77889	.10317	.20386	.61719	3.979	56	.000
	Pair 3	pre-Na pre-Na+ - post op Na+ post op Na++	-1.14035	5.74903	.76148	-2.66577	.38507	-1.498	56	.140
	Pair 4	pre-k pre k+ - post op k post op k+	.25965	.73917	.09791	.06352	.45578	2.652	56	.010
	Pair 5	pre hco3 - post op hco3	.27018	2.42281	.32091	-.37268	.91303	.842	56	.403

Table 4: Group statistics.

	Group	N	Mean	Std. Deviation	Std. Error Mean
blood transfusion in no of units of blood	Case	29	2.00	2.053	.381
	Control	57	1.51	.947	.125
IV fluid requirement in liters	Case	29	4.2276	1.78963	.33233
	Control	57	3.4088	.90992	.12052
urine output per hr day1	Case	29	98.48	46.568	8.647
	Control	57	95.53	17.543	2.324
urine output per hr day2	Case	29	87.97	23.208	4.310
	Control	57	85.47	13.638	1.806
pass of flatus (day)	Case	29	3.97	1.636	.304
	Control	57	4.04	1.117	.148
pass of motion (day)	Case	29	5.48	2.029	.377
	Control	57	5.42	1.133	.150
full diet started on(day)	Case	29	6.14	2.356	.438
	Control	57	6.74	1.587	.210

In the above table, under the heading of mean lies value stating the difference in between the means of pre and post values. For example, the mean of pre-operative hemoglobin concentration in case group is 10.6310 and that of post-operative group is 10.0207, so the difference is 0.61034 which is mentioned in column of mean. The minus sign states that the post value is increased. This can be seen in Na+ in case group. The standard deviation in the above table states the standard deviation of the standard difference score.

Table 5: Operation performed in case group.

Valid	Frequency	%	Valid %	Cumulative %
APR	5	17.2	17.2	17.2
Ca bladder excision with ileal conduit	2	6.9	6.9	24.1
Exploratory laparotamy	1	3.4	3.4	27.6
Hemicolectomy	2	6.9	6.9	34.5
Hepaticojujunostomy	1	3.4	3.4	37.9
Klatskins tumor excision	1	3.4	3.4	41.4
Mass excision with sigmoid colostomy with Hartmann procedure	1	3.4	3.4	44.8
Omentectomy with pelvic peritonectomy	1	3.4	3.4	48.3
Ovarian ca excision	7	24.1	24.1	72.4
RCC excision	1	3.4	3.4	75.9
Rectopexy	1	3.4	3.4	79.3
Stoma closure	2	6.9	6.9	86.2
Whipples sx	4	13.8	13.8	100.0
Total	29	100.0	100.0	

Table 6: Operation performed in control group.

Valid	Frequency	%	Valid %	Cumulative %
Anterior resection with anastomosis.	1	1.8	1.8	1.8
APR	6	10.5	10.5	12.3
Ca bladder excision with ileal conduit	2	3.5	3.5	15.8
Ca oesophagus excision	1	1.8	1.8	17.5
Cholecystojejunostomy	1	1.8	1.8	19.3
Choledocoduodenostom	1	1.8	1.8	21.1
Coloplast	1	1.8	1.8	22.8
Exp lap for abdominal lump	1	1.8	1.8	24.6
Gist removal	1	1.8	1.8	26.3
Hartmann reversal	1	1.8	1.8	28.1
Hemicolectomy	10	17.5	17.5	45.6
Ileostomy closure	1	1.8	1.8	47.4
Lap anterior resection	1	1.8	1.8	49.1
Lap hemicolectomy	2	3.5	3.5	52.6
Lap nephrecotomy	1	1.8	1.8	54.4
Ovarian ca excision	5	8.8	8.8	63.2
Pancreatico jejunostomy	4	7.0	7.0	70.2
Pancreatico jejunostomy sx	5	8.8	8.8	78.9
Rectopexy	1	1.8	1.8	80.7
Stoma closure	2	3.5	3.5	84.2
Whipples sx	9	15.8	15.8	100.0
Total	57	100.0	100.0	

The Std. Error Mean column provides an index of the variability one can expect in repeated random samples of patients similar to the ones in this study. The 95% Confidence Interval of the Difference provides an estimate of the boundaries between which the true mean difference lies in 95% of all possible random samples of patients similar to the ones participating in this study. The Sig. (2-tailed) column displays the probability of obtaining a t statistic whose absolute value is equal to or greater than the obtained t statistic. That is the p value.

According to above table, the p value is less in following observations.

- Post op Hemoglobin concentration in case group
- Post op PCV in control group
- Post op K+ in control group.

The difference of Hemoglobin concentration is significant than those occurring by chance. This observation may be due to loss of concentrated volume of blood due to dehydration. The post op PCV is decreased though the difference is not significant stating that the patient is well hydrated intra operatively to maintain the volume of plasma.

The post-operative PCV level is decreased in the case group and this difference is significant implying that there was dilution of blood post operatively. The post-operative K+ value is also decreased implying that the fluids infused contained less potassium. The difference noted in rest of values is not significant. The unpaired variable analysis showed the following.

The above table states the statistics of unpaired variables. The N in the above table states the number of subjects. Mean is the mean of the values, blood transfusion in number of units (each unit contains standard 45 ml of CPDA and 350 ml of human whole blood.). IV fluid requirement in liters intra and post operatively for 24 hrs.

The point to be noted in above table is that there appears a significant difference of means of the blood transfusion requirement and I V fluid requirement of case and control group. The analysis of above is done to find if this difference is significant with independent t test

Type of operations

The statistics of type of operation performed in Case and Control group is given below. The above tables represent that the type of operation though included bowel operations, but not of one single type increasing the variability of values in between the case and control group.

DISCUSSION

Mechanical bowel preparation was primitive till 1980 till the need for development of ideal preparation method lead to the development of Poly ethylene glycol.[22] The large volume and bad taste lead to development of better options which were more tolerable like sodium phosphate. As more experience accumulated, the occasional life-threatening complications like renal toxicity and hyperphosphatemia came to notice.[23]

More and more studies then compared the quality of preparation of bowel during colonoscopy with PEG and Nap and superiority of one over other was discovered. Also, this led to development of low dose 2 lit regimen of PEG and flavoring agents. [24]

Studies then were more inquisitive regarding the side effect of bowel preparation in regard to healing of anastomosis, chances of leak and effects of dehydration postoperatively. Present study is for same purpose. International studies regarding this topic showed that there is significant dehydrating effect of mechanical bowel preparation. One study showed that post operatively there was decrease in hemoglobin concentration.[25] Present study was directed towards finding the postoperative outcome regarding post-operative electrolytes, post-operative hemoglobin concentration and pack cell volume concentration and post-operative return of bowel motion. Our results were comparable with those of international studies.

In our results we found that mechanical bowel preparation causes significant dehydrating effect which can be counter acted well with intra and post op rehydration. Though the differences were significant in some of the parameters, the values both pre and post operatively were in normal physiological range.

Case group

Bowel preparation causes the post-operative increase in IV fluid requirement and the post-operative hemoglobin concentration to decrease if proper rehydration is not given with calculated amount of IV fluids. The post-operative difference in electrolyte and urine output was not significant implying that the rehydration in the intra and post-operative group was adequate. There was also no difference in the bowel movement, and time required to take regular diet of the patients implying that the outcome of surgery for recovery was also not altered.

Control group

The post-operative K+ concentration showed a decrease in control group. This may be due to administration of I V fluids which were low in K+. The post-operative PCV was also decreased stating that there was hemodilution occurring post operatively. There was no statistically significant difference in urine output and hemoglobin concentration implied that blood and fluids were adequately replaced.

Confounding factors

There was lot of confounding factors noted while analyzing the study.

Type of operation

The difference in between the means of blood requirement was due to cases and controls being operated for different purpose. The blood loss in case group ranged anywhere between 0 to 11 and that of group ranged in

between 0 to 4. This occurred because the inclusion criteria did not consider only one type of surgery but included all surgeries in which bowel was involved.

Type of IV fluid infused intra and post operatively

The intra operative and post-operative fluid management was done by anesthetist in OT and in recovery room. The anesthetist was blinded for the above study and the fluid to be infused was according to their discretion and lacked any fixed protocol. So, the post-operative value of K+, though significant was not reliable and this constitutes type II error in accepting the null hypothesis of difference in two means.

It can be said that more studies with stringent inclusion criteria are needed for studying the above findings which could be due to stated confounding factors.

CONCLUSION

In present study it is observed that there is increase in IV fluid requirement in the patients in whom mechanical bowel preparation is given without IV fluid rehydration and the post-operative outcome in view of returning of bowel activity was unaltered.

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