

## Comparison of two oral evacuants (Citromag and Golytely) for bowel preparation before barium enema

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**Abstract.** Oral regimens for bowel preparation before barium enema examination are routinely used because of their convenience and simplicity, rather than the traditional method of colonic wash-out. We performed a prospective study comparing the side-effects and efficacy of two commonly used oral bowel evacuants (Citromag and Golytely) for bowel preparation before barium enema examination in 102 patients. The side-effects associated with the agents were assessed by analysing a questionnaire completed by the patients. There was no significant difference in the side-effects between the two agents although more patients taking Golytely (45.5%) deemed its taste unacceptable than those taking Citromag (25.9%). The results of the bowel preparation were assessed by two independent radiologists giving scores on the amount of faecal residue and the quality of mucosal coating. The amount of faecal residue was less in the Golytely group ( $p < 0.05$ ). The quality of mucosal coating by barium was also better in the Golytely group than the Citromag group ( $p < 0.05$ ).

Despite the advent of colonoscopy, double contrast barium enema remains an important and frequently requested investigation [1]. It has been suggested that double contrast barium enema is safer, more cost-effective and better tolerated by patients than colonoscopy [2, 3]. The sensitivity of barium enema is comparable to colonoscopy [4, 5]. A clean colon, free from residue and with good coating of barium is the prerequisite for a successful examination. To date, there is still no substantial consensus on the optimal method for bowel preparation before barium enema examination. Each method has its own merits and drawbacks, preference varying between different hospitals [6]. The traditional method is to use dietary restriction, purgation and cleansing water enemas [7]. However, the constraints on time, space and nursing manpower in most radiology departments render non-washout oral regimens the preferred method. This is a prospective study on the efficacy of two cathartics, Golytely and Citromag. These two agents are among the cheapest agents available on the market and have documented efficacy [8–12].

### The regimens

Golytely (Golytely Products, Melbourne) is a water-soluble powder reconstituted by dissolving in water. The ingredients are summarised in

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Table 1. It is isotonic with respect to colon contents and isosmotic. The powder is dissolved in 2 l of water. The patient drinks the reconstituted solution the night before the barium enema examination.

Citromag (Rougier Inc., Chambly) is a hypertonic solution of magnesium citrate. Each preparation of 300 ml contains 15 g of magnesium citrate. The patient drinks the solution the night before the barium enema exam.

The same dietary restriction advice was given to both groups of patients: a low residue diet for lunch and a fluid diet for dinner the day before the examination.

### Methods

This prospective study was based on outpatients scheduled for barium enema examinations. Patients with known contraindications for cathartics (including gastrointestinal obstruction, severe renal insufficiency and difficulties in swallowing) and aged below 16 or over 75 years were excluded from the study. Patients with previous colonic

**Table 1.** Composition of Golytely

Content	Amount per preparation of 137 g
Polyethylene glycol 3350	118.0 g
Potassium chloride	1.5 g
Sodium chloride	2.9 g
Sodium bicarbonate	3.36 g
Sodium sulphate anhydrous	11.36 g

surgery were also excluded from the study. Those deemed suitable for the study were randomly assigned to one of the two regimens. On the day of examination, the patients were asked to complete a questionnaire about side-effects of the agent. The films were assessed after the examination by two independent radiologists who gave scores on the cleanliness of the bowel and the quality of mucosal coating. An ordered grading was employed: 1 = good; 2 = satisfactory; 3 = poor; 4 = unacceptable. In essence, Scores 1 and 2 had an acceptable quality for diagnosis. Scores 3 and 4 were those in which diagnostic sensitivity was compromised by unsuccessful bowel preparation and a repeat of the examination or colonoscopy may be warranted for confident exclusion of lesion.

## Results

113 patients were entered into the study. 11 did not attend for the examination, leaving 102 patients for the study. Out of the 11 non-attendees, five belonged to the Citromag group and six belonged to the Golytely Group. The examinations were unsuccessful in four patients who were unable to retain the barium and were excluded from the analysis of the results of the bowel preparation, although their questionnaires were included in the data analysis for side-effects. The data were analysed using computer software Statistica version 5.0 (StatSoft, Inc.). The  $\chi^2$  test was used for 2 × 2 nominal/categorical data. The Mann-Whitney test was used for the nominal-ordinal data. Student's *t*-test was used for the nominal-quantitative (normally distributed) data [13-15].

Citromag was administered in 58 patients and Golytely in 44 patients. The difference in numbers in the two groups was due solely to randomization. The two groups were comparable in age and sex (Table 2). Both groups of patients showed good compliance in taking the cathartics (Table 3). The range of demonstrated pathology was similar in both groups: mostly diverticular disease, some polypoid lesions, and a few constricting carcinomas. There were no cases of inflammatory bowel disease.

## Symptoms and side-effects

There is no statistically significant difference in the incidence of symptoms and side-effects between the two agents. However, the taste of Citromag was more acceptable to the patients (Table 3).

## Amount of faecal residue

Results of the two groups of patients are shown in Table 4. In general, Golytely gave better results than Citromag ( $p < 0.05$ ).

## Barium coating of bowel wall

The results are summarised in Table 5. Better mucosal coating was seen with the Golytely group than in the Citromag group ( $p < 0.05$ ).

## Interobserver agreement

Comparisons of the scoring given by the two radiologists are shown in Tables 6 and 7. The interobserver agreement, as measured by weighted kappa are 0.82 ("very good") and 0.70 ("good") for the assessment of residual faeces and barium coating, respectively [16].

## Discussion

Studies have shown that oral bowel evacuants can be as effective as colonic washout [6, 17]. However, there is no consensus on the best regimen among the many available oral preparations.

Magnesium citrate (Citromag) is a commonly used saline cathartic. This inorganic solution is hyperosmolar to body fluid. Water passes out from the vascular and extracellular spaces into the intestinal lumen until the cathartic salt solution becomes isotonic with the extracellular fluid. The resulting large volume of fluid retained in the intestine stimulates peristalsis. After reaching the colon, the abnormally expanded contents are expelled.

Polyethylene glycol (Golytely) is a macromolecule and is not absorbed by the small intestine. It cleans the bowel rapidly by inducing diarrhoea. Golytely has the theoretical advantage of causing

**Table 2.** Age and sex distribution of the two patient groups

		Agent		
		Citromag	Golytely	
Sex	Male	25 (43.1%)	17 (38.6%)	No significant difference ( $p = 0.8$ )
	Female	33 (56.9%)	27 (61.4%)	
Age/years	Mean ± SE	50.6 ± 1.85	53.7 ± 2.20	No significant difference ( $p = 0.29$ )
	Median	51	56.5	

**Table 3.** Compliance and complaints of patients

		Agent		
		Citromag	Golytely	
Patient compliance	Yes	56 (96.6%)	42 (95.5%)	NSD, $p=0.78$
	No	2 (3.4%)	2 (4.5%)	
Abdominal pain	No	31 (53.4%)	20 (45.5%)	NSD, $p=0.48$
	Mild	25 (43.1%)	23 (52.3%)	
	Severe	2 (3.4%)	1 (2.3%)	
Nausea	No	34 (58.6%)	22 (50.0%)	NSD, $p=0.34$
	Mild	20 (34.4%)	17 (38.6%)	
	Severe	4 (6.9%)	5 (11.4%)	
Dizziness	No	42 (72.4%)	34 (77.3%)	NSD, $p=0.74$
	Mild	16 (27.6%)	10 (22.7%)	
	Severe	0 (0%)	0 (0%)	
Vomiting	No	56 (96.6%)	40 (90.1%)	NSD, $p=0.44$
	Yes	2 (3.4%)	4 (9.1%)	
Taste	Acceptable	43 (74.1%)	24 (54.5%)	NSD, $p=0.041$
	Poor	15 (25.9%)	20 (45.5%)	
Sleep disturbance	No	35 (60.3%)	28 (63.6%)	NSD, $p=0.73$
	Yes	23 (39.7%)	16 (36.4%)	

Percentage in parentheses.  
NSD, no statistical difference.

**Table 4.** Amount of residual faecal matter

	Citromag		Golytely	
	Radiologist 1	Radiologist 2	Radiologist 1	Radiologist 2
Score 1	12 (21.1%)	11 (19.3%)	19 (46.3%)	18 (43.9%)
Score 2	35 (61.4%)	34 (59.6%)	18 (43.9%)	18 (43.9%)
Score 3	7 (12.3%)	9 (15.8%)	4 (9.8%)	5 (12.2%)
Score 4	3 (5.3%)	3 (5.3%)	0 (0%)	0 (0%)

The Citromag group has higher (less favourable) scores than the Golytely group:  $p=0.024$  (Radiologist 1) and  $p=0.027$  (Radiologist 2).

**Table 5.** Coating of bowel wall by barium

	Citromag		Golytely	
	Radiologist 1	Radiologist 2	Radiologist 1	Radiologist 2
Score 1	29 (50.9%)	25 (43.9%)	28 (68.3%)	28 (68.3%)
Score 2	21 (36.8%)	25 (43.9%)	12 (29.3%)	10 (24.4%)
Score 3	7 (12.3%)	7 (12.3%)	1 (2.4%)	3 (7.3%)
Score 4	0 (0%)	0 (0%)	0 (0%)	0 (0%)

The Citromag group has higher (less favourable) scores than the Golytely group:  $p=0.041$  (Radiologist 1) and  $p=0.025$  (Radiologist 2).

minimal transmucosal flux of sodium and water. However, the agent has to be reconstituted before administration and the resultant solution is a relatively large volume (2 l) to drink.

Golytely is not available in some countries. However, other commercial products, for example Kleanprep, utilizing similar polyethylene glycol, exist. The results of the different commercial

preparations utilizing the same bases are likely to be similar but this cannot be guaranteed.

More patients preferred the taste of Citromag, but otherwise there was no significant difference between the two agents in regard to patient acceptability. The incidence and severity of side-effects of the two agents were comparable in our study. However, the results of bowel preparation, in terms

**Table 6.** Radiologist 1 vs Radiologist 2 in the scoring for "amount of faecal residue"

Radiologist 1	Radiologist 2			
	Score 1	Score 2	Score 3	Score 4
Score 1	25	6	0	0
Score 2	4	46	3	0
Score 3	0	0	11	0
Score 4	0	0	0	3

Weighted kappa=0.82 (strength of agreement="very good").

**Table 7.** Radiologist 1 vs Radiologist 2 in the scoring for "mucosal coating by barium"

Radiologist 1	Radiologist 2			
	Score 1	Score 2	Score 3	Score 4
Score 1	47	12	0	0
Score 2	6	23	1	0
Score 3	0	1	8	0
Score 4	0	0	0	0

Weighted kappa=0.70 (strength of agreement="good").

of bowel cleanliness and barium coating of the bowel wall, were better using Golytely. The slight disadvantage of Golytely in being less palatable may be overcome by its new preparation with pineapple flavour. There is also a slight difference in the cost of the agents locally in Hong Kong, Citromag being slightly cheaper than Golytely. It is considered that this small difference in price is insignificant compared with the total cost of a barium enema examination.

Our study also demonstrated that side-effects and symptoms due to the oral bowel evacuant are common. The most common symptoms are nausea and abdominal pain, which were reported in nearly half of the patients. It is recommended that patients should be informed of these side-effects beforehand. The use of parenteral metoclopramide before drinking the agent has led to a decreased incidence of nausea and vomiting [18]. The incidences of side-effects were also reported to be quite significant in other studies [8, 11].

The main limitation of our study is that the study population included only ambulant outpatients and excluded bed-ridden inpatients.

Despite oral evacuants usually being effective, the diagnostic quality of the barium enema examination was compromised in 10–20% of cases. The ratio of unsuccessful bowel preparation varies in different studies, from 3% to 29% [11, 19–21]. Direct comparisons among different studies are difficult because there is no standard method of assessing the quality of bowel preparation.

Oral bowel evacuants are still far from ideal. Further research and development is required in order to provide a better agent.

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