Colon Capsule Endoscopy: Can Moviprep® be used as Bowel Preparation as well as Booster? Observation Study in 95 Patients

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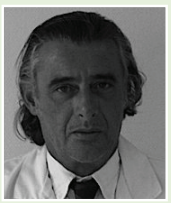
Introduction

Pillcam colon capsule endoscopy (CCE) enables colic visualisation without the need of general anesthesia (Given Imaging, Ltd, Yoqnéam, Israel). It includes a CMOS system (complementary metal oxide silicone) which captures 2 images per head and per second, a battery and an ASIC system (Application specific integrated circuit) including a radio-frequency transmitter with a LED-type lightening (White light emitting diode). This technique requires a long enough battery life to perform an entire colonic recording as well as an excellent bowel preparation. Similarly to colonoscopy, preparation includes a low-residue diet several days before, with most of the time 4 litres of PEG (polyethylene glycol).[1,2] During CCE, capsule propulsion should be boosted in the colon once it has entered the small intestine. Fleet® (sodium phosphate) (Table 1) is used in most of the studies, yet Fleet® can be contra-indicated in some cases.[3] The goals of this study was to assess the quality of the bowel preparation with 2 litres of Moviprep® (PEG + ascorbic acid + ascorbate and Na sulfate) and its efficacy as booster when substituted to Fleet®.

Material and Method

Patients

This prospective observation study was carried out from November 2009 through December 2012 in 95 consecutive patients, refusing general anesthesia despite its insightful information on colonoscopy indication.



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Eighty five CCE were used in 44 females and 51 males, with a mean age of 58 ±3 (range 16 to 84): 55 first generation CCE1 and 40 second generation CCE2 (5 patients with a contraindication to anesthesia, 8 patients with anticoagulant therapy, 13 patients with antiplatelet treatment).

Capsule Endoscopy

First generation CCE size 1 is similar to the size of the small bowel capsule (31 mm long and 11 mm in diameter), with a field of view per head of 156°. It stops recording after 5 minutes and then automatically starts again after 105 minutes (1h45) to finally stop recording at 600 minutes (10 h). Direct visualisation of the GI tract can be performed thanks to a laptop and the "Rapid access" software.

Second generation CCE2 is slightly bigger (31.5 mm long and 11.6 mm diameter), with a larger field of view per head of 172°. It switches off after 3 minutes, records 14 images per minute and starts recording again according to an algorithm which detects the small intestine between 30 and 120 minutes after ingestion, then switches off between 600 and 900 minutes (10 to 15 hours). CCE2 records from 2 to 15 images per second and per head depending on speed progression in the colon. Continuous visualisation of the GI tract is performed using the DR3 hardware, and "Rapid 7" version allows polyps size assessment in millimeter as well as their spectral analysis with FICE (Fuji intelligent chromo endoscopy).[4]

There is a significant difference ($p < 0.0001$) in colonic transit times between group 1 and 2, using the Student test.

Bowel Preparation

3 days before the examination, all patients followed a low-residue diet and any iron therapy was stopped about ten days before. All of them had a bowel preparation based on an amended "standard" protocol[1-3] with 2 litres of Moviprep® the day before or the morning of the examination, depending on the ingestion schedule (8.00 a.m. or 11.30 a.m.) and the "booster" varied according to two consecutive periods: period A, the first 70 patients included received Fleet® as a "booster"

"Standard" Protocol	Protocol #1	Protocol #2
D5 to D2 Low-residue diet	D5 to D2 Low-residue diet	D5 to D2 Low-residue diet
D2 Intake of 2 L of clear liquids Sennosides 4 tablets in the evening	D2 Intake of 2 L of clear liquids Sennosides 4 tablets in the evening	D2 Intake of 2 L of clear liquids Sennosides 4 tablets in the evening
D1 07.00 am- 7.00 pm: clear liquids 7.00 pm- 9.00 pm: 3 or 2 L of PEG	D1 07.00 am- 7.00 pm: clear liquids 7.00 pm- 9.00: pm 2 L of Moviprep®	D1 07.00 am- 7.00 pm: clear liquids
D Day 06.00 am – 07.00 am: 1 or 2L of PEG (4 L in total) 07.45 am: 1 tablet domperidone 20 mg 08.00 am: PillCam Colon ingestion 10.00 am: Booster 1 30 to 45 mL Fleet® + 1L water 2.00 pm: Booster 2 15 to 30 mL Fleet® + 1L water 4.30 pm: bisacodyl suppository (10 mg) if capsule is not egected	D Day 07.45 am: 1 tablet of domperidone 20 mg 08.00 am: PillCam Colon ingestion 10.00 am: Booster 1 45 mL Fleet® + 1L water 2.00 pm: Booster 2 22.5 mL Fleet® + 1L water 4.30 pm: bisacodyl suppository (10 mg) if capsule is not egected	D Day 06.00 am – 07.00 am: 1 L of Moviprep® (+ 1 L Water) 08.00 am - 10.00 am: 1 L of Moviprep® (+ 1 L Water) 11.00 am: 1 tablet of domperidone 20 mg 11.30 am: PillCam Colon ingestion 1.30 pm: Booster 1 0.5L Moviprep® (+ 0.5L H20) 5.00 pm: Booster 2 0.5L Moviprep® (+ 0.5L water) 6.30 pm: 10 mg bisacodyl suppository if capsule is not egected

Table 1. Preparation protocols to perform a colon capsule endoscopy.

(protocol #1); period B, the last 25 patients received Moviprep® as a "booster" (protocol #2).

Protocol #1 (70 patients): low-residue diet (D5 to D2), pursenide (D2), clear liquid diet and 2L of Moviprep® on D1, capsule ingestion at 8.00 a.m., booster #1 with 45mL of Fleet® 2 hours later and booster# 2 with 22.5mL of Fleet® 6 hours after ingestion if the capsule had not been egested.

Protocol #2 (25 patients) : low-residue diet (D5 to D2), pursenide (D2), clear liquid diet on D1, 2L of Moviprep® the morning of the examination, capsule ingestion at 11.30 a.m., booster #1 with 500mL of Moviprep® 2 hours later and booster #2 with 500mL of Moviprep® 6 hours after ingestion if the capsule had not been egested.

Examination

Once the cutaneous electrodes had been placed, the hardware control and its CCE recognition had been performed, procedures were performed early or later in the morning according to periods A and B. The capsule was ingested with 25 mL of cold water.

Egestion rate was evaluated in both groups as well as the quality of the bowel preparation according to 4 grades (excellent, fair, average, poor) later summarised by 2 items: adequate (excellent/fair) or inadequate (average/poor).[5]

Recordings were all read and analysed by the same investigators (JC.L, P.AL, M.C) following a 3-step reading: a. reading in "Quick view" mode forward and backward to define the anatomical landmarks; b. normal mode forward reading with backward or targeted reading using one or 2 heads on a lesion (7 to 15 images per second). All digestive lesions viewed during the examination were reported.

Recording times were collected on all patients, from the mouth to the Bauhin valve (oro-caecal transit time) and from the caecum to the anus (bowel transit time). Student Test was used to perform all of the statistical comparisons of these data.

Results

No ingestion-related failure, as well as no complication related to the bowel preparation or the device was recorded. Only 3 patients called the secretariat for further information. Hardware was returned to the secretariat in the evening or the day after the examination, all undamaged.

In the group including 70 patients with preparation protocol #1 (55 CCE1 and 15 CCE2), 60 examinations were rated complete (85.7%), 10 incomplete (14.3%) including 5 cases of sigmoid retention, 4 cases where the rectum was difficult to analyse due to dark rectal residual liquids and one case of premature recording termination in the ascending colon. Preparation was rated adequate in 59 patients

(84.2%). Mean colic and oro-caecal transit times were respectively 2 hours 47 min and 3 hours 22 min.

In the group including 25 patients with preparation protocol #2 (25 CCE2), 13 examinations were rated complete (52%), 12 incomplete (48%) including 7 cases of sigmoid retention and 5 cases where the rectum was difficult to analyse due to dark rectal residual liquids. Preparation was rated adequate in 14 patients (56%). (Ascending colon 64%, transverse colon 64%, descending colon 68% and rectum 34%). In this group, CCE expulsion occurred in less than 6 hours in

Authors	Year	Patients	Adequate preparation (excellent/ fair)	Complete bowel examination	Detection rate of colonic polyps	Type of preparation
Gay[4]	2009	128	81.7%	90.5%	53.2%	Bowel preparation: 3+1 L of PEG Booster 1: 45 mL Fleet® Booster 2: 30 mL de Fleet®
Eliakin[7]	2009	104	78%	81%	44%	Bowel preparation: 3+1 L of PEG Booster 1: 45 mL Fleet® Booster 2: 30 mL de Fleet®
Sacher Huvelin[9]	2010	545	52%	91%	46%	Bowel preparation: 3+1 L of PEG Booster 1: 45 mL Fleet® Booster 2: 30 mL de Fleet®
Spada[6]	2011	117	81%	88%	41.3%	Bowel preparation: 2+2 L of PEG Booster 1: 30 mL Fleet® Booster 2: 20 mL de Fleet®
Spada[3]	2011	20	53%	75%		Bowel preparation: 3+1 L of PEG Booster 1: 500 mL of PEG Booster 2: 500 mL of PEG
		20	35%	100%	3.52%	Bowel preparation: 3+1 L of PEG Booster 1: 45 mL Fleet® Booster 2: 30 mL de Fleet®
Letard	2012	70	84.3%	86%	45.7%	Bowel preparation: 2 L Moviprep® Booster 1: 45 mL Fleet® Booster 2: 25 mL de Fleet®
		25	56%	52%	32%	Bowel preparation: 2 L Moviprep® Booster 1: 500 mL Moviprep® Booster 2: 500 mL de Moviprep®

Table 2. Results on preparation quality, complete or incomplete examination and number of colonic polyps depending on the various types of preparations.

27% of cases, in less than 8 hours in 19% of cases and in more than 10 hours in 54% of cases or it was blocked in the sigmoid. Mean colic and oro-caecal transit times were respectively 3 hours 03 min and 6 hours 07 min. Due to insufficient preliminary results, protocol #2 had to be prematurely stopped.

There is a significant difference ($p < 0.0001$) in colonic transit times between group 1 and 2, using the Student test.

9 out of 40 CCE 2 had a recording time superior to 12 hours, with a maximum recording time of 17 hours 53 min in one patient.
139 lesions were identified in 53 patients (56%) (7 esophagitis, 13 gastritis, 8 lesions of the small intestine, 24 diverticulosis , 1 ischemic colitis, 2 caecal angiodysplasia, 2 inflammatory bowel disease, one colic melanosis, 81 colic polyps larger than 5 mm in 40 patients (32 in protocol #1 and 8 in protocol #2).

Once the CCE was completed, further endoscopic examinations were recommended to 44% of patients: 6 esogastroduodenal fibroscopies, 7 recto-sigmoidoscopies and 24 colonoscopies. Considering the obtained results, the prescribed endoscopies were performed in most of the patients (5 persistent refusals of the anesthesia).

Discussion

In this study, CCE seemed easy to perform no matter when it was ingested in the morning. No ingestion failure of CCE1 or CCE2, nor device damage or any other preparation or medical device related complication was observed despite the slightly larger size of the second generation. Patients understood fairly well the examination, with only 3.3% calling back our secretariat for further information. In Spada *et* Eliakin study, 6.8 to 8% of patients suffered from nausea, vomiting, headaches or abdominal pain, 24 to 48 hours following the examination, and could most of the time be preparation-related.[6, 7]

When performing a CCE, bowel preparation is critical, as residues can't be rinsed out. Initially, the preparation protocol included 4 litres of PEG (3 litres the day before and 1 litre the morning of the examination), whereas currently 2 litres of PEG the day before and 2 litres the morning of the examination are preferred. Results from various authors sometimes differ, with an adequate preparation rate ranging from 52 to 81.7%, with a complete examination rate when associated to Fleet® as a booster ranging from 81 to 91% depending on series.

In our study, when 2 litres of Moviprep® was given the day before the examination, adequate preparation rate was 84.2% and complete examination rate was 85.7%. Bowel transit times were 3 hours 22 min on average, slightly superior to transit times with 4 litres of PEG preparation reported in the literature.[3, 4]

Booster is essential, as there are few longitudinal contractions in the colon. CCE propulsion is thus required. The booster goal is to accelerate CCE in the small intestines and then in the colon before the battery stops. In fact, Sieg *et al*. tried to stop giving a booster, and their egestion rate after 6 hours decreased from 84 to 0%.[8] However, Fleet® can be sometimes contraindicated, as it can induced an acute nephropathy with kidney failure.

In our study, and when Moviprep® was used as a booster, only 56% of preparations were rated adequate and examinations were only complete in 52% of cases, with a major increase of bowel transit time to 6 hours 07 min on average, similarly to Spada *et al*. results where mean bowel transit time was 5 hours 32 min in case of PEG use as a « booster ».[3]

In our patients, the number of colonic polyps visualised with CCE was 42% for both protocols, with yet 45.7% with regards to protocol #1 and 32% with regards to protocol #2 where preparation and CCE progression were insufficient (Table 2). These results are similar to the results published in the literature, and vary from 41.3 to 53.2% depending on the type of bowel preparation and transit time.[3, 4, 6, 7, 9, 10]

In our patients, other lesions could be visualised, further leading to a GI endoscopy in 44% of them, with few of them refusing anesthesia once lesions had been visualised (5%).

Conclusion

In patients for whom 4 litres of PEG in-take to perform a CCE is impossible, a bowel preparation with 2 liters of Moviprep® the day before is associated with fair quality examination in 84.2% of adequate preparations and a complete bowel examination in 85.7% of cases, if Fleet® is associated as a booster.

In contrast, Moviprep® as booster, similarly to PEG, is less efficient on bowel peristalsis than Fleet®, twice as long bowel transit times.

Future discussion could include Fleet® dosage to be prescribed for phases 1 and 2 of the booster.

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