



Comparison of Water Aided Technique in Colonoscopy versus Air Insufflation Colonoscopy

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ABSTRACT

Background: Colonoscopy is a common diagnostic and therapeutic method for assessing the lower gastrointestinal system. This study aimed to compare the differences between water immersion, water exchange and air insufflation colonoscopy under good bowel preparation conditions. **methods:** Randomized controlled trial study was conducted in 30 patients who performed a colonoscopy between January 2023 to July 2023 in internal medicine department, hepato-gasterontrology unit at Zagazig University Hospitals, equally divided into three groups; Group A: Air insufflation who were submitted to traditional method with minimal insufflation, with warm water used to wash residual stool. Group 2: Water immersion who were submitted to infusion with clean water to improve the visibility of the intestinal lumen. Group 3: Water exchange participants were subjected to infusion using an insertion strategy that included gasless insertion to the cecum, maximizing cleanliness during insertion, and preventing colon distension through excess water removal and residual air preparation. **Results:** there was no statistical significant difference regarding use of anesthetic drugs or time of procedure. Regarding result of colonoscopy (internal piles was the most prevalent result; 40%, 40% and 70% within air insufflation, water immersion and water exchange groups). Regarding cecal intubation time; difference is significant between air insufflation and water immersion group where time is significantly higher in air insufflation group as compared to water immersion group) $p \leq 0.001$. **Conclusion:** Water exchange colonoscopy is superior to Water immersion, in reducing insertion pain, and cecal intubation time, minimizing sedation requirements.

Keywords: Colonoscopy, Air insufflation, Water immersion, Water exchange.

INTRODUCTION

Colonoscopy is a diagnostic and therapeutic procedure used to inspect the terminal ileum, which is the distal part of the small intestine, as well as the large intestine (colon, rectum, and anus). Through these additional channels, we can evaluate, biopsy, and remove mucosal lesions using various types of biopsy devices thanks to the visual information provided by the camera, allowing us to

spot anomalies as well as colonic wall overgrowth [1].

Colonoscopies can be done for a variety of reasons. There are two categories of indications: both therapeutic and diagnostic. Additionally, diagnostic cues can be separated into screening and elective categories. Depending on the patient's risk (low vs. high), to screen for colorectal cancer, screening colonoscopies are performed [2].

Air insufflation (AI), which works by inhaling air into the big bowel to expand the gut lumen, is used to perform traditional colonoscopies. However, an excessive air infusion could result in discomfort like stomach pain [3].

Water aided colonoscopy includes water immersion and water exchange. Several small single center studies have suggested that the use of water rather than air insufflation during colonoscopy reduces pain on insertion. Water-aided method for colonoscopy can be broadly subdivided into two major categories. Water Immersion (WI), characterized by suction removal of the infused water predominantly during the withdrawal phase of colonoscopy, and Water Exchange (WE), characterized by the gasless insertion to the cecum in clear water, minimizing distension and suction removal of infused water predominantly during the insertion phase of colonoscopy. Several studies showed that WE significantly reduces pain compared to WI and colonoscopy with traditional air insufflation (AI). Water exchange is an alternative colonoscopy technique that may reduce discomfort, time to reach the cecum and facilitate insertion of the instrument [4]. Therefore; this study aimed to compare the differences between water immersion, water exchange and air insufflation colonoscopy under good bowel preparation conditions

METHODS

After taking approval from Institutional Review Board (IRB#10646-29-03-2023) Zagazig University and written informed consent was obtained from all participants, we designed a randomized controlled trial using a computer software program that generates the random sequence. This study was conducted on patients aged 18–80 who were willing to undergo screening or diagnosis of colonoscopy in the Internal Medicine Department hepatogastroenterology unit at Zagazig University Hospitals from January 2023 to July 2023. Equally divided into three groups 10 in each group; group 1 Air insufflation, group 2 Water immersion, group 3 Water exchange were submitted. The study was done according to the Code of Ethics of the World Medical Association

(Declaration of Helsinki) for studies involving humans.

Exclusion criteria were patients who refused to participate in the study. Patients who had undergone partial or complete colectomy. Patients with poor bowel preparation before colonoscopy, Patients who requested to undergo colonoscopy with sedation. Patients with other causes of abdominal pain known before the procedure. Patients with any symptoms or signs of colonic obstruction. Patients with severe co-morbidity.

All patients underwent history taking with special emphasizing on diagnosis age and time of onset were used to estimate disease duration, social habits, and history of co-morbidities included the history of gastrointestinal tract and drugs taken, complete physical examination including general examination and local abdominal examination and Laboratory Investigations In order to obtain an accurate Complete Blood Count (CBC) sample, venous blood required to be properly mixed after being anticoagulated with ethylene diamine tetraacetic acid (EDTA). Because certain tests' results are affected by extended periods of storage, the test was conducted within 6 hours after acquiring the blood sample. The sample was then analyzed by an automated cell counter to get the TLC count values “Sysmex XN-2000™ Hematology System” (Sysmex Corporation), as well as the evaluation of peripheral blood smears stained with Leishman's solution for differential leucocytic count to determine eosinophils. Viral Screening (HBsAg, HBcAb, and HIVAb). Kidney function tests (serum creatinine and blood urea). Examples of tests for evaluating liver function include alanine and aspartate transaminase, alkaline phosphatase, gamma-glutamyl transferase, and serum bilirubin.

All patients underwent a bowel preparation with 4L of polyethylene glycol electrolyte lavage solution on divided doses. This preparation was critical for colonoscopy because it permitted visualization of the entire colonic mucosa and increased the safety of therapeutic maneuvers. In our study, colonoscopies for the three groups (the water immersion group, the water exchange group, and the air insufflation group) were carried

out by skilled endoscopists. Before a colonoscopy, blood pressure, body temperature, respiration rate, pulse, and oximetry and electrocardiography had been monitored.

The colonoscope's shaft was coated with gel before being introduced into the lumen from the anus at the start of the procedure. The colonoscope might then be moved through the lumen all the way to the cecum and even the terminal ileum beyond that. The colonoscope was removed in not less than 6 minutes. The patient's basic features, abdominal pain score, cecal intubation rate (CIR), and cecal intubation time were noted during the colonoscopy.

Randomization

Patients were randomly allocated by computer generated simple randomization table into three equal groups according to the method used (10 patients each);

Group I (Air Insufflation method): Colonoscopy was conducted by traditional method with minimal insufflation, with warm water used to wash residual stool. The patient is positioned in the left lateral position to begin the colonoscopy.

Group II (Water Immersion method): In order to avoid inadvertent insufflation, we turned off the air pump before starting the procedure. The volume of water that was infused into the colon in order to improve the visibility of the intestinal lumen was not restricted. Instead of trying to maximize colon cleanliness, the water was infused primarily to open the lumen. When necessary, opaque water was drained away to speed up the process without sacrificing cleanliness. To avoid the unclean content, residual air spaces were utilized. The majority of the infused water was eliminated during withdrawal figure 1.

For Group III (Water exchange): Water exchange (WE), a variant of WI. During this step, all leftover air pockets were aspirated. The suction port was retained in the lumen's center (the tip of the colonoscope moves along the colon wall at 11 o'clock). When the lumen ahead was not visible, the instrument was slightly retracted to allow for

water exchange, and the infusion was restarted. During insertion, the majority of the infused water was withdrawn figure 2.

Pain was assessed using a visual analogue scale (VAS) with a score 0=absence of pain, 2=simply "discomfort", 10=the worst possible pain were primary outcomes. Secondary outcome measures were the sedation medication was administered based on the patients' confirmation that the pain is no longer tolerable, and not at the colonoscopist's discretion. No more sedatives or analgesics were given. Patients' requests for sedation during the colon segment were noted. Cecal intubation rate was defined as the amount of time the colonoscope's tip was advanced past the ileocecal valve before the medial wall of the cecum was visible. The duration it takes for the colonoscope to go from the rectum to the cecum was called the cecal intubation period. The overall satisfaction of cases were assessed as (dissatisfied, satisfied or very satisfied) and the overall experience was assessed as (acceptable, comfortable or embarrassing).

Statistical analysis

Data analysis was performed using the software SPSS (Statistical Package for the Social Sciences) version 26 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). Categorical variables were described using their absolute frequencies and were compared using chi square test, and Monte Carlo tests when appropriate. To compare ordinal data between two groups, chi square for trend test was used. Shapiro-Wilk test was used to verify assumptions for use in parametric tests. To compare quantitative data between two groups, one way ANOVA test (for normally distributed data) was used. When the difference is significant, pairwise comparison and Fisher LSD comparison were used to detect difference between each two individual groups. ROC curve was used to determine best cutoff of certain quantitative parameter in diagnosis of certain health problem. Binary logistic regression was used to identify independent risk factors associated with certain health problem. Linear regression analysis was performed to measure associated independent

factors for dependent factor. The level statistical significance was set at $P < 0.05$. Highly significant

difference was present if $p \leq 0.001$ [5].

RESULTS

Table (1) Comparison between the studied groups regarding demographic data:

	Air insufflation group	Water immersion group	Water exchange group	χ^2	P
	N=10(%)	N=10(%)	N=10(%)		
Sex:					
Female	4 (40%)	3 (30%)	6 (60%)	MC	0.433
Male	6 (60%)	7 (70%)	4 (40%)		
Marital status					
Married	8 (80%)	9 (90%)	8 (80%)	MC	>0.999
Single	2 (20%)	1 (10%)	2 (20%)		
Occupation:					
Not working	5 (50%)	7 (70%)	3 (30%)	MC	0.267
Working	5 (50%)	3 (30%)	7 (70%)		
Residence:					
Rural	7 (70%)	9 (90%)	6 (60%)	MC	0.367
Urban	3 (30%)	1 (10%)	4 (40%)		
Travel abroad:					
No	9 (90%)	10 (100%)	10 (100%)	MC	>0.999
Yes	1 (10%)	0 (0%)	0 (0%)		
Contact with canal water					
No	7 (70%)	6 (60%)	7 (70%)	MC	>0.999
Yes	3 (30%)	4 (40%)	3 (30%)		
Smoking:					
No	8 (80%)	5 (50%)	8 (80%)	MC	0.267
Yes	2 (20%)	5 (50%)	2 (20%)		
Education:					
No education	2 (20%)	3 (30%)	0 (0%)	MC	0.167
Primary	0 (0%)	3 (30%)	1 (10%)		
Secondary	6 (60%)	2 (20%)	5 (50%)		
University	2 (20%)	2 (20%)	4 (40%)		
	Mean \pm SD	Mean \pm SD	Mean \pm SD	F	P
Age (year)	39.4 \pm 18.69	48.1 \pm 19.82	36.4 \pm 16.49	1.081	0.353
BMI (kg/m ²)	27.14 \pm 6.77	28.47 \pm 5.29	22.92 \pm 5.53	3.153	0.059

χ^2 Chi square test MC Monte Carlo test F One way ANOVA test

Table 1; showed that there was statistically non-significant difference between the studied groups regarding age, sex, residence, education,

occupation, smoking, body mass index, history of exposure to canal water or traveling abroad.

Table (2) Comparison between the studied groups regarding preparation used for colonoscopy

	Air insufflation group	Water immersion group	Water exchange group	χ^2	P
	N=10(%)	N=10(%)	N=10(%)		
Preparation: Epimag+minalax Prepawest	1 (10%) 9 (90%)	0 (0%) 10 (100%)	0 (0%) 10 (100%)	MC	>0.999
Adherence to instruction: No Yes	1 (10%) 9 (90%)	0 (0%) 10 (100%)	0 (0%) 10 (100%)	MC	>0.999
How easy: Difficult Tolerant Acceptable	3 (30%) 3 (30%) 4 (40%)	0 (0%) 7 (70%) 3 (30%)	0 (0%) 1 (10%) 9 (90%)	MC	<0.001* *
p (chi square for trend test)	P ₁ 0.52	P ₂ 0.01*	P ₃ 0.019*		
Overall experience: Good Poor	3 (30%) 7 (70%)	8 (80%) 2 (20%)	5 (50%) 5 (50%)	MC	0.1
Taste of preparation Good Tolerable Poor	1 (10%) 6 (60%) 3 (30%)	8 (80%) 1 (10%) 1 (10%)	3 (30%) 3 (30%) 4 (40%)	MC	0.067
Would you use it again: No Yes	5 (50%) 5 (50%)	1 (10%) 9 (90%)	2 (20%) 8 (80%)	MC	0.233
Preparation: Minor residual stinging Partial portion seen Seen well	3 (30%) 2 (20%) 5 (50%)	1 (10%) 0 (0%) 9 (90%)	5 (50%) 3 (30%) 2 (20%)	MC	0.1

χ^2 Chi square test MC Monte Carlo test p₁ difference between air insufflation group and water immersion group p₂ difference between water immersion and water exchange groups p₃ difference between air insufflation and water exchange groups *p<0.05 is statistically significant **p≤0.001 is statistically highly significant

Table 2; showed that there was statistically significant difference between the studied groups regarding how easy usage of preparation was (p <0.001). On comparing each two group, difference is significant between water exchange group and each other group (90% of individuals in the water exchange group were prepared, compared to 40% and 30% in the air insufflation

and water immersion groups, respectively). There was no statistically significant difference between the studied groups in terms of preparation type, adherence to preparation instructions, overall experience of using preparation, taste of preparation, if they would use it again, and whether preparation affected process.

Table (3) Comparison between the studied groups regarding procedure of colposcopy

	Air insufflation group	Water immersion group	Water exchange group	χ^2	P
	N=10(%)	N=10(%)	N=10(%)		
Difficulty:					
Difficult	3 (30%)	0 (0%)	0 (0%)	MC	<0.001**
Easy	3 (30%)	7 (70%)	1 (10%)		
Tolerable	4 (40%)	3 (30%)	9 (90%)		
p (chi square test)	P ₁ 0.52	P ₂ 0.02*	P ₃ 0.019*		
Additional sedation:					
No	1 (10%)	8 (80%)	7 (70%)	MC	<0.001**
25 mg pethidine	6 (60%)	1 (10%)	3 (30%)		
50 mg pethidine	3 (30%)	1 (10%)	0 (0%)		
p (chi square for trend test)	P ₁ 0.01*	P ₂ >0.999	P ₃ 0.005*		
Use of anesthetic drugs					
No	7 (70%)	10 (100%)	10 (100%)	MC	0.1
Yes	3 (30%)	0 (0%)	0 (0%)		
Type (drug)					
20 mg Propofol	1 (33.3%)				
30 mg Propofol	1 (33.3%)				
50 mg Propofol	1 (33.3%)				
Recovery:					
5	2 (66.7%)				
7	1 (33.3%)				
	Mean ± SD	Mean ± SD	Mean ± SD	F	P
Time of total procedure (minute)	16.8 ± 3.68	13.6 ± 3.47	17.1 ± 6.57	1.642	0.212
Cecal intubation time (minute)	11.5 ± 2.01	8.1 ± 1.97	9.2 ± 3.29	4.809	0.016*
LSD	P ₁ 0.005*	P ₂ 0.334	P ₃ 0.05		

χ^2 Chi square test MC Monte Carlo test F One way ANOVA test p1 difference between air insufflation group and water immersion group p2 difference between water immersion and water exchange groups p3 difference between air insufflation and water exchange groups *p<0.05 is statistically significant **p<0.001 is statistically highly significant LSD Fisher least significant difference

Table 3; there was statistically non-significant difference between the studied groups regarding use of anesthetic drugs (only needed for three patients within air insufflation group where 2 recovered after 5 (minutes) and one after (minutes), one of them needed 20 mg propofol, one needed 50 mg propofol and one received 30 mg propofol) or time of procedure. There was statistically significant difference between the studied groups regarding difficulty of procedure (the different is significant between water exchange group and each other group) (p <0.001). There was statistically significant difference

between the studied groups regarding need for additional sedation (the difference is significant between air insufflation and each other group where 10%, 70% and 80% within air insufflation, water immersion and water exchange groups did not need additional sedation) (p <0.001). There was statistically significant difference between the studied groups regarding cecal intubation time (on posthoc test, difference is significant between air insufflation and water immersion group where time is significantly higher in air insufflation group as compared to water immersion group (p= 0.016).

Table (4) Comparison between the studied groups regarding result for colonoscopy

	Air insufflation group	Water immersion group	Water exchange group	χ^2	P
	N=10(%)	N=10(%)	N=10(%)		
Result:					
No problem	1 (10%)	4 (40%)	1 (10%)	MC	0.3
Mass	1 (10%)	1 (10%)	0 (0%)	MC	>0.999
Ulcer	1 (10%)	0 (0%)	1 (10%)	MC	>0.999
Piles	4 (40%)	4 (40%)	7 (70%)	MC	0.4
Polyp	1 (10%)	1 (10%)	2 (20%)	MC	>0.999
Congested mucosa	5 (50%)	2 (20%)	4 (40%)	MC	0.533
Diverticulum	0 (0%)	0 (0%)	1 (10%)	MC	>0.999

χ^2 Chi square test MC Monte Carlo test

Table 4; demonstrated that there was no statistically significant difference between the examined groups in terms of colonoscopy results

(piles were the most common; 40%, 40%, and 70% in the air insufflation, water immersion, and water exchange groups).

Table (5) Comparison between the studied groups regarding satisfaction with procedure

	Air insufflation group	Water immersion group	Water exchange group	χ^2	P
	N=10(%)	N=10(%)	N=10(%)		
Satisfaction:					
Dissatisfied	3 (30%)	0 (0%)	0 (0%)	MC	<0.001**
Satisfied	7 (70%)	2 (20%)	5 (50%)		
Very satisfied	0 (0%)	8 (80%)	5 (50%)		
p (chi square for trend test)	P ₁ <0.001**	P ₂ 0.175	P ₃ 0.005*		
Overall patient experience:					
Acceptable	6 (60%)	3 (30%)	1 (10%)	MC	<0.001**
Comfortable	0 (0%)	7 (70%)	9 (90%)		
Embarrassing	4 (40%)	0 (0%)	0 (0%)		
p (chi square test)	P ₁ 0.002*	P ₂ 0.582	P ₃ <0.001**		
Willing to re-endoscopy if necessary	10 (0%)	10 (100%)	10 (100%)	-	-

χ^2 Chi square test MC Monte Carlo test F One way ANOVA test p₁ difference between air insufflation group and water immersion group p₂ difference between water immersion and water exchange groups p₃ difference between air insufflation and water exchange groups *p<0.05 is statistically significant **p<0.001 is statistically highly significant LSD Fisher least significant difference

Table 5; there was statistically significant difference between the studied groups regarding patient satisfaction (30% within air insufflation group were dissatisfied versus 0% within water exchange and water immersion groups with significant difference between air insufflation group and each other group) (p <0.001). There was statistically significant difference between the

studied groups regarding overall patient experience (0% within air insufflation group found it comfortable versus 70% and 90% within water exchange and water immersion groups respectively, the difference is significant between Air insufflation group and each other group) (p <0.001). All patients within each group accept to subject to endoscopy if there is further need

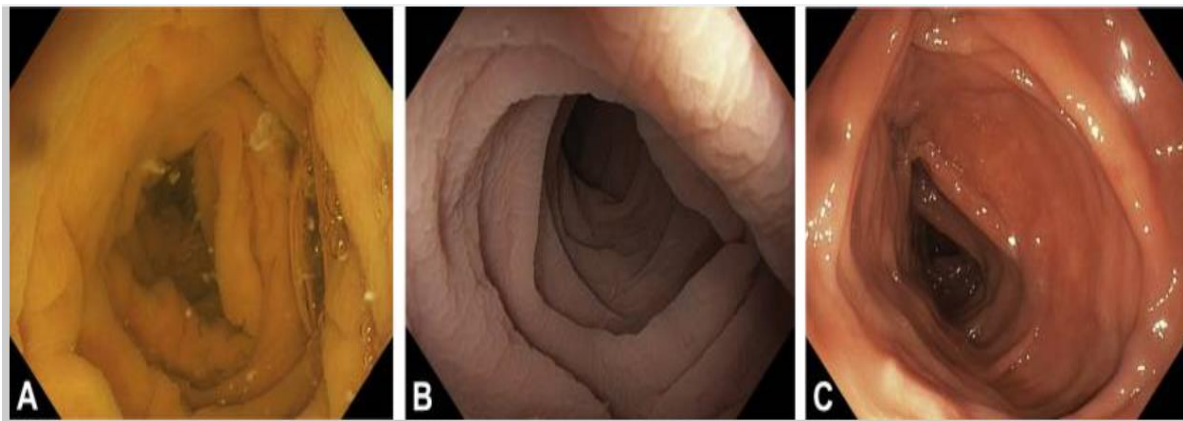


Figure (1): A, Water immersion. During insertion, colon preparation remnants can be used to aid instrument insertion. B, Water exchange. Insertion is done in clear water. C, Gas insufflation. View of the gas-distended lumen.

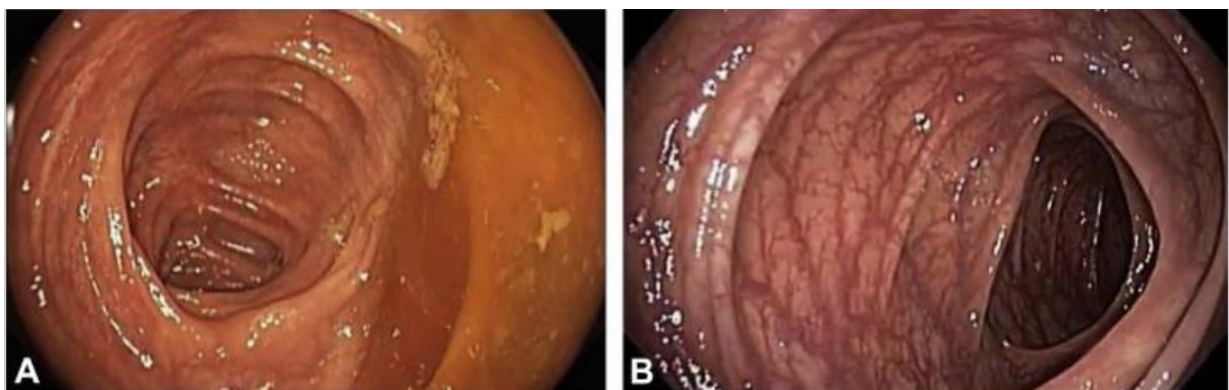


Figure (2): A, Water immersion. During withdrawal, some residual ponds of water must be aspirated to clean the lumen. B, Water exchange. During withdrawal, the lumen is perfectly clean.

DISCUSSION

There was statistically significant difference between the studied groups regarding difficulty of procedure (that was highly tolerable in water exchange group than the two other groups).

There were no statistically significant differences between the groups tested were the current study showed that there was no statistical significant difference between the studied groups regarding age, sex, residence, education, occupation, smoking, body mass index, history of exposure to canal water or traveling abroad, Which in agreement with the study of **Cadoni et al [6]** whose study included total of 1224 patients aged 50 –70 years (672 males) who had screening colonoscopy, and were randomized as 1:1:1 to water exchange, water immersion, or air insufflation, respectively there was no statistical significant difference between the studied groups

regarding demographic data (age, sex, body mass index).

The present analysis revealed statistically significant difference regarding how easy usage of preparation was. When comparing the two groups, the water exchange group and each other group differ significantly (90% of those within water exchange group were acceptable to preparation versus 40% and 30% within air insufflation and water immersion respectively, groupings. Regarding the type of preparation, between the studied groups, there is a statistically insignificant difference, adherence of instruction of preparation, overall experience of using preparation, taste of preparation, if they would use it again.

Leung et al [7] On withdrawal, WE and CWE had better overall stool preparation than AI (measured as the mean of bowel prep score for all

segments; $p < 0.001$). The average time to intubate the cecum was comparable (13.3 vs 12.0 vs 12.2 min, respectively), but the withdrawal time for CWE and WE was substantially higher than for AI ($p < 0.001$). The CWE operation took longer in total. Only after scope withdrawal did the three groups' stool preparation quality differ considerably, with the best bowel preparation being found in WE and CWE. We postulate that WE and CWE may be able to increase the detection rate of serrated lesions (SLs) by improving the examination during scope removal. Given that CWE and WE do not differ statistically significantly, it seems likely that WE by itself is adequate for proximal SL detection.

Azevedo et al [8] there were no noticeable differences between the two groups in terms of bowel preparation quality, length of cecal intubation, length of withdrawal, or quantity of position changes. Rather of using a validated scale as advised by ESGE, patients' experiences were assessed by taking into account two questions about how difficult they thought the procedure would be and whether they would be willing to repeat it. Results revealed that significantly more patients in the water group believed the surgery would be "easier than expected."

According to the current study's findings, there was no statistically significant change in the usage of anesthetic medications (only needed for three patients within air insufflation group where 2 recovered after 5 (minutes) and one after 7 (minutes), one of them needed 20 mg propofol, one needed 30 mg propofol and one received 50 mg propofol) or time of procedure. There was statistical **significant** Differences in procedure complexity between the groups investigated (process is challenging) in 30% versus 0% within each other group). There was a statistically significant difference in the need for additional sedation between the studied groups (the difference is significant between air insufflation and each other group, where 10%, 70%, and 80% of the water immersion and water exchange groups within the air insufflation group did not require additional sedation).

Catinean et al [9] revealed that a disproportionately larger number of people in the AI group underwent further 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 ($p < 0.001$).

The duration of the procedure as a whole was the same in the two groups, but the AI group's cecal intubations took 3 minutes longer than those in the WI group. 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.

Vyas et al [10] showed that while the amounts of propofol delivered were equivalent between the GE + R (water) group required less fentanyl and midazolam than the air group ($p < 0.001$ for midazolam and $p < 0.001$ for fentanyl).

The current study showed that there was statistical **significant** Difference in cecal intubation time between the examined groups is substantial between the air insufflation and water immersion groups (time is significantly longer in the air insufflation group than in the water immersion group). These findings support the study of **Cadoni et al [6]** who found that the cecal intubation rate in the water exchange group was 96.4% and 98.8% in the air insufflation group ($P=0.08$). The insertion time in the water exchange group was much longer (by 2 minutes), but the difference was not statistically significant.

Leung et al [7] reported comparable success rates for intubation. In comparison to CWE and WE, AI needed noticeably A larger scope to reach the cecum, increased abdominal compression ($p < 0.001$), and a position change are all present the overall amount of sedatives required by the three groups did not differ significantly, however.

Leung et al [11] reported that fewer patients compared to the control group in the water immersion group needed extra medication (46/112 vs. 83/114; $P < 0.0001$).

Lower midazolam and fentanyl doses were given to patients who also received supplemental

medicine in the water group than in the air group ($P = 0.0002$ for midazolam dose and $P < 0.0001$ for fentanyl dose). Both sets of patients had all reached the cecum. However, compared to utilizing regular air insufflation, using the water immersion reduced the amount of time needed to intubate the cecum (10.2 ± 7.9 minutes vs. 15.2 ± 13.1 minutes). The duration of the cecal intubation for the present gastroenterologists did not differ statistically between the two methods. However, the water immersion arm had a considerably lower cecal intubation time for trainees (13.0 ± 7.5 minutes vs. 20.5 ± 13.9 minutes). For both attending endoscopists, the total procedure time was shorter in the water immersion group than in the normal air group (14.9 ± 9.5 vs. 20.9 ± 10.6) and trainees (31.1 ± 13.3 vs. 36.0 ± 13.6).

The most frequent colonoscopy outcome was internal piles, and the current study revealed that there was no statistically significant difference in this regard between the studied groups (air insufflation, water immersion, and water exchange groups, 40%, 40%, and 70%).

According to some published research, WE is more effective than WI and AI at boosting the rate of adenoma detection. Better colon cleansing, easier polyp detection due to the floating effect of water, better visualization of flat lesions because water does not fully distend the colonic wall the way gas insufflation does, and improved operator focus during the withdrawal phase because there are fewer distractions from washing and cleaning procedures could all be factors in this [4, 6].

The current Study results revealed that patient satisfaction varied statistically significantly between the tested groups (30% within air insufflation group were dissatisfied versus 0% within water exchange and water immersion groups with a notable distinction between the air insufflation group and the other groups).

Leung et al [7] reported that patients showed similar satisfaction with no significant difference between study groups. Compared to the group receiving regular air, patients in the water immersion arm reported less pain during the

treatment ($P = 0.001$). Patients who participated in the trial experienced no complications from the operation (bleeding or perforation) or side effects of the anesthesia (arrhythmia, hypoxia, or hypotension).

The current study showed that there was a statistical **significant** difference between the study groups in terms of how comfortable patients felt overall (0% in the air insufflation group versus 70% and 90% within the groups for water immersion and exchange, respectively). Each patient in each group consents to having an endoscopy if necessary.

In the line with our results, Leung et al[11] found showed there was no discernible difference in post-discharge outcomes across the three groups patient satisfaction scores or willingness to undergo another colonoscopy using the same random technique of testing.

Catinean et al [9] reported that Statistics showed that patients in the AI group were more uncomfortable than those in the WI group ($p < 0.001$). Only 46% of the AI group's patients expressed a positive willingness to repeat the treatment, compared to 98% of the WI group's patients.

The current study also has some strengths. To the best of our knowledge, this is the first study to be done in Zagazig university Hospitals and the current design has allowed the comparison and validation of the results in a homogeneous population, thus increasing the reliability of the data. Our study limitation were small sample size, in a single center and short term follow up period, so we recommended further studies with large number of patients with long period of follow up in multi-center studies to confirm our findings.

CONCLUSION

Water-aided colonoscopy compared with standard air insufflation significantly reduced discomfort during the procedure in on-demand sedated patients whatever the indication of colonoscopy, achieving comparable procedural outcomes. Water-aided colonoscopy should be considered as an option to reduce intraprocedural

pain in inflammatory bowel disease patients who prefer to undergo an on-demand sedation colonoscopy.

WE colonoscopy is superior to WI, 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.

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