

An easy method for the intraluminal administration of peppermint oil before colonoscopy and its effectiveness in reducing colonic spasm

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Background: Systemic administration of a cholinergic blocking agent or glucagon is used to reduce spasms, but it is inconvenient and sometimes causes side effects. This study is an evaluation of the intracolonic administration of peppermint oil during colonoscopy for the control of colonic spasm.

Methods: Each patient in the treated group ($n = 409$) was given approximately 200 mL of the solution (a mixture of 8 mL of peppermint oil and 0.2 mL of Tween 80 per 1 L of water with 0.04% indigo carmine) by using a hand pump attached to the accessory channel of the colonoscope. Changes in patient posture were made to distribute the solution. The patients in the control group ($n = 36$) were given the solution without peppermint oil.

Results: A satisfactory spasmolytic effect was seen in 88.5% of the treated patients and in 33.3% of those in the control group ($p < 0.0001$). No adverse effect was observed. The mean time to onset was 21.6 ± 15.0 seconds, and the effect continued for at least 20 minutes. In patients with irritable bowel syndrome, efficacy was significantly lower ($p < 0.0001$).

Conclusions: The intraluminal administration of peppermint oil by using a hand pump is a simple, safe, and convenient alternative to the systemic injection of a cholinergic blocking agent or glucagon during colonoscopy. (Gastrointest Endosc 2001;53:172-7.)

It is now possible to detect flat or depressed types of colon cancer by colonoscopy and to treat them by polypectomy and endoscopic mucosal resection.^{1,2} For safe treatment, relaxation of the smooth muscle of the colon is essential so that small lesions behind interhaustral septae are not overlooked and to provide relief of pain caused by colonic spasm. Anticholinergic drugs have been given by intramuscular or intravenous injection during radiologic and endoscopic examinations.³ However, systemic use of these drugs sometimes causes side effects such as palpitation, dry mouth, urinary retention, orthostatic hypotension, anaphylactic reactions, and temporary visual impairment.^{4,5} Thus, the use of medication is contraindicated for patients with heart disease, prostatic hypertrophy, and narrow angle glaucoma.⁶ For all of these reasons, a safer and more convenient

method has been needed for obtaining the proper state of colon relaxation during colonoscopy.

Peppermint oil is an essential oil, well known as a flavoring agent and also known to have a direct relaxation effect on smooth muscle in the colon.⁷ Leicester and Hunt⁸ used peppermint oil during 20 colonoscopies. No subsequent studies have evaluated the use of peppermint oil during endoscopy. We developed an easy and effective method to administer peppermint oil throughout the entire colon. The method requires the use of a hand pump and changes in patient position. With this method we evaluated the efficacy of peppermint oil to reduce colonic spasm during routine colonoscopy.

PATIENTS AND METHODS

Colonoscopy was performed by 1 endoscopist in 445 patients (409 in a treated group, 36 in a control group). Indications included a positive test for occult blood in feces by using an antibody that recognizes human hemoglobin, an abnormal barium enema, or surveillance after previous polypectomies.⁹ Patients with a history of colectomy or severe colitis were excluded. Patient characteristics are shown in Table 1. Informed consent was obtained from all patients. In the initial 71 cases, a randomized control study was performed to assess the effects of the intracolonic administration of peppermint oil. The study was approved by our institutional review board. Bowel

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Figure 1. Hand pump for injection of peppermint solution during colonoscopy. The rubber bulb is connected to the accessory channel of the colonoscope. By squeezing the bulb, 30 mL of solution is injected.

preparation was by total bowel irrigation.¹⁰ No medication was given other than the peppermint oil. Medications with effects on bowel motility were stopped before the examinations. All patients were interviewed about colon irritability,¹¹ which was characterized by rectal urgency and discomfort after defecation. It was assumed that the peppermint oil could be ineffective in cases with potential spasmodic colon irritability. A video colonoscope (CF-240I; Olympus Optical Co. Ltd., Tokyo, Japan) was used. Pulse and oxygen saturation were monitored in patients with heart disease. After colonoscopy, all patients had blood pressure monitoring, and they were evaluated for possible side effects before they left the hospital.

Preparation of peppermint oil solution

Because it is insoluble, the peppermint oil was solubilized by the addition of a surface-active agent, Tween 80 (Wako Pure Chemical Industries, Inco, Osaka, Japan), that is widely used as a detergent for preparation of medicines. Eight mL of peppermint oil and 0.2 mL of Tween 80 were mixed in 1 L of water and kept overnight at room temperature. The insoluble fraction was removed, and the clear water fraction was packed as a peppermint solution in a sealed plastic bag. The solution was used within a month of preparation. Indigo carmine was added to the solution before use in a concentration of 0.04%. The distribution of the peppermint oil in the colon was estimated by reference to the blue indigo color of the solution. The blue solution could additionally be used chromoscopically in the evaluation of small flat or depressed lesions in the colon.¹ In the control group, the same solution without the peppermint oil was used.

The hand pump apparatus

The hand pump system consisted of a rubber bulb with 2 one-way valves, a connecting tube, and a bottle for storage of the peppermint solution. After aspiration of all residual irrigation fluid in the colon, the bulb was connected to the inlet of the accessory channel of the colono-

Table 1. Patient characteristics

	Treated group	Control group
No. of cases	409	36
Male/Female	309/100	26/10
Age (yr) (mean \pm SD, range)	56.8 \pm 11.3 (25-89)	55.2 \pm 11.9 (21-76)
Anamneses		
Abdominal operation	25	2
Gastrectomy	12	1
Cholecystectomy	5	1
Gynecologic	8	0
Irritable bowel syndrome	50	7
Cardiovascular	8	0
Hypertension	34	3
Prostate hypertrophy	12	0
Asthma	2	0
Diabetes	16	0
Glaucoma	2	0

No significant differences were found between the treated and control groups.

scope (Fig. 1). Approximately 30 mL of the solution was injected each time the rubber bulb was squeezed. The bulb returned to its original shape on release and automatically filled for the next injection with the solution supplied from the bottle through the connecting tube.

Position changes

Colonoscopy was begun with the patient in a left decubitus position following a digital rectal examination. At the rectosigmoid junction, the peppermint or control solution was injected by pumping the bulb once or twice; the solution then flowed to the sigmoid colon by gravity. Before the tip of the colonoscope passed the sigmoid-descending colon junction, patient position was changed to right lateral decubitus. The sigmoid colon could be deflated by aspiration of air with the patient in this position. The right-turn and shortening technique was used for insertion into the descending colon without stretching the sigmoid colon. In the same manner, the transverse colon was filled by gravity with the solution by pumping the bulb at the splenic flexure. After this injection, patient position was changed again to supine and the colonoscope was inserted into the transverse colon. Additional solution was injected in the cecum. When the color of the residual fluid in the colon was no longer indigo blue, additional intraluminal injections were made after aspiration of residual irrigation fluid. When severe colon spasm interrupted insertion of the colonoscope despite an adequate concentration of the peppermint solution in the colon, an anticholinergic agent or glucagon was given by intramuscular injection. In these cases, the colonic spasm was considered severe (+3). The time required for insertion of the colonoscope to the cecum was measured with a stopwatch built into the videoendoscopy unit.

Measurement of onset time

In an additional 31 cases, the peppermint solution was not used until the colonoscope was inserted into the sigmoid colon. When narrowing due to spasm was identified,

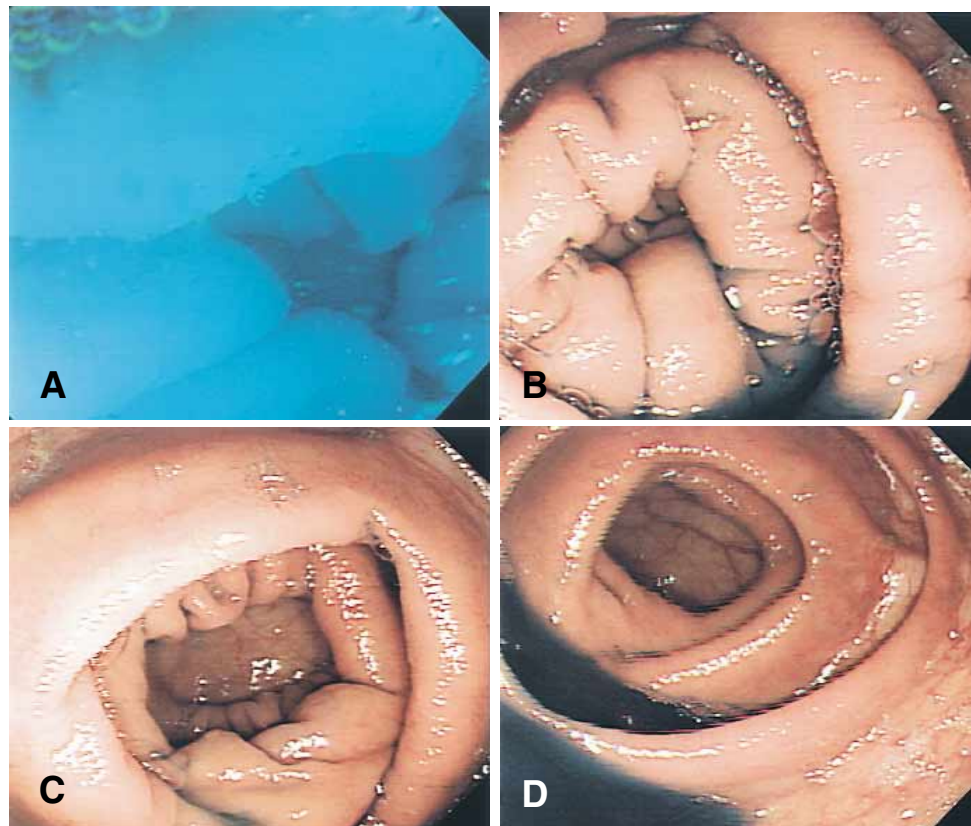


Figure 2. Endoscopic appearance of sigmoid colon after injection of peppermint solution. **A**, Immediately after an injection of peppermint oil, the lumen of the colon is not seen due to spasm. **B**, Twenty seconds after injection of the peppermint solution, a spasmolytic effect is noted. **C**, Forty seconds after injection, the lumen of the colon is seen. **D**, At 90 seconds, the colon is relaxed and readily evident.

30 mL of the peppermint solution was injected intraluminally. After injection, digital images of the colon were recorded every 10 seconds at the same position. The onset time of bowel relaxation was determined by using the digital image filing system (EVIS-NET; Olympus). If relaxation did not occur, observation was continued for at least 5 minutes at the same position until systemic administration of spasmolytic agents.

Barostat observations

The motility of the sigmoid colon after peppermint oil administration was monitored with a barostat (Isobar-3; G&J Electronic, Willowdale, Ontario, Canada)¹² in 5 volunteers to study colon motility after the intraluminal administration of the peppermint oil solution. A catheter with a balloon (bag) made of a highly compliant material was introduced into the sigmoid colon with the aid of the colonoscope. The volume of air required to maintain a preset pressure (10 mm Hg) in the bag was recorded by the barostat. After a rhythmic cycle of volume changes was recorded, 30 mL of the control or peppermint solution was injected via the infusion channel of the barostat at the start of a periodic contraction. Monitoring was continued after the intraluminal injection of the solution until peristalsis of the colon recovered.

Evaluation of the efficacy of peppermint oil

In the patients who could undergo the total colonoscopy without systemic administration of antispasmodic agents, the effects of the peppermint oil on muscle relaxation were evaluated during withdrawal of the colonoscope from the cecum.

Colonic spasm was estimated by using a 4-grade score: (+0), no movement observed, with colon dilated; (+1), colon movement not observed, but haustral septae with mild spasm remained; (+2), colon movement; (+3), severe spasm requiring systemic spasmolytic agents for colonoscopic insertion. Efficacy was calculated as the percentage of patients with either a +0 or a +1 score. The chi-square test or Student *t* test was used for evaluation of differences. A *p* value of less than 0.05 was considered significant.

RESULTS

Endoscopic findings after administration of peppermint oil

A series of colonoscopic images at the sigmoid colon in 1 patient before and 20, 40, and 90 seconds after an intraluminal injection of 30 mL of the peppermint solution is shown in Figure 2. The spastic colon started to relax at 20 seconds after the injection.

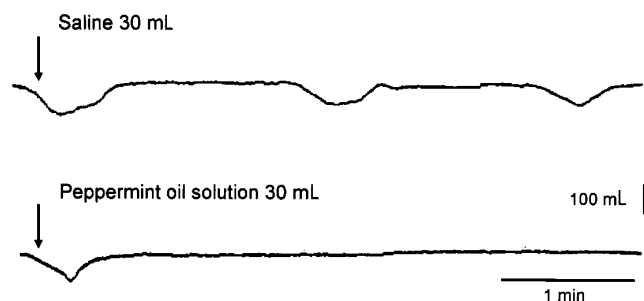


Figure 3. Inhibition effect of peppermint oil on colonic motility. Volume changes in the barostat balloon in a healthy volunteer. The pressure in the balloon is constant during measurement. Saline injection via the infusion channel of a catheter does not affect peristaltic constriction (*upper part* of this figure). The peristaltic change of volume is diminished after the injection of the peppermint solution (*lower part*). Relaxation of the colon was sustained for 20 minutes in this case.

tion (Fig. 2B) and was relaxed sufficiently for colonoscopic observation at 40 seconds after administration of the peppermint oil (Fig. 2C).

Colon relaxation was observed after the intraluminal administration in 29 of the 31 additional cases in which the peppermint oil solution was introduced with the colonoscope in the sigmoid colon. The onset time for spasmolysis was 21.6 ± 15.0 seconds (mean \pm SD) in these 29 patients.

Barostat measurements

A rhythmic cycle of volume changes was seen with a frequency of approximately 0.5 per minute. Figure 3 shows a typical chart of the balloon volume recorded by the barostat after intraluminal injections of saline and peppermint solution through the infusion channel of the barostat. The volume record indicated that the tone of the colon started to decrease at 15 seconds after the intraluminal administration of 30 mL of peppermint solution, and the motility of the colon was diminished. This inhibitory effect on colon motility was observed in all 5 cases. In contrast, the same volume of control solution without peppermint oil did not affect the peristaltic movement of the colon.

Peppermint oil distribution

In almost all patients, the solution could be distributed along the length of the sigmoid colon by injections at the rectosigmoid junction with the patient in a left decubitus position. However, the peppermint solution was diluted in the right side of the transverse colon when residual irrigation solution was present. In this situation, additional injections after aspiration of the irrigating solution were helpful. The hand pump apparatus greatly facilitat-

ed repeated intraluminal injection during colonoscopy. The average solution volume used in each patient was estimated at 200 mL.

Colonoscopic findings

A total of 409 patients underwent total colonoscopy with intraluminal administration of the peppermint solution. A total of 375 neoplastic lesions were found (8 cancers, 331 polyps, and 36 flat adenomas) and 303 lesions were treated endoscopically without any complication (289 polypectomies and 14 endoscopic mucosal resections).

Antispasmodic effects of peppermint oil

The effects of the peppermint oil on smooth muscle relaxation are shown in Table 2. As an initial study, a small number of patients were randomized into treated and control groups. In this initial study efficacy for smooth muscle relaxation was significantly higher in the treated group (91.4%, $n = 35$) than the control group (33.3%, $n = 36$; $p < 0.0001$). After this initial analysis, the peppermint oil solution was administered to all patients.

In the final analysis, the percentage of patients with +0 or +1 grade of spasm was 88.3% and 33.3% in the treated and control groups, respectively ($p < 0.0001$). There was no significant difference observed in the mean of time for insertion of the colonoscope to the cecum.

The correlation between efficacy of the peppermint oil and certain patient characteristics is shown in Table 3. The percentage of cases in which the peppermint oil was effective was significantly lower among men ($p = 0.03$) and patients with irritable bowel syndrome ($p < 0.0001$). However, the presence of diverticulosis and patient age did not influence the effects of the peppermint oil in ameliorating spasm.

Side effects

No adverse effects of the peppermint solution were observed during or after colonoscopy. After completion of the colonoscopy procedures with the peppermint solution, biopsy specimens from the rectum in the initial 35 patients did not demonstrate any pathologic changes in the mucosa. Patients with comorbid diseases, including cardiovascular disorder, prostatic hypertrophy, narrow angle glaucoma, and asthma (Table 1), underwent colonoscopy with peppermint solution without any complications.

DISCUSSION

Peppermint oil, an essential oil, directly affects colonic smooth muscle. The mechanism of smooth muscle relaxation has been investigated in models

Table 2. Evaluation of spasmolytic effects of peppermint solution

Group	Grade of spasm				Total	Efficacy rate*	Mean time [†] (range)
	+0	+1	+2	+3			
Treated with peppermint oil	296	66	18	29	409	88.5% [‡]	13.7 ± 6.7 (4-41)
Control	4	8	9	15	36	33.3%	14.4 ± 6.4 (5-30)

*Percentage of cases with grade of spasm of a (+0) or a (+1).

[†]Time for insertion from anus to cecum (min), mean ± SD.

[‡] $p < 0.0001$.

by using the smooth muscle of guinea pigs and rats. The effect reportedly resembles that of dihydropyridine calcium antagonists by directly reducing calcium influx.^{13,14}

Peppermint oil as an antispasmodic agent has been found to be useful for barium enema procedures.¹⁵ Treatment of irritable bowel syndrome with peppermint oil has been attempted.^{7,16,17} For endoscopic procedures, the intraluminal administration of an agent that acts rapidly and directly on smooth muscle can have advantages over the systemic administration of an anticholinergic agent. Our barostat and endoscopic observations showed rapid and strong effects of peppermint oil on colonic muscle relaxation and inhibition of motility within 20 seconds after intraluminal administration. This onset time is short enough for use in performing barium enemas or in the treatment of irritable bowel syndrome. However, for colonoscopy it is not practical to wait for more than 20 seconds for relaxation after an injection of the peppermint solution through the colonoscope accessory channel. Therefore, an efficient method was required to distribute the peppermint solution proximally in the colon before passage of the colonoscope. Adequate distribution of peppermint oil throughout the colon could be easily achieved with changes in the patient position and repeated injections given with the hand pump, which improved visualization in the relaxed colon. The duration of the effect of the peppermint oil is probably more than 20 minutes judging from the fact that the sigmoid colon was relaxed and without spasm as the colonoscopy was completed.

High concentrations of peppermint oil have been reported to cause anal burning¹⁸ and heartburn because of premature release from capsules containing peppermint oil taken orally for treatment of irritable bowel syndrome⁷ and nonulcer dyspepsia.¹⁹ In a study by Nash et al.,¹⁷ with colonic administration of peppermint oil during a barium enema, in the same concentration that was used for colonoscopy in this study, there were no side effects. Moreover, this agent was found to be safe in a subchronic toxicity study at a high dose in rats.²⁰ In the present study,

Table 3. Efficacy on colonic relaxation during colonoscopy after intraluminal administration of peppermint oil according to patient characteristics

Patient characteristic	n	Efficacy rate	<i>p</i> Value
Gender			
Male	309	86.4%	0.03
Female	100	95.0%	
Irritable colon			
-	359	91.9%	< 0.0001
+	50	64.0%	
Diverticulum			
-	366	89.3%	Not significant
+	43	81.4%	

no adverse effects were seen, and peppermint oil was safely used in patients with ischemic heart disease, narrow angle glaucoma, prostatic hypertrophy, asthma, and diabetes.

In conclusion, colonic spasm during colonoscopy can be safely, easily, and conveniently reduced by the intraluminal administration of peppermint oil by means of a hand pump system.

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