

Comparison of Golytely Lavage with Standard Diet/Cathartic Preparation for Double-Contrast Barium Enema

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In a two-part study, two groups of 100 outpatients each were randomly assigned a colon preparation. In part 1, a standard 1-day diet/cathartic combination was compared with Golytely. In part 2, diet/cathartics was compared with Golytely plus Dulcolax (bisacodyl). The standard preparation provided good or excellent feces removal in 81 (80%) of 101 subjects. Golytely alone was successful in only 21 (53%) of 40 patients, but Golytely followed by Dulcolax achieved good or excellent feces removal in 31 (82%) of 38. Degraded mucosal coating with Golytely alone, due to excessive fluid retention, was also corrected by the addition of Dulcolax. Golytely alone is not an adequate method of colon cleansing for double-contrast barium enema, but Golytely plus Dulcolax is as effective as the standard preparation.

Colon cleansing by oral whole-gut lavage using osmotically balanced electrolyte and/or mannitol solutions has been reported in patients undergoing colon surgery [1–4], colonoscopy [2, 4–6], and barium enema [5, 7–9]. Davis et al. [10] reported the development of a gut lavage solution, Golytely, that has no significant net absorption or secretion of water and electrolytes (Golytely is a registered trademark of Braintree Laboratories, Braintree, MA). This solution was derived by substituting sodium sulfate for some of the sodium chloride in a balanced electrolyte solution and adding polyethylene glycol to adjust osmolality (table 1). Golytely has been shown to be a safe, effective method of colon cleansing, and has become the preparation of choice for colonoscopy [11–14].

Golytely preparation for double-contrast barium enema has been reported in two small groups of 16 and nine patients [13, 15] as being equal in effectiveness to two different multiple-day diet/cathartic regimens. Our purpose was to compare in a prospectively randomized fashion our standard 1-day diet/cathartic regimen with Golytely as preparation for double-contrast barium enema studies.

Subjects and Methods

One hundred consecutive outpatients presenting for our standard double-contrast barium enema were randomly assigned to either our usual 1-day diet/cathartic preparation or to oral gut lavage using Golytely. The standard preparation consists of 1 day of low-residue diet and overhydration (2 L of fluids or more), clear liquid supper, an osmotic-type cathartic at 6 p.m. (magnesium citrate, 320 cm³), and a contact-type cathartic at 8 p.m. (Dulcolax [bisacodyl], four 5 mg tablets) [16, 17].

The Golytely method has no dietary restriction until supper, which is limited to clear liquids. A 10 mg tablet of metaclopramide, previously shown to decrease bloating and nausea during whole-gut lavage [18], is taken orally at 6 p.m. Golytely, which has been refrigerated for better taste, is then drunk, aiming at a rate of 1.5 L/hr. The patient is instructed to stop drinking Golytely when the diarrhea becomes clear and free of particles, or when the 4 L supply is finished. Oral intake is then proscribed until after the enema study, except for regular medications.

Each patient who returned for the barium enema was asked to fill out a questionnaire to

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TABLE 1: Golytely Compounding Formula

Ingredients	Concentration
Sodium chloride (25 mM/L)	1.45 g/L
Sodium sulfate (40 mM/L)	5.68 g/L
Potassium chloride (10 mM/L)	0.74 g/L
Sodium bicarbonate (20 mM/L)	1.68 g/L
Polyethylene/glycol 4000 (Carbowax)	59.1 g/L
Distilled water	q.s. 1000 ml
Preservative added:	
Methylparaben	0.2 g/L
Propylparaben	0.1 g/L

TABLE 2: Radiologic Grading Criteria

Grade	Description
Quality of feces removal:	
1, Excellent	Free of feces on all views
2, Good	Nonadherent particles, less than 5 mm
3, Fair	Some adherent particles, 5 mm or less
4, Poor	Adherent particles over 5 mm
5, Unacceptable	Abundant residue, 1 cm or more
Quality of mucosal coating:	
1, Diagnostic	Good coating immediately
2, Borderline	Marginal coating only after extra positioning or barium
3, Nondiagnostic	Failure of any part to coat

rate on a five-point scale the degree of any abdominal discomfort, sleep loss, anal irritation, or dietary restriction problems encountered during the preparation. Golytely patients also reported the amount consumed and time spent drinking the solution. These data were subjected to statistical analysis by the chi-square test.

Double-contrast barium enemas were administered by radiology residents and staff with undiluted liquid polybarium (100% wt/vol, 55% wt/wt; E-Z-EM Co., Westbury, NY) using a modified Miller technique.

A second group of 100 consecutive outpatients was studied in a similar manner adding four 5 mg tablets of Dulcolax just after Golytely ingestion.

In each examination, five of the overhead double-contrast radiographs (supine, both decubitus, both upright obliques) were reviewed independently by two radiologists (C. M. G. and K. S. R.) with no knowledge of the preparation used. Each study was graded on a five-point scale, modified from Dodds et al. [19] as to quality of feces removal, and on a three-point scale for mucosal coating (table 2). Differences in grading of one point occurred in 8% of cases and differences of two points in 2%. These were resolved by consensus. Statistical evaluation of differences between the groups was accomplished by the chi-square test.

Results

There were no statistically significant differences in age or gender between the two sets of patients (table 3). The radiographic evaluation data from the first and second parts of the study are listed in tables 4 and 5.

In part 1 of the study, 52 of 54 patients in the diet/cathartic group showed up for their appointment, filled out question-

TABLE 3: Comparison of Group Members

	Part 1		Part 2	
	Diet/Cathartics	Golytely	Diet/Cathartics	Golytely/Dulcolax
No. enemas evaluated	51	37	50	38
Age, mean (years)	50.8	46.1	49.8	41.1
Age, range (years)	18-84	20-82	21-74	18-76
Male:female ratio	1:2.2	1:1.2	1:1.8	1:1.8

TABLE 4: Evaluation of Preparation Quality—Part 1

Grade	No. (%)	
	Diet/Cathartics (n = 51)	Golytely (n = 40)
Quality of feces removal:		
Excellent	14 (27)	11 (28)
Good	28 (55)	10 (25)
Fair	6 (12)	11 (28)
Poor	1 (2)	1 (2)
Unacceptable	2 (4)	7 (17)
Quality of mucosal coating:		
Diagnostic	36 (71)	13 (33)
Borderline	12 (23)	18 (45)
Nondiagnostic	3 (6)	9 (22)

TABLE 5: Evaluation of Preparation Quality—Part 2

Grade	No. (%)	
	Diet/Cathartics (n = 50)	Golytely/Dulcolax (n = 38)
Quality of feces removal:		
Excellent	12 (24)	6 (16)
Good	27 (54)	25 (66)
Fair	8 (16)	6 (16)
Poor	2 (4)	1 (2)
Unacceptable	1 (2)	0
Quality of mucosal coating:		
Diagnostic	38 (76)	28 (74)
Borderline	10 (20)	8 (21)
Nondiagnostic	2 (4)	2 (5)

naires, and received double-contrast barium enemas. In the Golytely group 41 of 46 showed up, but three were rescheduled because of obviously inadequate preparations on the scout view or history of inability to drink Golytely. These three were included in the data categories of unacceptable in quality of feces removal and nondiagnostic in quality of mucosal coating. Numbers of radiographic studies retrieved for these two groups were 51 of 52 and 37 of 38, respectively, giving a total of 40 Golytely-prepared patients (37 + three rescheduled) in table 4.

In part 2, 53 of 54 diet/cathartic patients and 41 of 46 Golytely plus Dulcolax patients showed up and received double-contrast barium enemas. Radiographic sets found for each group were 50 of 53 and 38 of 41, respectively.

The amount of Golytely drunk before the clearing end point averaged 2.8 L in both parts 1 and 2 (range 0.2–4 L). Some patients reporting less than 0.5 L ingestions were graded good or excellent in quality of feces removal. Complaints regarding the drinking of Golytely included bad taste (28%), nausea (18%), and fullness (9%). There were no statistically significant differences between paired groups regarding degree of abdominal discomfort, sleep loss, anal irritation, or dietary restriction.

Discussion

Regarding the quality of feces removal in part 1, Golytely alone fell significantly short of our standard diet/cathartic preparation with only 21 (53%) of 40 graded excellent and good versus 42 (82%) of 51 for the standard preparation ($p = 0.005$). However, combining the top three grades as adequate shows that Golytely at 81% was not significantly different from the standard preparation at 94% ($p > 0.05$) and is still a viable alternative for patients in whom cathartics may be relatively contraindicated (e.g., inflammatory bowel disease).

Poor mucosal coating, due to excess fluid retained in the colon lumen, was Golytely's greatest shortcoming as a barium enema preparation. In part 1, Golytely produced only 13 (33%) of 40 diagnostic-quality coatings versus 36 (71%) of 51 for our standard preparation ($p = 0.001$). This confirms the results of Bakran et al. [20] and others [9] using isotonic electrolyte solutions, and the preliminary comments in the four previously noted Golytely trials [11–13, 15]. Those patients in the borderline category required either additional quantities of barium and/or extra position manipulations to attain an acceptable degree of coating.

In part 2, we added oral Dulcolax tablets at the end of the Golytely preparation in the same 20 mg dosage as used in our standard preparation. As seen in table 5, the Golytely plus Dulcolax preparation improved to the same quality as the standard ($p = 0.71$).

While the Golytely plus Dulcolax combination is equal in quality to our 1-day diet/cathartic combination, it is not currently the preparation of choice for most double-contrast barium enemas due to the cost of local compounding, current lack of commercial availability, and bulkiness of storage. However, it is an alternative when diet/cathartic preparations fail, when short-notice scheduling is necessary, and in patients who are unable or unwilling to adequately hydrate for a cathartic preparation. Golytely's proven lack of dehydration or overhydration [10, 13, 15] suggests it might be safe for patients in delicate fluid balance, but the effect of the addition of Dulcolax is not yet clearly defined.

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REFERENCES

- Hewitt J, Rigby J, Reeve J, Cox AG. Whole-gut irrigation in preparation for large-bowel surgery. *Lancet* 1973;2:337–340
- Crapp AR, Powis SJA, Tillotson P, Cooke WT, Alexander-Williams J. Preparation of the bowel by whole-gut irrigation. *Lancet* 1975;2:1239–1240
- Chung RS, Gurli NJ, Berglund EM. A controlled clinical trial of whole gut lavage as a method of bowel preparation for colonic operations. *Am J Surg* 1979;137:75–80
- Minervini S, Alexander-Williams J, Donovan IA, Bentley S, Keighley MRB. Comparison of three methods of whole bowel irrigation. *Am J Surg* 1980;140:400–402
- Rhodes JB, Zvargulis JE, Williams CH, Gonzales G, Moffat RE. Oral electrolyte overload to cleanse the colon for colonoscopy. *Gastrointest Endosc* 1977;24:24–26
- Gilmore IT, Ellis WR, Barrett GS, Pendower JEH, Parkins RA. A comparison of two methods of whole gut lavage for colonoscopy. *Br J Surg* 1981;68:388–389
- Levy AG, Benson JW, Hewlett EL, Herdt JR, Doppman JL, Gordon RS. Saline lavage: a rapid, effective, and acceptable method for cleansing the gastrointestinal tract. *Gastroenterology* 1976;70:157–161
- Skucas J, Cutcliff W, Fischer HW. Whole-gut irrigation as a means of cleaning the colon. *Radiology* 1976;121:303–305
- King DM, Downes MO, Heddle RM. An alternative method of bowel preparation for barium enemas. *Br J Radiol* 1979;52:388–389
- Davis GR, Santa Ana CA, Morawski SG, Fordtran JS. Development of a lavage solution associated with minimal water and electrolyte absorption or secretion. *Gastroenterology* 1980;78:991–995
- Goldman J, Reichelderfer M. Evaluation of rapid colonoscopy preparation using a new gut lavage solution. *Gastrointest Endosc* 1982;28:9–11
- Thomas G, Brozinsky S, Isenberg JI. Patient acceptance and effectiveness of a balanced lavage solution (Golytely) versus the standard preparation for colonoscopy. *Gastroenterology* 1982;82:435–437
- Ernstoff JJ, Howard DA, Marshall JB, Jumshyd A, McCullough AJ. A randomized blinded clinical trial of a rapid colonic lavage solution (Golytely) compared with standard preparation for colonoscopy and barium enema. *Gastroenterology* 1983;84:1512–1516
- DiPalma JA, Brady CE, Stewart DL, et al. Comparison of four cleansing regimens for colonoscopy (abstr). *Gastroenterology* 1983;84:1138
- Davis GR, Smith HJ. Double-contrast examination of the colon after preparation with Golytely (a balanced lavage solution). *Gastrointest Radiol* 1983;8:173–176
- Barnes MR. How to get a clean colon—with less effort. *Radiology* 1968;91:948–949
- Zezulin W. Effective 24-hour preparation for radiologic examination of the colon. *Surg Clin North Am* 1971;51:799–805
- Rhodes JB, Engstrom J, Stone KF. Metoclopramide reduces the distress associated with colon cleansing by an oral electrolyte overload. *Gastrointest Endosc* 1978;24:162–163
- Dodds WJ, Scanlon GT, Shaw DK, Stewart ET, Youker JE, Metter GE. An evaluation of colon cleansing regimens. *AJR* 1977;128:57–59
- Bakran A, Bradley JA, Bresnihan E, et al. Whole gut irrigation, an inadequate preparation for double contrast barium enema examination. *Gastroenterology* 1977;73:28–30