

## **WHICH IS MORE EFFECTIVE: AIR INSUFFLATION COLONOSCOPY OR WATER-ASSISTED COLONOSCOPY TECHNIQUE IN ADDITION TO STANDARD COLONOSCOPY TECHNIQUE?**

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### **ABSTRACT**

**Objective:** We aimed to compare success of traditional colonoscopy with alternative water-assisted colonoscopy technique.

**Material and method:** This prospective study included 147 patients meeting inclusion criteria who presented to Gastroenterology Department of Manisa Celal Bayar University, Medicine School January, 2016 and December, 2017 and were considered to have colonoscopy indication. In all patients, colonoscopy was performed by a single endoscopist with 17 years of experience. Seventy-six patients underwent water-assisted colonoscopy while 71 patients underwent traditional air insufflation colonoscopy. The 2 groups were prospectively included to the study.

In the study, we assessed following parameters in both techniques: 1) we detected cecal intubation rate and time to cecal access; 2) we calculated pain symptom index during procedure; 3) we asked patient whether he/she will be willing to undergo same procedure; 4) we evaluate whether there is difference in detection rate of colorectal disease (such as polyp, ulcer, cancer, diverticulitis, angiodysplasia) between groups.

**Findings:** Time to cecal access was shorter in water-assisted colonoscopy with minimal sedation when compared to traditional air insufflation colonoscopy. In water-assisted colonoscopy, cecal intubation was achieved in 68 patients (89.47%) while it was failed in 4 patients (5.2%) and they were excluded. In traditional air insufflation colonoscopy, cecal intubation was achieved in 69 patients (97.18%) while it was failed in one patient (1.4%) and patient was excluded.

The pain index was rated from 0 to 5 points. The pain index was lower in water-assisted colonoscopy than traditional air insufflation colonoscopy (mean pain index: 2.66 vs. 3.23;  $p < 0.05$ ). A colorectal disease was detected in 36 patients (50%) underwent water-assisted colonoscopy whereas in 48 patients (68.5%) underwent air insufflation colonoscopy, indicating no significant difference ( $p > 0.05$ ).

**Conclusion:** Cecal intubation is faster and associated to less pain in water-assisted colonoscopy when compared to traditional air insufflation technique. There is no significant difference in patient satisfaction. However, colorectal disease detection rate and cecal intubation rate are comparable among groups.

**Keywords:** Water-assisted colonoscopy, air insufflation colonoscopy, time to cecal and ileal access

## INTRODUCTION

Colorectal cancer is one of the most common cancers worldwide. It is third most common cancer among men whereas second most common cancer among women. Early diagnosis improves life expectancy and decreases mortality [1, 2].

Despite technologic advances, colonoscopy remains to be most valuable tool in screening and diagnosis of colorectal cancer. Currently, traditional air insufflation is most commonly used technique in colonoscopy. However, distressing air distention and intestinal loop may develop during the procedure, resulting in pain. Thus, patients require sedo-analgesia and time to cecal and ileal access and lesion detection rate in colon depend on skills of endoscopist [3, 4, 5].

In 1989, it was reported for the first time that water-assisted colonoscopy is better in colonoscopic procedure than air insufflation alone in reducing colonic spasm [6]. It was reported that colon could be visualized more clearly with lesser loop development and angulation during water-assisted colonoscopy.

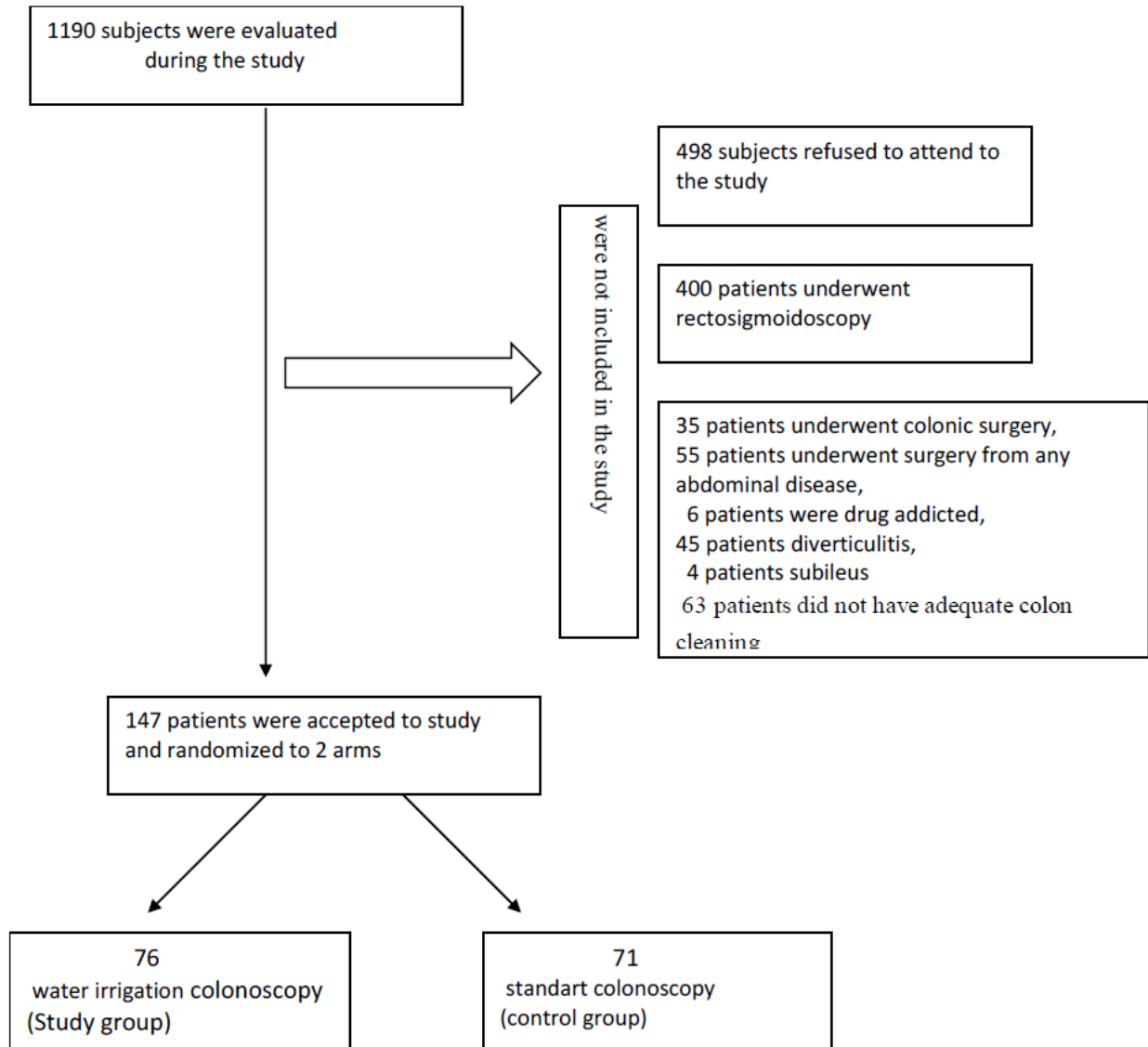
In previous studies, it was shown that need for sedation was lower and that colonoscopy can be performed minimal sedation. In addition, it was reported that cecal and ileal intubation is better in water-assisted colonoscopy. There are contradictory results about polyp detection rate and time to cecal and ileal access in water-assisted colonoscopy in comparison to standard air insufflation colonoscopy.

There are studies reporting differences in colonic polyp and disease detection rate, time to cecal and ileal access and pain during procedure between colonoscopy using water and air after access to rectum and colonoscopy using air alone.

In most studies, colonoscopy was performed by several clinicians and results might differ based on differences in experience and skills of endoscopist.

In this study, our aim was to evaluate whether there are differences between these two techniques and to reveal whether differences, if present are relevant by a study design in which all colonoscopy procedures were performed by a single endoscopist.

**Schema 1: Study design**



**MATERIALS AND METHODS**

This randomized-controlled study was performed at Endoscopy Unit of Gastroenterology Department of Manisa Celal Bayar University, Medicine School.

The study included 147 patients meeting inclusion criteria among 1249 patients who presented to Gastroenterology Department of Manisa Celal Bayar University, Medicine School January, 2016 and December, 2017 and were considered to have colonoscopy indication. The study was

approved by Institutional Ethics Committee (approval #: 20478486-050.04.04). All patients gave written informed consent before participation.

In all patients, procedure was documented. The patients were randomly assigned into 2 groups. Standard air insufflation colonoscopy was performed in one group while water-assisted colonoscopy was performed in the second group.

All patients were asked to consume liquid diet beginning 3 days before procedure. Two oral BT solutions (45 mL; sodium dihydrogen phosphate plus disodium hydrogen phosphate) were used at the night before procedure for colonic cleansing.

In all patients, colonoscopy was performed by a same endoscopist with experience of 17-years and more than 10,000 colonoscopy procedures.

All patients were positioned to left lateral decubitus position. Intravenous line was inserted by a nurse and clinician. In all patients, low-dose sedo-analgesia (2 mg midazolam plus 10 mg butyl scopolamine) was given. In 76 patients (39 men, mean age: 51.45 [25-89] years and 37 women, mean age: 50.15 [25-79] years) undergoing water-assisted colonoscopy, 100 cc water at room temperature (24°C) was given from colonoscopy canal after reaching rectum. A chronometer (with minute and second display) was started at beginning of colonoscopy.

As control group, air insufflation colonoscopy was performed in 71 (45 men, mean age: 55.74 [24-83] years and 26 women, mean age: 51.80 [34-68] years) of 147 patients with colonoscopy indication. The same low-dose sedo-analgesia procedure was employed in this group of patients. Cecal intubation was performed by air insufflation. Time to cecal access was recorded. After cecal access, lumen and mucosa were visualized by air insufflation. Cecal intubation was failed in 4 patients from study group and in one patient from control group; thus, these patients were excluded from study.

The following parameters were compared between groups: 1) cecal intubation rate; 2) time to cecal access; 3) pain score as rated from 0 to 5 points (0: no pain; 1: mild pain; 2: distention and abdominal gas; 3: sharp pain at abdomen; 4: severe pain, not intractable; 5: severe pain, intractable); 4) detection rate of colorectal disease (such as polyp, ulcer, cancer, diverticulitis, angiodysplasia); and 5) patient comfort and willingness for repeated procedure.

**Exclusion criteria:**

- 1) Previous colon surgery
- 2) Unwillingness to provide informed consent,

- 3) Age<18 years
- 4) Colon stricture
- 5) Failure to cecal intubation
- 6) Known inflammatory bowel disease
- 7) Severe cardiac failure
- 8) History of acute infarction
- 9) Drug addiction (narcotics or benzodiazepines)
- 10) Acute peritonitis and diverticulitis

**Analysis:** During study period, overall 1190 patient presented to our clinic fro colonoscopy. Of these, 490 patients didn't accept to participate to the study. Rectosigmoidoscopy was performed in 400 patients. There was history of previous colorectal surgery in 35 patients, history of abdominal surgery in 55 patients. We excluded 6 patients due to drug addiction 45 patients due to diverticulitis, 4 patients due to and 63 patients due inadequate colonic cleansing. Overall, 147 eligible patients were randomly selected for study. Of these, water-assisted colonoscopy was performed in 76 patients while traditional air insufflation colonoscopy was performed in 71 patients.

**Statistical analysis:** The Mann-Whitney *U* test was used. A *p* value of <0.05 was considered as statistically significant. Data were compared by  $\chi^2$  (SPSS 24.0 for Windows; SPSS Inc., Chicago, IL) or Fisher exact tests where appropriate. A *p* value of <0.05 was considered as statistically significant.

## **FINDINGS**

Mean time to cecal access was 5.15 (2-14) minutes in water-assisted colonoscopy whereas 5.79 minutes in air insufflation colonoscopy.

Cecal intubation was failed in 4 patients (5.2%) in water-assisted colonoscopy and in one patient (1.4%) in air insufflation colonoscopy. All of 5 patients were excluded from study. Mean pain index was 2.66 in water-assisted colonoscopy whereas 3.23 in traditional air insufflation colonoscopy ( $p<0.05$ ). In water-assisted colonoscopy group, 65 patients (90.27%) reported that he/she would be willingness to undergo repeated procedure and 7 patients (10.0%) reported dissatisfaction with procedure. In the control group, 61 patients (87.0%) reported satisfaction while 9 patients (13.0%) reported dissatisfaction with procedure ( $p>0.05$ ).

When detection rate of colorectal disease was considered, the colorectal disease (polyp, ulcer, cancer, diverticulitis, angiodysplasia) was detected in 36 (50%) of 72 patients underwent water-assisted colonoscopy whereas in 48 (68.5%) 70 patients underwent air insufflation colonoscopy (Table 1).

**Table 1: Characteristics of study and control groups**

	Water-assisted colonoscopy (Study group) n:72	Traditional colonoscopy (control group) n:70	P
Male/Female Age (mean)	51.45/50.15	55.76/51.80	>0.05
Number of cecal intubation(%)	68(94.44%)	69(98.57%)	>0.05
Time to cecal access (min) (mean)	5,15 (2-14)	5.79 (2-16)	<0.05
Pain index (mean)(0-5)	2,66	3,23	<0.01
Willingness to repeated colonoscopy (%)	65(90,27%)	61(87%)	>0.05
Lesion detection rate (Polyp, ulcer etc)	36(50%)	48(68.5%)	>0.05

## DISCUSSION

Colonoscopy is a widely used diagnostic method in diagnosis and treatment of colon disorders. In particular, it is best tool for colorectal screening, treatment of early colon cancers, assessment of suspicious lesions seen on barium enema, treatment and assessment of inflammatory bowel disorders, assessment of terminal ileum, evaluation of cancer development in high-risk patients such as those with inflammatory bowel disorder and in patients with family history of colon cancer and polyps, familial polyposis syndromes and hereditary nonpolyposis colon cancer, colorectal cancer screening in individuals aged  $\geq 50$  years, patients with lower gastrointestinal bleeding, , screening of patients with symptoms lower abdominal pain, distention or diarrhea, and follow-up after polypectomy and colon cancer treatment [1].

In addition, it is also used for therapeutic purposes (polypectomy, hemostasis in hemorrhagic disorders, dilatation and stent implantation in case of stricture, treatment of radiation proctitis,

labeling before surgical resection, foreign body removal, hemorrhoid ligation, decompression) [2].

The contraindications for colonoscopy include peritonitis, acute diverticulitis, recent acute myocardial infarction and pulmonary embolism, fulminant colitis, shock, severe colonic hemorrhage, advanced cardiovascular disease, poor bowel preparation, coagulopathy, and complete colon obstruction [3].

Colon cancer accounts for 7% of all cancers in Turkey (Turkish Statistics Institute, Cancer-related death statistics, 2009). In USA, it is the second common cause of cancer-related deaths. Annually, 150,000 new colorectal cancer diagnoses are made in USA, resulting in 60,000 deaths. Colorectal cancer incidence shows a wide geographical variation. Its incidence is higher in USA and Europe than developing countries, which is thought to be due to environmental factors. In individuals emigrating from low-risk countries to high risk countries, colorectal cancer incidence is increased up to levels in high-risk country. Although specific gene mutations have been defined in both sporadic and hereditary colorectal cancers, it has been proven that some diets lead increases the risk for colon cancer [4].

Ileoscopy is evaluation of mucosa and lumen by intubation of terminal ileum via colonoscopy. Ileoscopy isn't performed frequently in practice due to patient intolerance, need for additional time, belief of low diagnostic utility and difficulty in ileocecal intubation although it is an integral component of colonoscopy. Cecal and ileal intubation is difficult or failed during colonoscopy in some cases but it is reported that ileoscopy is a useful method in some disorder such as chronic diarrhea, lymphoma, tuberculosis, Behçet's disease, ileal infections and inflammatory bowel diseases that may involve terminal ileum [5].

In previous studies, it was reported that there are differences in time to cecal access and cecal intubation rate, patient comfort and lesion detection rate between air insufflation and water-assisted colonoscopy because of difficulty in intubation of ileum and ileocecal valve, additional time and discomfort during colonoscopy [8-11].

In a meta-analysis of 9 studies (1283 patients) comparing standard air insufflation with water immersion by Rabenstein et al., it was reported that there was no significant difference time to cecal access, poly detection rate but there was significantly less abdominal pain and lower sedation and/or analgesic need in patients received warm water during colonoscopy ( $p < 0.00001$ ) [8].

In a study using water enema during colonoscopy, Hammoto et al. performed colonoscopy in 259 patients by assigning patients into two groups. In group 1, 500-1000 cc water with enema was instilled to colon at start of colonoscopy. In group 2 (control group), 129 patients underwent

traditional air insufflation colonoscopy. Authors compared time to cecal access, disease detection rate, patient discomfort during colonoscopy between groups. They found that there was no significant difference in cecal intubation rate (95.4% vs. 96.1%) and disease detection rate (30% vs. 32.6%) but time to cecal access was significantly shorter in group 1 (10.5 min) than group 2 (16.2 min) ( $p < 0.0001$ ). In addition, it was reported that abdominal pain was found to be 17.1% in group 1 and 33.3% in group 2 ( $p < 0.001$ ). Authors concluded that there is less discomfort with shorter time to cecal access in water-assisted colonoscopy technique but no difference in disease detection rate and cecal intubation time [9].

In a study comparing water-assisted colonoscopy with minimal sedation and air insufflation colonoscopy in 229 patients, Leung et al. reported that cecal intubation rate was 79% in water-assisted colonoscopy and 47% in traditional colonoscopy ( $p < 0.02$ ); in addition, times to cecal access were  $13 \pm 7.5$  and  $20.5 \pm 13.9$  minutes, respectively ( $p < 0.0001$ ). Authors reported comparable satisfaction rates and malignancy detection rates between groups but less abdominal pain in water-assisted colonoscopy ( $p < 0.001$ ) [10].

In a meta-analysis of 18 studies (2797 patients) comparing water-assisted colonoscopy and standard air insufflation colonoscopy, Hu et al. found that cecal intubation rate was higher ( $p < 0.005$ ) while time to cecal access was shorter ( $p < 0.04$ ) in water-assisted technique when compared to air insufflation colonoscopy. In addition, authors reported that there was less abdominal pain among patients underwent water-assisted colonoscopy than traditional colonoscopy ( $p < 0.001$ ). In the meta-analysis, no significant difference was found in poly detection rate but rate of willingness for repeated colonoscopy was found to be significantly higher in water-assisted technique when compared to traditional air insufflation method ( $p < 0.01$ ) [11].

In our study, there was no significant difference in willingness and satisfaction between water-assisted and air insufflation colonoscopy groups. This may be due to less water (100 ml) during colonoscopy in our study.

Table 2 presents studies comparing water-assisted colonoscopy and traditional air insufflation colonoscopy worldwide.



**Table 2**

	Country	Count (n) Water-assisted/ air insufflation colonoscopy	Gender Male/female Water-assisted/ air insufflation colonoscopy	Age(Mean) Water-assisted/ air insufflation colonoscopy	Sedation	Water temperature	Cecal intubation(min) Water-assisted/ air insufflation colonoscopy	Volume (ml)
Park et al. (12)	Korea	41/39	20/21 20/19	56/52	<b>No sedation</b>	36 °C	7.1+/-3	200
Radoelli et al. (13)	Italy	116/114	68/48 66/48	58/59	Optional	37°C	7(5-11) 5(4-8)	
Hsieh et al. (14)	Taiwan	90/89	49/41 51/38	57/58	Minimal	Room temperature	6.4+/-3.1 4.5+/-2.4	80-90
Leung et al. (15)	USA	50/50	49/1 50/10	61/58	Optional	37°C	13.1+/-8.1 11+/-3	755
Raminez et al. (16)	USA	177/191	170/7 185/6	60/55	Sedatized	Room temperature	6.9+/-0.3 5.3+/-0.3	
Ryu et al. (17)	Korea	48/53	23/25 34/19	51	Optional	30°C	6.2+/-0.5 8.4+/-0.6	300
Falt et al. (18)	Czech	100/101	52/48 54/47		Minimal	Room temperature	8.8+/-4.8 7.8+/-4.5	120

In a study on 117 patients, Park et al. reported that cecal access was achieved in shorter time by water-assisted colonoscopy when compared to traditional air insufflation colonoscopy [12].

In a study by Radoelli et al., pain score was found to be lower with better tolerance in water-assisted colonoscopy ( $p < 0.05$ ) but no difference was found in additional sedo-analgesia requirement and cecal intubation rate ( $p > 0.05$ ) and adenoma detection rate was found to be lower in water-assisted colonoscopy (25% vs. 40.1%;  $p = 0.013$ ) [13].

In a study by Hsieh et al., it was reported that adenoma detection rate was lower in water-assisted colonoscopy than air insufflation colonoscopy [19].

In our study, time to cecal access was shorter in water-assisted colonoscopy with minimal sedation when compared to traditional air insufflation colonoscopy ( $p < 0.05$ ). Pain score was lower in patients underwent water-assisted colonoscopy ( $p < 0.01$ ). Our results are in agreement with literature; however, there are discrepant results regarding cecal intubation time and amount and temperature of water used in the literature (Table 2).

In water-assisted technique, fewer loops occur in sigmoid colon. Thus, colonoscopy is better tolerated with less pain and no additional analgesia or sedation is needed.

Image quality may be limited in water-assisted colonoscopy. In our study, although lesion detection rates (ulcer, malignancy, diverticulitis, angiodysplasia) seemed to be lower in water-assisted technique when compared to traditional air insufflation colonoscopy, no significant difference was found between groups ( $p>0.05$ ).

No electrolyte disorder related to water instillation was detected during water-assisted colonoscopy in our study.

## **CONCLUSION**

In this study, we found that time to cecal access was shorter with higher patient satisfaction and that pain score was lower with minimal sedo-analgesia in water-assisted colonoscopy technique. However, detection rate of colorectal pathology was lower in water-assisted colonoscopy when compared to traditional air insufflation technique.

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