The advantages of water immersion colonoscopy in ambulatory service

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ABSTRACT

Background/Aims: The purpose of this prospective study was to compare patients' discomfort during water immersion (WI) colonoscopy without sedation or available on request, with that of patients during air insufflation (AI) colonoscopy with sedation, in the ambulatory setting.

Material and Methods: A prospective observational study was conducted in 100 patients who performed a colonoscopy between August 2015 and February 2016 in an Ambulatory Gastroenterology Center in Cluj-Napoca, Romania. They were divided into two branches A and B. Patients in Group A underwent a classic colonoscopy with AI and standard sedation (2 mg of midazolam and 50 mg of tramadol), while patients in Group B underwent an unsedated or on demand sedation colonoscopy with WI technique.

Results: The patients in group A presented a higher discomfort (statistically significant) compared to those in group B, and had also the median total discomfort score higher than those in group B. The patients in group A had also a higher discomfort score after examination. The total time of examination was the same in the two groups, but in group B the progression to cecum time was 3 minutes lower than for those in group A. A greater discomfort of the patient was correlated with the longer time required to reach the cecum.

Conclusion: In conclusion, WI colonoscopy is superior to AI technique in reducing insertion pain, progression-to-cecum time, minimizing sedation requirements and also in the willingness to repeat the technique.

Keywords: Water immersion, air insufflation, colonoscopy, pain, discomfort, sedation

INTRODUCTION

Colonoscopy is one of the most commonly used and accurate tests for screening of colorectal cancer and diagnosis of several gastrointestinal diseases (1,2). The rate of patient adherence to colonoscopy procedures performed with gas insufflation is lower than expected due to the discomfort caused by pain, occurrence of complications, or unpleasant experiences faced during pre-colonoscopic preparation of the intestine (1). It is very important for patients to receive complete information about the steps and the benefit-risk ratio of colonoscopy undergoing the procedure (3).

Air insufflation colonoscopy (AI) causes pain due to distension and elongation of the colon and looping at the sigmoid. This technique can be performed in patients without sedation, however, analgesic or sedative agents (propofol, fentanyl, midazolam, etc.) are routinely administered to improve tolerance and patient satisfaction (2). Nevertheless, these medications carry the risk of complications, the most fatal being respiratory and cardiovascular problems (4).

Due to these limitations of AI seen in the last decade, new techniques have been investigated to reduce patient discomfort, one of which is water immersion colonoscopy (WI). WI colonoscopy technique was first described in the 1980s. It was initially used in patients with diverticulosis where the intubation of the sigmoid is difficult (5). In the left lateral position, WI straightens the sigmoid, causes less looping, and produces local distension and colon elongation. In addition, if warm water is infused into the surgical site, smooth muscles spasms in the colon are minimized (6). Due to these reasons, WI decreases colonoscopy pain, requires less or no sedation, and maintains high patient satisfaction (7,8).

The purpose of this prospective study was to compare patient discomfort during WI colonoscopy without sedation or available on request with that of patient discomfort experienced during AI colonoscopy with sedation in an ambulatory setting.

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MATERIALS AND METHODS

The study was conducted according to the principles of the Declaration of Helsinki (1964) and its amendments (Tokyo 1975, Venice 1983, Hong Kong 1989). The clinical protocol was reviewed and approved by the Ethics Committee of the University. As provided in the study protocol, written informed consent in compliance with the current revision of the Declaration of Helsinki was obtained from each subject prior to enrolment, in which they were informed of their rights, obligations, and other study details.

Subjects

A total of 100 patients from an Ambulatory Gastroenterology Center who underwent colonoscopies from August 2015 to February 2016 were enrolled in the study. The patients were divided into two groups: AI group and WI group, based on a random computer-generated list. Patients in AI group underwent a classic colonoscopy with AI and standard sedation (2 mg of midazolam and 50 mg of tramadol), while patients in group WI underwent a non-sedated or on-demand sedation colonoscopy with WI technique. Patients were informed of the group they were assigned to.

Prior to the procedure, the following data were collected from each patient through a questionnaire: the purpose of the examination, the personal medical history, and the body mass index (BMI). Patients were excluded from the study if they met the following criteria: (1) history of partial colon resection or colostomy, (2) indication for sigmoidoscopy, (3) patient refused to sign the informed consent, (4) severe heart failure, severe hepatic, pulmonary or renal disease, and (5) poor bowel preparation (ingestion of up to 2 liters of purgative solution macrogol 4000 instead of the recommended 4 liters prior to colonoscopy).

Colonoscopy

To clean the colon, the patients in both groups received 4 liters of polyethylene glycol solution in split dose fashion: 2 liters the night before and 2 liters early in the morning, 6 hours prior to the colonoscopy. Further, the patients were trained in the importance of good colon preparation. All colonoscopies were performed by one experienced gastroenterologist, using the Olympus 180 colonoscope (Olympus Corp, Hamburg, Germany). Prior to the beginning of this study, the colonoscopist had performed more than 10,000 colonoscopies with AI and about 50 colonoscopies with WI.

The idea of this study was formulated after reading a review article. Our team started using WI technique in order to promptly facilitate the progression of the exploratory scope in the sigmoid and descending colon area, and this technique was found to be very useful. Colonoscopies were performed by placing the patients in the standard left lateral decubitus position during the procedure. For the WI technique, the colonoscope was inserted into the rectum with the air turned on. It was turned off at a distance of 5 cm from the anal verge and the infusion of water at room temperature was started using a peristaltic pump (Erbe Elektromedizin GmbH 2015, Germany) at a rate of 10 mL/sec. Air insufflation was resumed after hepatic flexure. We did not use immersion after passing the hepatic flexure.

Pain assessment and sedation

The first parameter used to evaluate the patient's discomfort was real-time insertion pain. The evaluation was performed by a nurse with 15-year work experience in various endoscopy units. The pain was assessed using the visual analog scale (VAS) with the following scores; 0: absence of pain, 1 or 2: simple discomfort, and 10: worst possible pain. All patients received VAS information from the nurse before the procedure and were informed that this information was not intended to make the examination uncomfortable, rather it was important to warn the physician to take necessary measures to minimize patient discomfort (e.g., removal of colon content, change of patient position, or recommendation of an analgesic agent).

The nurse asked the patients about their discomfort or pain at regular intervals during the colonoscopy (every 2-3 minutes). The patient's response was recorded. This pain score was a relevant measure to guide the need for sedation medication (dosage of analgesic drugs) for the patient during the colonoscopy. If the patient discomfort score reached 7 or greater, the patients received supplemental sedation of 1 mg of midazolam (maximum dose used was 5 mg of midazolam). We recorded the pain score in real time during colonoscopy and after the procedure, we calculated the average of this score. The result obtained was considered the median score of the pain.

Post examination score measures

Other secondary outcomes included overall discomfort after the procedure and the patient's willingness to repeat the examination. Post-procedural discomfort was recorded 5 minutes after the colonoscopy by the same nurse who recorded the discomfort during colonoscopy. The discomfort was evaluated using a different scale

from the VAS. This scale had 4 levels; 0: discomfort absent, 1: minimal discomfort, 2: moderate discomfort, and 3: severe discomfort. The total procedure time was also recorded. Prior to discharge, the patient received a telephone number to contact the team if they had any questions.

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences software (SPSS Inc., version 17, Chicago, IL, USA). Quantitative variables were tested for normality of distribution using the Kolmogorov-Smirnov test.

Descriptive analysis included frequencies of ordinal variables, mean±standard deviation for normally distributed continuous variables and median for non-normally distributed continuous or ordinal variables. Differences in means between the groups were assessed with the T-test for normally distributed continuous variables. Differences in medians between the groups were analyzed using the Mann-Whitney test for non-normally distributed continuous or ordinal variables.

The correlation between continuous variables was assessed using Spearman's correlation. The Chi-square test was used to compare categorical variables. Multivariate analysis was performed using linear regression when the dependent variable was continuous. Ordinal regression was used when the dependent variable was ordinal. The level of statistical significance was set at $p<0.05$.

RESULTS

Baseline characteristics

A total of 100 patients were randomly allocated to AI group (n=50) and WI group (n=50). The mean age of patients in AI group was 50.46±17.1 years and the mean age of patients in WI group was 49.9±13.96 years. The baseline data (age, sex, and BMI) were comparable in the two groups (Table 1).

Real-time insertion pain

Patients in the AI group presented a higher discomfort (statistically significant) compared to those in the WI group (OR: 10.5, 95% CI: 1.52-3.18, $p<0.001$), and also showed the median total discomfort score higher than those in the WI group (score of 7 vs. score of 3, $p<0.001$) (Table 2).

Further, gender differences were observed using the total discomfort score because women had a higher discomfort score (OR: 2.43, p=0.01, 95% CI: 0.15-1.61) as compared to men. There was no statistically significant correlation between age and total discomfort score (Spearman's correlation rho; r=-0.20; p=0.93).

Post examination score

The median post-examination discomfort score in the AI group was 1, while the mean post-examination discomfort score in WI group was 0 ($p<0.001$) (Table 2). The patients in the AI group had a higher discomfort score after the examination (OR: 22.3, 95% CI: 1.18-5.03, p=0.002). There was no statistically significant correlation between post-examination score, sex (Mann-Whitney test; p=0.52), and age (Spearman's correlation rho; r=0.049; p=0.63).

Sedation

As seen in Table 2, a significantly higher proportion of those in the AI group received additional sedation compared to those in the WI group (46 patients vs. 6 patients, p=<0.001). Additionally, the median dose of midazolam used in AI group was 3 mg, and the median dose in the WI group was 1.8 mg (p=<0.001) (Table 2). The total procedure time was the same in the two groups, but the cecal intubations time in WI group was 3 minutes slower than that of the AI group (Table 3). Cecal intubation rate was 92% (n=46/50) in the AI group due to looping and 98% (n=49/50) in the WI group due to intolerance. No procedure was interrupted due to any adverse event.

There was a statistically significant correlation between the cecal intubation time and the total discomfort score (Spearman's rho; r=0.565; $p<0.001$). Greater patient discomfort was correlated with longer time required to reach the cecum.

DISCUSSION

Colonoscopy is the standard procedure used for screening and diagnosing many intestinal diseases, from hemorrhoids to neoplastic lesions. An important factor to be considered during this procedure is the patient's discomfort, which can potentially limit the scope of the procedure. Thus, the colonoscopy team should continually assess the patient's discomfort during the procedure. When using propofol, the presence of an anesthetist is mandatory.

Our results confirm the data from previous publications which suggested that the WI technique produced less insertion pain than AI colonoscopy (5,7). We also demonstrated that the WI technique reduced the number of patients who required additional anesthesia (6 patients

Table 1. Water-aided colonoscopy and air insufflation colonoscopy: baseline characteristics and indications of 100 patients.

Variable	AI	WI	p
Age (mean±SD, years)	50.46±17.11	49.9±13.96	0.86*
Male (number of patients)	24	26	1**
Female	26	24	1**
BMI (kg/m2) mean±SD	27.35±5.51	26.27±3.83	0.26*
Indications for colonoscopy			
1. Screening	4	9	0.28**
2. Rectal Bleeding	17	12	0.27**
3. Surveillance	3	7	0.36**
4. Pain as main symptom	10	13	0.76**
5. Other indications	16	9	0.11**
(diarrhea, or constipation)			

*T-Test; ** Chi-square test.
AI: classic colonoscopy with air insufflation; WI: water immersion colonoscopy.

Table 2. Patient assessment and use of sedation.

Variable	AI	WI	p
Midazolam dosage (mg) (mean)	3	1.8	<0.001***
Additional sedation (number of patients)	46	6	<0.001**
Total discomfort score (mean)	7	3	<0.001***
Post-examination discomfort (mean)	1	0	<0.001***
Willingness to repeat	23	49	<0.001***

vs. 46 patients) and the amount of anesthetic/analgesic drugs used (1.8 mg vs. 3 mg).

Devising new techniques to reduce pain during colonoscopy allows clinicians to perform these procedures without sedation being a priority. Colonoscopy done using sedation carries with it the obvious disadvantages of increased cost, presence of sedation complications, increased time taken to return to normal activity, and requirement of an additional person to transport the patient after the procedure (9).

It has been shown that the WI technique reduces pain during insertion by avoiding loop formation, minimizing distension, and reducing colon elongation (10,11). Further, water is considered by some colonoscopists an important lubricating agent that can alleviate pain during the procedure (12).

Although the standard sedation method uses midazolam and an opioid, in many countries the combination

Table 3. Examination Time[1]

Time	AI	WI	p
Cecal intubations time (minutes)	8	5	<0.001***
Total procedure time (minutes)	15	15	0.34***

[1]*** Mann–Whitney Test

of propofol and midazolam is the first option. Thus, numerous colonoscopies are performed under anesthesia with propofol, an agent with rapid onset of action and a high sedation level (13). This type of sedation is difficult to perform in an ambulatory setting because the drug is required to be administered by a person trained in general anesthesia. Furthermore, there are a few disadvantages in terms of patient satisfaction or rapid discharge from the endoscopy unit (14). Currently, this technique is widely available and has been demonstrated as a safe procedure and a less costly tool than AI colonoscopy. It is important that the WI procedure be performed by the endoscopy team (gastroenterologist and nurses) without the support of the anesthetist, especially for outpatients. It is recommended as the first option, especially in patients known to present with a redundant colon (15).

In our country, methods of optimizing and implementing colonoscopy performance without sedation (e.g., patient acceptance) should be encouraged and patients should be provided with complete information about this procedure. Furthermore, an anesthetic-assisted colonoscopy might be a problem, especially for active patients. The main reason for refusing the procedure is that patients need to take time off work after the intervention and need to be assisted for a few hours after the procedure, especially those who drive. Another reason for which anesthetic-assisted colonoscopy is a problem is the shortage of anesthetists in our country (16).

Gender differences between women and men were also observed. Females have already been identified as being at risk for moderate or severe pain during colonoscopy (17). A probable reason for their increased sensitivity to pain is due to the specific pelvis anatomy, colon length, and lower muscle tone in women as compared to men. These characteristics predispose females to loop formation in the sigmoid colon, which can contribute to increased pain (18). In contrast to insertion pain, the post-examination scores did not depict significant differences between women and men.

Although the total procedure time was similar in both AI and WI groups (15 minutes vs. 15 minutes), the mean ce-

cal intubation time was significantly lower in the WI group that in the AI group (5 minutes vs. 8 minutes, respectively; p<0.001). In addition, to support our expectations, we evaluated the patients' desire to repeat the procedure and only 46% of the AI group responded positively as compared to 98% in the WI group.

WI colonoscopy is advantageous in that the endoscopist can disregard sedation and concentrate completely on manipulating the colonoscope.

The limitations of our study are that the colonoscopists and assistant nurses were not blinded. An additional measure taken to reduce bias was that the colonoscopist was not involved in collecting the pain score.

Colonoscopy remains the primary method of screening for colorectal cancer (19). However, this is not a perfect tool and needs continuous improvement in order to increase both the quality of the procedure as well as patient satisfaction.

In conclusion, WI colonoscopy is superior to AI colonoscopy in reducing insertion pain, and cecal intubation time, minimizing sedation requirements and also propagating a willingness among patients to repeat the technique. The multiple benefits of this technique are very useful, especially in the ambulatory setting.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of "Iuliu Hatieganu" University of Medicine and Pharmacy.

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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