

Limited water infusion decreases pain during minimally sedated colonoscopy

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Author contributions: Hsieh YH and Lin HJ contributed equally to this work; Hsieh YH designed the research; Hsieh YH and Tseng KC performed the research; Hsieh YH analyzed the data; Hsieh YH and Lin HJ wrote the paper.

Supported by Research funds from Buddhist Dalin Tzu Chi General Hospital

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Received: September 25, 2010 Revised: January 10, 2011

Accepted: January 17, 2011

Published online: May 7, 2011

water group than in the air group (2.5 ± 2.5 vs 3.4 ± 2.8 , mean \pm SD, $P = 0.021$). The cecal intubation time was significantly longer in the water group than in the air group (6.4 ± 3.1 min vs 4.5 ± 2.4 min, $P < 0.001$). More water was infused in the water group (322 ± 80.9 mL vs 26.2 ± 39.4 mL, $P < 0.001$).

CONCLUSION: Limited airless water infusion in the distal colon reduces patients' pain during colonoscopy.

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Key words: Water; Pain; Colonoscopy; Looping; Intubation time

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Hsieh YH, Lin HJ, Tseng KC. Limited water infusion decreases pain during minimally sedated colonoscopy. *World J Gastroenterol* 2011; 17(17): 2236-2240 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v17/i17/2236.htm> DOI: <http://dx.doi.org/10.3748/wjg.v17.i17.2236>

Abstract

AIM: To investigate a limited water infusion method in colonoscopy.

METHODS: Consecutive patients undergoing minimally sedated colonoscopy were randomized to receive air insufflation ($n = 89$) or water infusion limited to the rectum, sigmoid colon and descending colon ($n = 90$). Completion rates, cecal intubation times, procedure times, need for abdominal compression, turning of patients and levels of discomfort were evaluated.

RESULTS: Completion rates, total procedure times, need for abdominal compression, and turning of patients were similar between groups. Less pain was experienced in the

INTRODUCTION

Colonoscopy is currently the gold standard for the evaluation and treatment of colon disease^[1,2]. The procedure can sometimes be quite painful and the success rate of intubation varies with the skills of the endoscopists^[3]. Various methods have been used to reduce the pain of colonoscopy, including variable stiffness colonoscopy, magnetic endoscope imaging and oil lubrication^[4-6]. Some of these measures require new instruments and their effects are controversial.

Pain during colonoscopy may originate from colon distension caused by air insufflation during the procedure. Adequate air insufflation opens the lumen of the

colon and improves the colonoscopic view. Overinflation, however, elongates the colon, accentuates the angles and results in difficult intubation. In addition, overinflation reduces mucosal blood flow in the laboratory setting and could possibly cause clinically significant ischemia^[7].

Water instillation into the colon can facilitate intubation by straightening the sigmoid colon and decreasing the friction between the scope and the colonic mucosa during colonoscopy^[6]. Recently, an airless water intubation method was proposed in which water, in lieu of air, was used to open the lumen of the colon^[8]. In previous studies, this method was found to decrease the use of sedative medication during sedated colonoscopy and to increase patient willingness to receive unsedated colonoscopy^[8-10]. However, a large amount of water was needed to inflate the colon adequately, and if water was infused manually with a syringe, the procedure time was prolonged^[8]. Otherwise, an automatic infusion pump was needed^[9-11].

In this randomized, controlled study, we simplified the water intubation method by limiting the infusion of water to the rectum and sigmoid colon. We aimed to investigate whether this limited water infusion method could reduce patient discomfort during minimally sedated colonoscopy.

MATERIALS AND METHODS

This prospective study was conducted between May and November 2009 at Buddhist Dalin Tzu Chi General Hospital. Patients undergoing minimally sedated colonoscopy performed by two endoscopists (Hsieh YH and Tseng KC) at our endoscopic suite were included. Patients with the following conditions were excluded: obstructive lesions of the colon, inadequate bowel preparation, allergy to meperidine, massive ascites, past history of partial colectomy, or refusal to provide written informed consent. The study was approved by the Institutional Review Board of the Buddhist Dalin Tzu Chi General Hospital.

Bowel cleansing was accomplished by asking the patients to ingest either 90 mL of sodium phosphate, or 4 bisacodyl tablets (4 × 5 mg) plus 250 mL of magnesium citrate (Purzer Pharmaceutical Co., Taipei, Taiwan) oral solution in two divided doses the night before the procedure.

Buscopan (hyoscine N-butylbromide, 20 mg), if not contraindicated, and 25 mg of meperidine were given intramuscularly immediately before the procedure to produce good colonic relaxation and reduce patient discomfort.

The colonoscopic examinations were performed by using a video colonoscope (CF 240AL, Olympus Optical Co. Ltd., Tokyo, Japan). All procedures were performed with the standard method, including starting with the patient in the left lateral decubitus position, avoiding and reducing loops as much as possible. The variable stiffness function was activated at the discretion of the endoscopist, usually after the sigmoid colon was passed and before manual abdominal pressure was applied. Intubation

of the cecum was defined as successful only if the base of the cecum could be touched with the tip of the colonoscope. Detailed examinations were undertaken during the withdrawal phase.

The patients were allocated into two groups randomly by means of a computer-generated list. In the air group, air insufflation was used throughout the procedure. In the water group, the air pump was turned off initially during the procedure. Instead, tap water in 50 mL syringes was instilled into the rectum and the sigmoid colon through the accessory channel to open the colon lumen. Water was not usually instilled into the descending colon because the infused water already accumulated in this dependent segment. If the tip of the scope came out of the water or could not find its way at the transverse colon, the air pump was then turned on. In addition, if the lumen could not be opened with water in the sigmoid colon after a 5-min attempt, the air pump was turned on.

Demographic data (age, gender, height, weight, and education level), indications for colonoscopy, history of abdominal surgery or hysterectomy, constipation and chronic use of laxatives were obtained before colonoscopy. At the end of the procedure, the following parameters were evaluated and recorded on the patient data sheet: quality of bowel preparation, cecal intubation time, total procedure time, activation of the variable stiffness function, use of abdominal pressure, use of changing position, presence of polyps and reasons for incomplete colonoscopy. Body mass index was calculated as body weight divided by body height squared (kg/m^2). The quality of bowel cleansing was classified by the endoscopist as: (1) good: dry colon or only a small amount of clear liquid; (2) fair: large amount of clear liquid fluid or minimal solid stools; (3) poor: significant amount of solid residue; and (4) inadequate: when stool residue precludes complete insertion.

A trained research assistant who was unaware of the randomization status administered a questionnaire to the subjects after the procedure. In the questionnaire, abdominal pain was graded according to 10 levels (VAS scale). The degree of satisfaction was also assessed by a similar scale.

Statistical analysis

A sample size of about 75 patients was chosen to detect a difference of 1 in the patient abdominal pain score during colonoscopy given a standard deviation of 2.2 with a two-tailed α of 0.05 and a β of 0.20. Statistical analysis was performed using SPSS version 12.0 software (SPSS Inc., Chicago, IL). All continuous variables were expressed as mean \pm SD. The Student's *t*-test and an analysis of variance to compare the means of continuous variables were used where appropriate. The χ^2 test, with Yates' correction for continuity, was used for comparison of categorical data, while the Fisher exact test was used when numbers were small. Multivariate logistic regression was performed using the application of assistant-administered abdominal pressure as the end point. A *P*

Table 1 Baseline characteristics of the patients undergoing colonoscopy (mean \pm SD) *n* (%)

	Air group (<i>n</i> = 89)	Water group (<i>n</i> = 90)	<i>P</i> value
Male	51 (57.3)	49 (54.4)	0.764 ²
Age (yr)	58.3 \pm 13.3	57.2 \pm 13.3	0.612 ¹
BMI (kg/m ²)	24.0 \pm 3.5	24.2 \pm 3.5	0.678 ¹
Previous abdomino-pelvic surgery	27 (36.0)	23 (30.7)	0.604 ²
Constipation	34 (38.2)	22 (24.4)	0.054 ²
Inpatients	5 (5.6)	3 (3.3)	0.497 ²
Indications			0.482 ²
Follow-up of polyps	34 (38.2)	29 (32.2)	
Abdominal pain	5 (5.6)	9 (10.0)	
Rectal bleeding	13 (14.6)	11 (12.2)	
Stool occult blood	12 (13.5)	18 (20.0)	
Change of bowel habit	16 (18.0)	18 (20.0)	
Anemia	3 (3.4)	1 (1.1)	
Loss of body weight	3 (3.4)	3 (3.3)	
Other	3 (3.4)	1 (1.1)	
Education level			0.969 ²
Primary school and less	21 (24.1)	21 (24.4)	
High school	38 (42.7)	40 (44.4)	
College and higher	30 (34.5)	29 (33.7)	
Bowel cleansing regimens			0.179 ²
Sodium phosphate	41 (46.1)	51 (56.7)	
Magnesium citrate-bisacodyl	48 (53.9)	39 (43.3)	
Anxiety	3.0 \pm 2.9	3.9 \pm 2.9	0.110 ¹
Antispasmodic agent use	72 (80.9)	75 (83.3)	0.700 ²
Colon preparation			0.276 ²
Good	49 (55.1)	60 (66.7)	
Fair	25 (28.1)	18 (20.2)	
Poor	15 (16.9)	12 (13.3)	

¹Student's *t*-test; ² χ^2 test. BMI: Body mass index.

value of less than 0.05 was considered to be statistically significant.

RESULTS

Between May 2009 and February 2010, 255 patients underwent colonoscopies performed by the two endoscopists at our hospital. Sixty-one patients wished to receive sedation, so they were not invited to participate in the study. Twelve patients were excluded because of prior hemicolectomy (*n* = 6), unwillingness to give written informed consent (*n* = 5), or massive ascites due to carcinomatosis (*n* = 1). The remaining 182 subjects were randomized to the air group (*n* = 90) or the water group (*n* = 92). Three patients were subsequently excluded because of inadequate preparation (one in each group) and severe colitis (one in the water group). The baseline characteristics of the remaining patients in both groups were similar (Table 1).

Incomplete colonoscopy occurred in 1 patient in the air group (1.1%) due to looping. Incomplete colonoscopy also occurred in 1 patient in the water group (1.1%) due to intolerance. However, air insufflation had to be used in 8 patients in the water group before reaching the transverse colon due to poor visibility in 2 patients, and an inability to open the lumen in 6 patients (4 at the sigmoid and 2 at the descending colon). These 8 patients were all subsequently intubated to the cecum.

Table 2 Outcomes of colonoscopy (mean \pm SD) *n* (%)

	Air group (<i>n</i> = 89)	Water group (<i>n</i> = 90)	<i>P</i> value
No. of failed cecal intubations	1 (1.1)	1 (1.1)	1.000 ⁴
Cecal intubation time (min)	4.5 \pm 2.4	6.4 \pm 3.1	< 0.001 ³
Procedure time (min)	13.8 \pm 5.6	14.5 \pm 4.7	0.333 ³
Volume of water used (mL)	26.2 \pm 39.4	322 \pm 80.9	< 0.001 ³
Time of air insufflation during intubation (min)	4.5 \pm 2.4	2.3 \pm 2.6	< 0.001 ³
No. of cases requiring assistant-administered abdominal pressure	51 (57.3)	49 (54.4)	0.764 ⁴
No. of cases requiring change of position	24 (27.0)	17 (18.9)	0.217 ⁴
Patient pain score ¹	3.4 \pm 2.8	2.5 \pm 2.5	0.021 ³
No. of cases without pain	18 (20.2)	32 (35.6)	0.030 ⁴
Patient satisfaction score ²	9.6 \pm 0.8	9.6 \pm 0.7	0.980 ³
No. of cases with polyps	52 (58.4)	44 (48.9)	0.232 ⁴
No. of cases with adenomas	31 (34.8)	32 (35.6)	1.000 ⁴

¹0 = no pain, 10 = worst pain imaginable; ²0 = not satisfied at all, 10 = completely satisfied; ³Student's *t*-test; ⁴ χ^2 test.

The need for abdominal compression, need for changing position and total procedure time were similar between groups (Table 2). The cecal intubation time was shorter in the air group than in the water group (4.5 \pm 2.4 min *vs* 6.4 \pm 3.1 min, *P* < 0.001).

Significantly less water was infused in the air group than in the water group during the procedure (26.2 \pm 39.4 mL *vs* 322 \pm 80.9 mL, *P* < 0.001). The time of air insufflation during the insertion phase was less in the water group than in the air group (4.5 \pm 2.4 min *vs* 2.3 \pm 2.6 min, *P* < 0.001). The mean pain scores, as rated by the patients, were higher in the air group than in the water group (3.4 \pm 2.8 *vs* 2.5 \pm 2.5, *P* = 0.021). Also, more patients in the water group had no pain at all compared to patients in the air group (35.6% *vs* 20.2%, *P* = 0.030). Overall satisfaction with the procedure was similar between groups (9.6 \pm 0.8 *vs* 9.6 \pm 0.7, *P* > 0.05) (Table 2).

Polyps were detected in 52 (58.4%) patients in the air group. Thirty-one (34.8%) of these polyps were adenoma, 5 (5.6%) were tubulovillous adenoma and 3 (3.4%) were carcinoma. Polyps were detected in 44 (48.9%) patients in the water group. Thirty-two (35.6%) polyps were adenoma, 4 (4.4%) were tubulovillous adenoma and 1 (1.1%) was carcinoma (Table 2).

DISCUSSION

The results of this study show that water infusion rather than air insufflation at the rectum and sigmoid is associated with less pain during minimally sedated colonoscopy. In experienced hands, about 35.6% of the patients felt no pain at all. The water was infused manually with a syringe without additional instruments, making this method readily available. Although the limited water infusion group had a longer intubation time than the air insufflation group, the difference was small (less than 2 min). To the best of our knowledge, this is the first study to compare this new water infusion method with traditional air insufflation.

Water infusion to facilitate colonoscopy has been reported by several authors in the past; however it has not been applied frequently. Most authors used water infusion in conjunction with air insufflation. Falchuk *et al.*^[12] found it helpful to infuse up to 300 mL of water into the sigmoid colon while intubating patients with severe diverticulosis. Baumann compared water infusion (200 mL) with traditional air insufflation during colonoscopic examination^[13]. He found that passing through the left colon was faster with the water method than with the air method. Brocchi *et al.*^[6] compared warm water (300 mL) infusion with seed oil and traditional air insufflation during colonoscopic examination. They found that water infusion was associated with a higher cecal intubation rate, shorter intubation time and less pain than in the control group.

Recently, Leung *et al.*^[9] employed a novel method with infusion of a large amount of water during the insertion phase. In their pilot study, airless water intubation permitted 52% of patients to complete the procedure without sedation. A mean volume of more than 1 L of water was infused in aliquots of 30 to 60 mL. The major drawback of this technique was the long intubation time of up to 22.6 min^[9]. In a subsequent randomized, controlled study comparing water intubation with air insufflation, the water was infused intermittently with a peristaltic pump with a blunt needle adaptor through the biopsy channel^[10]. The cecal intubation times were comparable between the two groups. The endoscopists found that the increments of medications and the maximum pain scores were significantly lower with the water method^[10].

Our study showed that a lower mean pain score was experienced in the water group (2.5 ± 2.5) than in the air group (3.4 ± 2.8 , $P = 0.021$). A previous study has shown that patient discomfort occurs when the colonoscope tip reaches the sigmoid colon^[14]. Loop formation of the colonoscope occurring mostly in the sigmoid colon is the major cause of pain^[15]. We infused water instead of air in the rectum and sigmoid colon in our study. By eliminating air in the sigmoid colon, we reduced the loop formation and caused less pain in these patients. The weight of the water might also be helpful in reducing looping over the sigmoid colon.

In the present study, we did not use air insufflation until the scope reached the transverse colon. The infused water accumulated at the descending colon due to gravity when patients were in the left lateral decubitus position. When the scope reached the transverse colon the air was switched on, otherwise much more water would have been needed to open the more proximal colon, which was at non-dependent areas. By limiting the use of water infusion to the distal colon, we could achieve intubation with little water (around 300 mL). This amount of water could easily be infused with a syringe instead of a peristaltic pump.

The intubation time was longer in the water group than in the air group (6.4 ± 3.1 min *vs* 4.5 ± 2.4 min). However, air had to be turned on prematurely in 8 (8.9%) patients in the water group. There are several reasons for

the longer time in the water group. Firstly, it took time to infuse water into the biopsy channel repeatedly with a syringe. Secondly, it was difficult to open a collapsed segment or acute angle at a non-dependent portion without enough water. Thirdly, the view was less clear and the lumen was more difficult to find under water than with air insufflation, especially when the preparation was less than optimal. With a limited amount of water infused, our method had little cleansing effect on colon contents^[8].

The polyp detection rates were similar in our study groups. After opening the lumen adequately with air insufflation and aspirating the residual stools and fluid, we inspected the mucosa closely when we withdrew the scope in both groups, so the infused water did not impair our ability to detect polyps. When the bowel preparation was adequate, we had no difficulty finding a polyp under water during insertion.

In this study, we infused water at room temperature. Some previous studies used warm water^[6,10,16], but others have used water at room temperature^[13,17]. Church *et al.*^[16] showed that warm water minimized colon spasms and decreased patient discomfort. Most of our patients had received intravenous buscopan before colonoscopy, so we did not encounter any colon spasms in this study.

This study has several limitations. The procedures were performed by two experienced endoscopists, since the procedure conditions cannot appropriately be handled by less experienced doctors. The endoscopists were not blinded to the methods, but the patients were blinded. The use of the water method only reduced a small proportion (about 26%) of the pain scores; however the procedure was simple and cost-effective. We did not compare the syringe infusion method with a peristaltic pump method, although this does warrant further studies.

In conclusion, compared with traditional air insufflation, limited infusion of water at the distal colon resulted in less pain in patients undergoing minimally sedated colonoscopy, although a longer intubation time was required.

COMMENTS

Background

Colonoscopy can sometimes be quite painful. Pain during colonoscopy may originate from colon distension caused by air insufflation. Water instillation into the colon can facilitate intubation by straightening the sigmoid colon and decreasing the friction between the scope and the colonic mucosa. The weight of water also helps prevent loop formation.

Research frontiers

Recently, an airless water intubation method was proposed in which water, in lieu of air, was used to open the lumen of the colon. In previous studies, this method was found to decrease the use of sedative medication during sedated colonoscopy. However, a large amount of water was needed to inflate the colon adequately, which might increase procedure time or require an additional peristaltic pump. In this randomized, controlled study, the authors simplified the water intubation method by limiting the infusion of water to the rectum and sigmoid colon.

Innovations and breakthroughs

In the limited water group in the present study, the air pump was turned off initially during the procedure. Tap water in 50 mL syringes was instilled into the rectum and the sigmoid colon through the accessory channel to open the colon lumen. Water was not usually instilled in the descending colon because the

infused water already accumulated in this dependent segment. The air pump was opened when the colonoscope reached the transverse colon. No additional instrument was needed with this method and only about 300 mL of water was used to complete the colonoscopy.

Applications

This article shows that limited airless water infusion in the distal colon reduces patients' pain during colonoscopy. Further research should be done by less experienced endoscopists. In addition, head-to-head comparison of the limited water infusion method with total water infusion is needed.

Peer review

Hsieh *et al* present the results of the largest randomized trial yet performed to assess the value of water instillation to facilitate colonoscopy, here in minimally sedated patients. In general the paper is well written, the methodology is good and the results will generate widespread interest amongst endoscopists.

REFERENCES

- 1 **Rex DK**, Rahmani EY, Haseman JH, Lemmel GT, Kaster S, Buckley JS. Relative sensitivity of colonoscopy and barium enema for detection of colorectal cancer in clinical practice. *Gastroenterology* 1997; **112**: 17-23
- 2 **Lindsay DC**, Freeman JG, Cobden I, Record CO. Should colonoscopy be the first investigation for colonic disease? *Br Med J (Clin Res Ed)* 1988; **296**: 167-169
- 3 **Waye JD**, Bashkoff E. Total colonoscopy: is it always possible? *Gastrointest Endosc* 1991; **37**: 152-154
- 4 **Yoshikawa I**, Honda H, Nagata K, Kanda K, Yamasaki T, Kume K, Tabaru A, Otsuki M. Variable stiffness colonoscopes are associated with less pain during colonoscopy in unsedated patients. *Am J Gastroenterol* 2002; **97**: 3052-3055
- 5 **Hoff G**, Bretthauer M, Dahler S, Huppertz-Hauss G, Saunar J, Paulsen J, Seip B, Moritz V. Improvement in caecal intubation rate and pain reduction by using 3-dimensional magnetic imaging for unsedated colonoscopy: a randomized trial of patients referred for colonoscopy. *Scand J Gastroenterol* 2007; **42**: 885-889
- 6 **Brocchi E**, Pezzilli R, Tomassetti P, Campana D, Morselli-Labate AM, Corinaldesi R. Warm water or oil-assisted colonoscopy: toward simpler examinations? *Am J Gastroenterol* 2008; **103**: 581-587
- 7 **Brandt LJ**, Boley SJ, Sammartano R. Carbon dioxide and room air insufflation of the colon. Effects on colonic blood flow and intraluminal pressure in the dog. *Gastrointest Endosc* 1986; **32**: 324-329
- 8 **Leung FW**, Aharonian HS, Leung JW, Guth PH, Jackson G. Impact of a novel water method on scheduled unsedated colonoscopy in U.S. veterans. *Gastrointest Endosc* 2009; **69**: 546-550
- 9 **Leung JW**, Mann S, Leung FW. Options for screening colonoscopy without sedation: a pilot study in United States veterans. *Aliment Pharmacol Ther* 2007; **26**: 627-631
- 10 **Leung JW**, Mann SK, Siao-Salera R, Ransibrahmanakul K, Lim B, Cabrera H, Canete W, Barredo P, Gutierrez R, Leung FW. A randomized, controlled comparison of warm water infusion in lieu of air insufflation versus air insufflation for aiding colonoscopy insertion in sedated patients undergoing colorectal cancer screening and surveillance. *Gastrointest Endosc* 2009; **70**: 505-510
- 11 **Leung JW**, Salera R, Toomsen L, Mann S, Leung FW. Pilot feasibility study of the method of water infusion without air insufflation in sedated colonoscopy. *Dig Dis Sci* 2009; **54**: 1997-2001
- 12 **Falchuk ZM**, Griffin PH. A technique to facilitate colonoscopy in areas of severe diverticular disease. *N Engl J Med* 1984; **310**: 598
- 13 **Baumann UA**. Water intubation of the sigmoid colon: water instillation speeds up left-sided colonoscopy. *Endoscopy* 1999; **31**: 314-317
- 14 **Shah SG**, Brooker JC, Thapar C, Williams CB, Saunders BP. Patient pain during colonoscopy: an analysis using real-time magnetic endoscope imaging. *Endoscopy* 2002; **34**: 435-440
- 15 **Shah SG**, Brooker JC, Williams CB, Thapar C, Saunders BP. Effect of magnetic endoscope imaging on colonoscopy performance: a randomised controlled trial. *Lancet* 2000; **356**: 1718-1722
- 16 **Church JM**. Warm water irrigation for dealing with spasm during colonoscopy: simple, inexpensive, and effective. *Gastrointest Endosc* 2002; **56**: 672-674
- 17 **Hamamoto N**, Nakanishi Y, Morimoto N, Inoue H, Tatukawa M, Nakata S, Kawai Y, Kurihara N, Ookuchi S, Shizuku T, Yamamoto S, Hamamoto S, Kazumori H, Kinoshita Y. A new water instillation method for colonoscopy without sedation as performed by endoscopists-in-training. *Gastrointest Endosc* 2002; **56**: 825-828

S- Editor Tian L L- Editor Logan S E- Editor Zheng XM