Original article

Colonoscopy outcome, safety and efficacy of colon cleansing in chronic renal failure

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SUMMARY

Objectives: **We investigated the effectiveness and safety of three different methods of colon cleansing and we also recorded the outcome and findings of lower gastrointestinal tract endoscopy in patients with chronic renal failure.**

Methods: **We prospectively collected 39 patients with chronic renal failure The patients who were referred for endoscopy were randomly given one of the following: For colonoscopy (a) Method I; liquid diet for three days, enemas with sodium phospate (Fleet) and X-Prep (senna-based laxative), and (b) Method II; gut – irrigation with a commercially available polyethylene glycol and electrolytes solution. For sigmoidoscopy (c) Method III; enemas with sodium phosphate (Fleet). A gastroenterologist graded the cleanliness of the segments of colon during endoscopy. Safety profile including renal function and electrolytes were recorded prior to preparation and prior to endoscopy for each patient. In addition, patient acceptance of bowel preparation methods (tolerance) was recorded, including any symptoms of discomfort.**

Results: **We found that among cleansing methods, method I and II were equally effective. Method III had a good cleansing effect on the rectosigmoid (10/12) but only fair cleansing effect on the descending colon (6/12). The tolerance of preparation was similar for all three methods. The safety profile was acceptable for all three methods. Twelve out of 39 patients had at least one positive endoscopic finding**

Conclusions: **Colon cleansing methods are safe for chronic renal failure patients, provided that adequate monitoring of electrolytes and renal function markers is available and an experienced nephrologist is reviewing the patient's records and current condition.**

Key words: colonoscopy, colon cleansing, chronic renal failure, hemodialysis, colon preparation, continuous ambulatory peritoneal dialysis (CAPD)

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INTRODUCTION

Colonoscopy has emerged as the procedure of choice for the diagnosis and treatment in colonic disease[1]. Proper bowel cleansing is of paramount importance for the safe detection of small lesions and reduces the duration of the examination and subsequently the discomfort of the patient and the anxiety of the endoscopist. Today, effective and well-tolerated methods of colon cleansing are available[1-5]. The standard preparation includes small-residue or liquid diet for 3 days, combined with a stimulant laxative like X-Prep on the afternoon before the examination and enemas the previous afternoon and in the morning just a few hours before endoscopy. The polyethylene glycol electrolyte lavage (PEG), developed by Davis et al[5], is an effective alternative that overwhelms dietary restrictions but requires the consumption of a large volume of a quite unpleasant tasting liquid the previous day. Some modifications of the PEG method, mainly involving improvement of the taste of the solution, did not dramatically alter the effect and the side effects of this method[1,2]. Newer effective regimens include sodium phosphate solutions with or without bisa-

codyl[6] and sodium picosulphate plus magnesium citrate[7]. Sodium phosphate is contraindicated in patients with chronic renal failure (CRF) because it may induce hyperphosphatemia[8-10].

Patients with CRF respresent a specific group of patients for colonoscopy. While the endoscopic assessment of the lower intestinal tract is sometimes mandatory, the cleansing regimen is a frequent concern because of the delicate balance of fluids and electrolytes in these patients. Usually, the endoscopic procedure is performed after a nephrologist-guided preparation of the colon. Some patients with CRF receive inadequate preparation regimens and undergo inaccurate and incomplete endoscopic examinations. In other instances, endoscopy is avoided in CRF patients because of the fear of causing short term electrolyte abnormalities or long term renal function deterioration during colon preparation[11].

For these reasons, we performed a prospective study to examine the following parameters in CRF patients: (a) the efficacy of colon preparation regimens comparatively, (b) the safety of those regimens, (c) the tolerance of preparation by patients, (d) the indications for lower gastrointestinal tract endoscopy and (e) the endoscopic findings, including diagnostic and therapeutic procedures

METHODS

Patients

Thirty-nine consecutive patients with CRF were included in this study. The Department of Nephrology between Februrary 1996 and September 1999 referred these patients to the Gastroenterology Laboratory for lower gastrointestinal tract endoscopy. The mean age of the patients was 58±8 years and 21 were male while 18 were female. Twenty-seven of 39 patients were referred for colonoscopy, while the remaining 12 for sigmoidoscopy. Among them, 15 were on hemodialysis (HD), 6 on continuous ambulatory peritoneal dialysis (CAPD), 12 had chronic renal failure without any dialysis (CRF) and 6 had renal disease but creatinine clearance levels within normal limits (NCL, normal creatinine clearance levels) [Table 1]. Patients who were appointed for colonoscopy were hospitalized in the Department of Nephrology, for close monitoring, measurement of biochemical parameters and monitoring/recording of the cleansing regimen. These patients were randomly administered one of the first two cleansing regimens I or II (as described below). Patients who were referred for sigmoidoscopy were not hospitalized, unless otherwise indicated. Before sigmoidoscopy, a nurse was assigned to carefully record any deviations from the preparation procedure.

Cleansing Method I

During the three days before examination only liquid diet with restriction of salt was allowed. On the last day before examination, at 4.00 p.m., a senna-based laxative, X-Prep[12] was administered (one bottle of X-Prep was swallowed followed by one-two glasses of water). On the day before examination, at 7.00 p.m., a 1-1 isotonic sodium chloride rectal washout was given. The same washout was repeated at 7.00 a.m. on the day of endoscopy.

Cleansing Method II

The day before examination only a liquid diet was allowed. In the afternoon of that day the patients were asked to drink 4 liters of a gut-irrigative product consisting of polyethylene glycol and electrolytes (Klean-Prep, Norgine - England)[13] in 6 hours. This product was actually found to produce no electrolytic abnormalities and no systemic absorption of fluids, so it was considered safe for CRF patients who were at close monitoring prior to colonoscopy.

Cleansing Method III

This method was used with patients referred for sigmoidoscopy. The patients were restricted to follow a liquid diet the day before the examination. On the day before examination, at 7.00 p.m., a 1-1 isotonic sodium chloride rectal washout was given. The same washout was repeated at 7.00 a.m. on the day of endoscopy.

Cleansing score

A gastroenterologist who was unaware of the cleans-

Table 1. Patient groups clinical characteristics related to colon cleansing.

	Groups			
Characteristics	**CRF**	**HD**	**CAPD**	**NCL**
Number	12	15	6	6
Sex (M/F)	7/5	8/7	3/3	3/3
Hospitalized	10	10	3	4
Outpatient clinic	2	5	3	2
Laxative use	0	0	0	1
Previous gastrointestinal operation	1	2	0	0
Previous gastrointestinal endoscopy	2	3	1	0

CRF: chronic renal failure

HD: hemodialysis

CAPD: continuous ambulatory peritoneal dialysis

NCL: normal creatinine clearance levels

ing method used graded the cleanliness of the inspected segments of colon during examination. The grading scale was as follows: 1 (poor) large amount of fecal residue, unacceptable; 2 (fair) moderate amount of residue, enough to prevent a completely reliable examination; 3 (good) small amount of residue not interfering with a thorough examination; and 4 (excellent) minimum amount of residue, >95% of intestinal mucosa visible. The graded parts of the colon were: rectosigmoid, descending, transverse, ascending-cecum.

Safety profile and tolerance

Renal function markers and electrolytes were recorded prior to preparation, prior to endoscopy and three days after endoscopy for each patient. In detail, the following parameters were recorded: weight, hemoglobin, urea, creatinine, creatinine clearance, serum sodium, potassium, chloride, calcium, phosphate, magnesium, total protein and albumin. In addition, patients' acceptance of bowel preparation methods (tolerance) was recorded including any symptoms of discomfort. Questions about any symptoms (pain, abdominal discomfort, nausea, vomiting, anal irritation, insomnia) were asked and patients were also asked whether they would be prepared to undergo the same preparation regimen in the future. According to the answers to these questions, patient's acceptance of the bowel preparation method was graded as follows: (a) good, minimal symptoms and willingness to repeat the preparation; (b) fair, more apparent symptoms such as nausea or abdominal discomfort that did not require any intervention or did not cause cessation of preparation - patient willing to repeat the preparation in the future; (c) poor, symptoms such as repeated vomiting or severe pain that possibly led to interruption of the preparation regimen - patient refusing to repeat the same preparation method.

Indications, findings and endoscopic procedures

An independent rater reviewed the indications for performing the endoscopic examination in each case. He recorded whether the examination was completed or not and the reasons of any incomplete examination. Finally he reviewed the endoscopic findings and reported the diagnostic and therapeutic interventions that took place during endoscopy.

RESULTS

Efficacy of cleansing methods

Table 2 shows a summary of the colon cleansing methods that were used in each group of patients.

We found that among colon cleansing methods, method I (standard preparation with X-Prep, enemas and liquid diet) and method II (PEG plus electrolytes solution) were equally effective. In detail, 14 of 15 (93.33%) patients who received cleansing regimen I and 12 of 12 (100%) who received cleansing regimen II had at least good cleansing effect (as defined above). Table 3 shows the mean cleansing scores in the various segments of the colon in patients who underwent colonoscopy. No statistically significant differences between the two methods (I and II) or among the examined groups of patients with chronic renal failure were found.

Colon cleansing method III of the study (enemas and liquid diet for one day) was used in patients who underwent sigmoidoscopy. This method had a good cleansing effect in the rectosigmoid in 10 of 12 patients (83.33%), but only half of 12 patients (50%) had a good cleansing

Table 2. Colon cleansing methods used in each patient group (number of patients)

Method	CRF	HD	CAPD	NCL
I	5	6	2	2
II	5	4	1	2
III	2	5	3	2

*__Method I:__ Liquid diet for 3 days, enemas and X-Prep

__Method II:__ PEG – electrolytes solution (Klean-Prep)

__Method III:__ Enemas

**__CRF:__ chronic renal failure

__HD:__ hemodialysis

__CAPD:__ continuous ambulatory peritoneal dialysis

Table 3. Mean cleansing score(±SD) in the various segments of the colon.

Colon segment	CRF	HD	CAPD	NCL
Recto-sigmoid	3.5±0.4	3.6±0.6	3.7±0.6	3.4±0.8
Descending	3.1±0.3	3.1±0.4	3.0±0.5	3.3±0.7
Transverse	3.3±0.4	3.2±0.4	3.4±0.5	3.5±0.8
Ascending	2.7±0.5	2.8±0.5	2.6±0.6	3.0±0.7

Cleansing score according to residue presence (feces, fluid, foam, mucous)

4= *excellent* (minimum amount of residue, >95% of mucosa visible)

3= *good* (small amount of residue, thorough examination possible)

2= *fair* (moderate amount of residue, not completely reliable exam)

1= *poor* (large amount of residue, unacceptable)

effect in their descending colon (further insertion of the instrument was not attempted in patients scheduled for sigmoidoscopy). So this method was equal to the previous two for the preparation of rectosigmoid, but was inferior to them for the preparation of the descending colon (P<0,05, Fisher exact test).

Safety profile and tolerance

Electrolytes and renal function did not change significantly in any of the patients during preparation. Table 4 shows the changes in electrolytes and creatinine clearance during preparation in the four examined groups of patients with CRF. Very small, non-significant changes were recorded and no patient developed electrolytic abnormalities or deterioration of renal function. Patients who were on dialysis (HD or CAPD) continued their dialysis without any variation after endoscopy according to their schedule. It is important to underline though, that patients were in close contact with their attending nephrologist during both preparation for colonoscopy and after endoscopy for the following three days.

Side effects of the cleansing regimens were generally mild and well-tolerated by CRF patients. One of 15 patients on cleansing method I reported anal irritation and abdominal discomfort and one more reported insomnia. Two of 12 patients on cleansing method II reported nausea and two more mild abdominal discomfort. Two of 12 patients on cleansing method III reported anal irritation. Patient's acceptance of the bowel preparation method was graded fair or good for all 39 patients of the study (Table 5). In contrast, 2 patients on method I and 1 on method II did not accept completion of colonoscopy and required interruption due to pain prior to reaching the cecum.

Table 4. Safety of bowel preparation methods in patients with renal failure.

Methods	I	II	III
Interrupted preparation	0	0	0
Side effects	2	4	2
Cre clearance changes	*	*	*
Sodium balance	*	**	**
Potassium balance	**	*	*
Calcium balance	*	**	*
Phosphate balance	**	**	*

*: changes above the level of statistical significance P>0.1

**: changes above the level of statistical significance P>0.05 (but P<0.1)

Indications, findings and endoscopic procedures

The indications for endoscopy in those 39 patients with CRF were: Abdominal pain in 5, Colon follow-up in 3, lower gastrointestinal bleeding (evidence or suspicion) in 19, family history of colon cancer in 2, changes of bowel habits (mainly diarrhea) in 5 and pre-transplantation examination in 5.

In patients who were referred for colonoscopy, the cecum was reached in 23 of 27 (85.18%) cases. Three patients required interruption of the examination because of pain – discomfort during the colonoscopy (although sedation with midazolam and pethidine was administered) and one patient (on cleansing method 1) had incomplete preparation of his colon necessitating discontinuation of colonoscopy. All twelve patients referred for sigmoidoscopy underwent a complete examination. In 8 patients biopsies were taken during endoscopy and 6 more patients underwent endoscopic polypectomy.

A positive endoscopic finding (one or more) was found in 12 of 39 CRF patients. These diagnostic findings were: diverticulosis in 4, angiodysplasia in 1, polyps in 7, colon cancer in 1, Crohn's disease in 1, ischemic colitis in 1 and pseudomembranous colitis in 1 patient.

DISCUSSION

This prospective study examined the safety, tolerance and importance of lower gastrointestinal tract endoscopy in different groups of CRF patients. Patients underwent sigmoidoscopy or colonoscopy according to the indications. The preparation of the colon was done following one standard regimen for sigmoidoscopy (method III) and two different regimens (method I and II) for colonoscopy. The efficacy of cleansing method was estimated using a graded scale. Side-effects, tolerance and acceptance of the cleansing method by the patient as well as endoscopic findings were assessed. In general, CRF patients are susceptible to developing elecrolytic abnormalities or renal deterioration. The colon cleansing method is thought to be a troublesome procedure that may lead to complications. This study demonstrated that CRF

Table 5. Patient acceptance to bowel preparation methods

	Method of Cleansing		
Acceptance	**I**	**II**	**III**
Good	12	9	11
Fair to good	3	3	1
poor	0	0	0

patients may undergo one of the common cleansing methods described above without any particular risks, provided that good monitoring of the patients is available. Cleansing methods for colonoscopy included PEG plus electrolytes or the standard regimen (liquid diet, enemas and X-Prep) and both were found safe and effective. Cleansing method for sigmoidoscopy was limited to liquid diet for one day plus enemas and was also found safe and effective. No electrolytic abnormalities or deterioration of renal function were observed during any of those preparation procedures and the patients continued taking their medications and having their dialysis without any changes in schedule. Tolerance and acceptance of these methods was, overall, very good. The endoscopic findings were positive in a significant proportion of patients (12/39, 30,76%) and some patients required diagnostic (biopsies) or therapeutic (endoscopic polypectomy) interventions.

In contrast to the colon-cleansing methods used in this study, other cleansing methods are less safe in patients with CRF. These cleansing methods are the balanced electrolytic solutions[14], that can cause increased absoprtion of sodium and water during preparation and sodium phosphate oral solutions[6,15-17], which can cause severe hyperphosphatemia and hypocalcemia in patients with CRF. It is important to note, however, that in another study, oral sodium phosphate was a very effective cleansing method for colonoscopy and did not cause any significant hypovolemia or hyperphospatemia in patients without renal insufficiency[18]. An editorial about colonoscopy preparation proposed two equal options for colon cleansing: a PEG-electrolytes lavage solution (method II) or an oral sodium phosphate laxative (the second contra-indicated in CRF)[19]. It is interesting to mention that in other studies, slight but statistically significant increases of serum phosphorus were found after sodium phosphate enemas[20-21], but in this study serum phosphorus remained within normal limits. While isotonic sodium phosphate enemas were found safe in our study for CRF patients, one should be aware of the possibility of developing hyperphosphatemia in any patient with high serum phosphate levels. Other cleansing regimens that were used in the past, like the sweet lavage with Mannitol enhanced the production of explosive gut mixtures[22]. These gases (mainly hydrogen, secondly methane in the presence of oxygen) could cause fatal colonic explosion during endoscopic polypectomy[23]. The cleansing methods used in our study were safe for endoscopic polypectomy procedures. Similar cleansing regimens were also compared in another prospective randomized clinical trial[24]. The authors found that cleansing efficacy was similar for 4L PEG solution and X-Prep, but it was worse for 2L PEG solution plus a cascara based laxative. Acceptance and tolerance was best for X-Prep in this study. Another study[25] concluded that bowel preparation with 2 liters of PEG and the laxative bisacodyl was more acceptable to patients than a 4 liter regimen of PEG and was equally effective in cleansing the colon. The same authors emphasized that PEG-electrolytes solutions preserve normal colonic mucosal histology and this represents a further reason for using PEG solutions for colonoscopy. On the other hand, bisacodyl can cause histologic and microscopic changes in colonic mucosa[2]. In addition, another study stressed the importance of correct timing of the cleansing regimen with PEG and proposed a short interval between administration of PEG and colonoscopy[26]. Safety and tolerance of the colon cleansing regimens was very good in the CRF patients of our study. No electrolytic or fluid abnormalities developed and only minor side effects were observed. A slightly higher proportion of side effects like nausea or abdominal discomfort accompanied PEG preparation, but no patient refused to complete the regimen, findings which are in accordance with the literature[1-6]. Another study showed that while PEG preparation had fewer side effects than sodium phosphate, patients preferred sodium phosphate to PEG as the best tolerated preparation regimen[27]. Oral ingestion of PEG lavage can be facilitated by metoclopramide administration, 10mg 30 minutes before commencing the preparation. One study presented a new attractive colonic preparation with sodium-picosulphate (analogue of bisacodyl) plus magnesium citrate[7]. The new preparation was well tolerated, had fewer side effects and resulted in higher quality of bowel cleansing than PEG. It would be worthwhile testing this regimen in CRF patients in the future.Indications for endoscopy in CRF patients were various, with the most common being chronic or acute blood loss. Polyps were the most common finding in our study. The presence of renal failure should not preclude an intestinal lesion, and the lower gastroinstestinal tract, especially the colon, should be investigated in CRF patients if indicated. Endoscopic diagnostic or therapeutic interventions in CRF patients are no different from those in other patients who undergo colonoscopy[28]. However, CRF patients should be closely monitored or hospitalized if indicated during preparation (opinion of attending nephrologist) and have laboratory assessment of serum creatinine and electrolytes[29]. They should also not interrupt or notably modify their regular treatment for chronic renal failure (dialysis or medicines). The administration of non-nephrotoxic antibiotics is necessary in patients on continuous ambu-

latory peritoneal dialysis. Older patients can take the colon preparation regimens with few symptoms, though they experience more overall discomfort but fewer abdominal cramps with PEG than younger patients[30].

In conclusion, this study demonstrated that effective and safe colon cleansing methods are available for various groups of patients with chronic renal failure (CRF). Tolerance and acceptance of colon preparation was good and no electrolytic abnormalities were recorded. The indications of lower gastrointestinal tract endoscopy and the endoscopic findings were various. Therapeutic interventions during endoscopy were performed. The patients' attending nephrologists supervised their renal function, electrolytes and overall condition before, during and after colonoscopy.

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REFERENCES

1. Cohen SM, Wexner SD, Binderow SR, et al. Prospective, randomized, endoscopic-blinded trial comparing precolonoscopy bowel cleansing methods. Dis Colon Rectum 1994; 37:689-696.
2. Di Febo G, Gizzi G, Galo G, et al. Comparison of a new colon lavage solution (Iso-Guliani) with a standard preparation for colonoscopy: a randomized study. Endoscopy 1990; 22:214-216.
3. Di Palma JA, Brady CE, Stewart DL, et al. Comparison of colon cleansing methods in preparation for colonoscopy. Gastroenterology 1984; 86:856-860.
4. Borkje B, Petersen R, Lund GM, et al. Effectiveness and acceptability of three bowel cleansing regiments. Scand J Gastroenterol 1991; 162-166.
5. Davis GR, Santa Anna CA, Morawski SG, et al. Development of a alavage solution associated with minimal water and electrolyte absorption or secretion. Gastroenterology 1980; 78:991-995.
6. Kohler L, Vestweber H, Mennigen, et al. Whole gut irrigation and prepacol laxative preparation for colonoscopy: a comparison. Br J Surg 1990; 77:527-529.
7. Regev A, Fraser G, Delpre G, et al. Comparison of two bowel preparations for colonoscopy: sodium picosulphate with magnesium citrate versus sulphate free polyethylene glycol lavage solution. Am J Gastroenterol 1998; 93: 1476-1482.
8. Mc Connel TR. Fatal hypocalcemia from phosphate absorption from laxative preparation. JAMA 1971; 216:147-148.
9. Zisper RD, Bischel MD, Abrams DE. Hypocalcemic tetany due to sodium phosphate ingestion in acute renal failure. Nephron 1975; 14:378-381.
10. Haskell LP. Hypocalcemic tetany induced by hypertonic-phoshate enema. Lancet 1985; 2:1433.
11. Burbige EJ, Bourke E, Tarder G. Effect of preparation for colonoscopy on fluid and electrolyte balance. Gastrointest Endosc 1978; 24:286-287.
12. X-Prep syrup. Monography. R+N Pharmaceutica AVEE.
13. Klean Prep PEG+E.Monograpgy. KITE Greece EPE.
14. Van der Heide H, Lantink JA, Wiltink E, et al. Comparison of whole-gut irrigation with golytely (GDL) and with a balanced electrolyte solution (BES) as preparation for colonoscopy. Endoscopy 1986; 18:182-184.
15. Golub RW, Kerner BA, Wise WE, et al. Colonoscopic bowel preparations-which one? Dis Colon Rectum 1995; 38:594-599.
16. Ahmed M. Oral sodium phosphate catharsis and acute renal failure. Am J Gastroenterol 1996 Jun; 91:1261-1262.
17. Lieberman DA, Ghormley J, Florak. Effect of oral sodium phosphate colon preparation on serum electrolytes I patients with normal serum creatinine. Gastrointest Endosc 1996; 43:467-469.
18. Huynh T, Vanner S, Paterson W. Safety profile of 5-h oral sodium phosphate regimen for colonoscopy cleansing: lack of clinically sighificant hypocalcemia or hypovolemia. Am J Gastroenterol 1995; 90:104-107.
19. Keffe EB. Colonoscopy preps: what's best [Editorial]. Gastroinst Endosc 1996; 43:524-528.
20. Schhchmann GD, Barcia PT. Phosphate absorption from fleet enemas in adults. Curr Surg 1989; 46:120-122.
21. Cohan SF, Kadakia SC, Kadakia AS. Serum electrolyte, mineral and blood pH changes after phosphate enema, water enema and electrolyte lavage solution enema for flexible sigmoidoscopy. Gastrointest Endosc 1992; 38: 575-578.
22. Avgerinos A, Kalantzis N, Rekoumis G, et al. Bowel preparatuion and the risk of explosion during colonoscopic polypectomy. Gut 1984; 25:361-4.
23. Bigard MA, Gaucher P, Lassalle C. Fatal colonic explosion during colonoscopic polypectomy. Gastroenterology 1979; 77:1307.
24. Hangartner PJ, Munch R, Ammann R et al. Comparison of three colon cleansing methods: evaluation of a randomized clinical trial with 300 ambulatory patients. Endoscopy 1989; 21:272-275.
25. Adams WJ, Meagher AP, Lubowski DZ, et al. Bisacodyl reduces the volume of polyethylene glycol solution required for bowel preparation. Dis Colon Rectum 1994; 37:229-234.
26. Church JM. Effectiveness of polyethylene glycol antegrade gut lavage bowel preparation for colonoscopy-timing is the key! Dis Colon Rectum 1998; 41:1223-1225.
27. Frommer D. Cleansing ability and tolerance of three bowel preparations for colonoscopy. Dis Colon Rectum 1997; 40:100-104
28. Alvarez L, Puleo J, Balint JA. Investigation of gastrointestinal bleeding in patients with end stage renal disease.

Am J Gastroenterol 1993; 88:30-33.
29. Lieberman DA, Ghormley J, Flora K. Effect of oral phosphate colon preparation on serum electrolytes in patients with normal serum creatinine. Gastrointest Endosc 1996; 43:467-469.
30. DiPallma JA, Brady CE 3rd, Pierson WP. Colon cleansing: acceptance by older patients. Am J Gastroenterol 1986; 81:652-655.