Original Article

Water-Aided Colonoscopy in Inflammatory Bowel Disease Patients—A Randomised, Single-Centre Trial

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Abstract

Background: Water-aided colonoscopy insertion reduces patients’ discomfort and need for sedation in unsedated and minimally sedated patients. However, water-aided technique has never been studied in inflammatory bowel disease patients, characterised by younger age, structural changes of the colon and need for repeated colonoscopies. Our trial was designed to evaluate discomfort associated with water-aided colonoscopy compared with air insufflation in on-demand sedated patients with known inflammatory bowel disease.

Methods: In a randomised, single-centre study, 92 patients were randomised to either water-aided insertion and air insufflation during withdrawal [Water] or air insufflation during both insertion and withdrawal [Air]. The main outcome measured was success rate of unsedated colonoscopy, defined as reaching the caecum without requiring sedation and with discomfort during insertion of less than or equal to 5 using 0–10 continuous scale [0 = none, 10 = maximum pain].

Results: Success rate of caecal intubation without sedation or invoking a discomfort score greater than 5 was significantly higher in the Water arm compared with the Air arm [73.9 vs 45.7%, p = 0.01]. Discomfort score during insertion [mean ± SD] was significantly lower in the Water than in the Air arm [3.8 ± 2.4 vs 5.4 ± 1.9, p < 0.001]. Other outcomes including procedural times, success rate of terminal ileum intubation, need for abdominal compression, and repositioning were comparable. There were no complications recorded in the study.

Conclusions: Compared with air insufflation, water-aided colonoscopy significantly reduces discomfort in on-demand sedated patients with inflammatory bowel disease, achieving comparable procedural outcomes.

Keywords: Water-aided colonoscopy; inflammatory bowel disease

1. Introduction

Water-aided colonoscopy is an alternative technique using water infusion instead of gas [air or carbon dioxide] insufflation to distend the lumen during insertion phase of the colonoscopy.1,4 Compared with air insufflation, water-aided colonoscopy has been consistently shown to reduce discomfort and need for sedation during screening and diagnostic colonoscopies.1,3,4,6 Water-aided colonoscopy can be subdivided into water immersion and water exchange techniques. Water immersion consists of using water infusion to facilitate insertion to the caecum with possible intermittent air insufflation. Residual colonic gas is usually not removed and infused water is suctioned predominantly during withdrawal. Water exchange is characterised by complete exclusion of air insufflation and simultaneous infusion and suction of water during insertion.1 Water exchange seems to
be superior to water immersion in pain reduction and concurrently improves the quality of bowel preparation before withdrawal. There are only limited data on using water-aided colonoscopy in specific situations. Several reports suggest that water technique is able to enhance caecal intubation in patients with redundant colon and with a history of abdominal and pelvic surgery.

Colonoscopy is the most important diagnostic tool in patients with inflammatory bowel disease (IBD) and it is used in various clinical settings. It plays a key role in the diagnostic algorithm in patients with suspected IBD, in monitoring inflammatory activity in treated patients and in endoscopic surveillance in patients with long-standing colonic disease. Compared with patients undergoing colonoscopy for other reasons, patients with IBD are generally characterised by younger age, structural changes of the colon including intestinal resections, and need for repeated and frequently difficult colonoscopies. Water-aided colonoscopy has never been studied in patients with IBD.

Our trial was designed to evaluate discomfort during water-aided colonoscopy compared with air insufflation in on-demand sedated patients with known inflammatory bowel disease.

2. Materials and Methods

2.1. Study protocol

The trial was conducted in the Digestive Diseases Center of Vítkovice Hospital in Ostrava, Czech Republic. All three colonoscopists participating in the study [PFa, VS, and PFo] had performed over 3000 colonoscopies, routinely using water method for colonoscope insertion. The study protocol was reviewed and approved by the local ethics committee and registered on ClinicalTrials.gov [NCT01933867]. All patients gave their written informed consent.

Male and female patients aged above 18 years, with known inflammatory bowel disease referred for outpatient colonoscopy, were consecutively recruited between September 2013 and August 2014. Subjects were excluded if they refused on-demand sedation colonoscopy, if only incomplete colonoscopy was planned, or if they had ulcerative proctitis or bowel resection different from ileocaecal anastomosis.

All patients underwent standard split-dose bowel preparation using polyethylene glycol [Fortrans, Beaufour Ipsen Pharma, Paris, France] or combination of polyethylene glycol and ascorbic acid [Moviprep, Norgine, Harefield, UK].

2.2. Randomisation

Patients fulfilling the inclusion criteria were randomised to water-aided colonoscopy [Water] or air insufflation colonoscopy [Air], using stratified block randomisation according to sex and age [female < 40, female ≥ 40, male < 40, male ≥ 40 years]. The allocation was kept in a sealed envelope for each patient and opened by the study nurse before the colonoscopy. All patients were blinded to the method, including masked endoscopy screen.

2.3. Procedure

The patient, with a peripheral intravenous cannula inserted, was placed in the left lateral position. After a digital rectal examination, the standard adult variable stiffness colonoscope [CF-HQ190, Olympus, Hamburg, Germany] was inserted. In the Water arm, a foot switch-controlled water pump [OFF Endoscopic Flushing Pump, Olympus, Hamburg, Germany] was used for infusion of room temperature [20–24°C] water during colonoscope insertion. Water was infused throughout the colon to distend the lumen sufficiently to permit advancement of the colonoscope. Air insufflation was excluded, and residual colonic gas and infused water were removed during insertion as much as possible. As soon as the caecum or ileocolonic anastomosis was reached, the air pump was switched on and the colon was fully distended. In the Air arm, standard air insufflation was used during both insertion and withdrawal. Forceps biopsies were always carried out during withdrawal.

Patients were asked about discomfort every 1–2 min exclusively by the assisting nurse. If a level of 5 or more was reported, sedation was offered. The patient could decline or accept, in which case initially 2 mg midazolam was administered intravenously, then in step-ups of 1 mg up to 5 mg midazolam if needed. Other medications were not used. Sedation was administered based on the patient’s demands, not at the discretion of endoscopist. After reaching the caecum or ileocolonic anastomosis, patient were asked about overall discomfort during insertion.

2.4. Endpoints

The primary endpoint was the success rate of unsedated colonoscopy, which was defined as reaching the caecum or ileocolonic anastomosis without administering sedation and with overall discomfort during insertion ≤ 5 on a continuous scale 0–10 [0 = none, 10 = maximum pain].

Other recorded endpoints were success rate of terminal or neoterminal ileum intubation, insertion and total colonoscopy time, infused and suctioned water volume during insertion, length of the inserted colonoscope, overall discomfort during withdrawal [0–10], need for patient repositioning and abdominal compression, and difficulty from the endoscopist’s point of view [1–5: 1 = very easy, 5 = very difficult].

2.5. Statistical analysis

In our preliminary experience with 20 IBD patients, the success rate of unsedated air insufflation colonoscopy was 40% [8/20]. A sample size of 46 patients per arm was calculated using \( \alpha = 0.05 \) and \( \beta = 0.2 \), assuming that a 20% increase in success rate would be clinically significant.

The correlations between dichotomous variables were tested by a two-tailed Fisher’s exact test, and the associations between other categorical variables were evaluated using a log-linear model. The success rate of unsedated colonoscopy was evaluated using a two-tailed Fisher’s exact test. Patients with an incomplete colonoscopy were excluded from further analysis. The success rate of terminal ileum intubation, need for repositioning and abdominal compression, and adenoma detection rate were analysed using a two-tailed Mann Whitney robust test. A \( p \)-value of \( <0.05 \) was considered to be statistically significant.

3. Results

3.1. Patients

A total of 157 patients were assessed for eligibility and 92 patients were enrolled and equally randomised to either Water or Air arm [Figure 1]. The baseline characteristics including sex, age, body mass index, proportion of patients with Crohn’s disease and ulcerative colitis, history of abdominal surgery and ileocaecal resection, indications for the procedure, endoscopic activity, and quality of bowel preparation were comparable between arms [Table 1].
3.2. Success rate of unsedated colonoscopy

The primary endpoint, success rate of unsedated colonoscopy, was 73.9% [34/46] in the Water arm and 45.7% [21/46] in the Air arm, and the difference was statistically significant \( p = 0.01 \). In the Water arm, 26.1% [12/46] of insertions were considered to have failed. The caecum was not reached in 1 patient, sedation was administered in 10 cases and discomfort score was > 5 in 1 patient who refused sedation. In the Air arm, 54.3% [25/46] of insertions were considered a failure. The caecum was not reached in 2 patients, sedation was given in 12 patients and discomfort score was > 5 in 11 patients who refused sedation [Table 2].

The terminal or neoterminal ileum was successfully intubated in 84.8% [39/46] in Water arm and 80.4% [37/46] in the Air arm \( p = 0.784 \) [Table 2].

3.3. Other colonoscopy characteristics

The overall discomfort score during insertion was significantly lower in the Water arm than in the Air arm [3.8 ± 2.4 vs 5.4 ± 1.9, \( p < 0.001 \)]. The discomfort score during withdrawal was also significantly lower in the Water arm [1.4 ± 2.0 vs 2.1 ± 1.9, \( p = 0.024 \)]. Insertion and total procedure times were similar in both arms [7.6 ± 2.7 and 15.7 ± 4.9 min, respectively, in the Water arm vs...
Table 3. Other colonoscopy characteristics [n = 89] in Water and Air arms.

<table>
<thead>
<tr>
<th></th>
<th>Water [n = 45] [A]</th>
<th>Air [n = 44] [B]</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Discomfort during insertion, mean ± SD</td>
<td>3.8 ± 2.4</td>
<td>5.4 ± 1.9</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Discomfort during withdrawal, mean ± SD</td>
<td>1.4 ± 2.0</td>
<td>2.1 ± 1.9</td>
<td>0.024&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Insertion time, mean ± SD, min</td>
<td>7.6 ± 2.7</td>
<td>7.4 ± 3.4</td>
<td>0.533&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total time, mean ± SD, min</td>
<td>15.7 ± 4.9</td>
<td>14.8 ± 5.0</td>
<td>0.496&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Water infusion during insertion, mean ± SD, ml</td>
<td>447 ± 127</td>
<td>42 ± 4.6</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Water suction during insertion, mean ± SD, ml</td>
<td>315 ± 139</td>
<td>44 ± 91</td>
<td>&lt;0.001&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Colonoscope length, mean ± SD, cm</td>
<td>88 ± 15</td>
<td>87 ± 14</td>
<td>0.940&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Repositioning, n [%]</td>
<td>4 [8.9]</td>
<td>3 [6.8]</td>
<td>1.000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Abdominal compression, n [%]</td>
<td>19 [42.2]</td>
<td>19 [43.2]</td>
<td>1.000&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Difficulty [1–5], mean ± SD</td>
<td>2.4 ± 0.8</td>
<td>2.5 ± 0.8</td>
<td>0.272&lt;sup&gt;b&lt;/sup&gt;</td>
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Patients with incomplete colonoscopy excluded from the analysis.
SD, standard deviation.
<sup>a</sup>Two-tailed Fisher’s exact test.
<sup>b</sup>Two-tailed Mann Whitney robust test.

We routinely infuse room-temperature water [20–24°C] during water-aided colonoscopy despite the fact that most of the published trials comparing water with air insufflation have used warm water [36–42°C]. At least two randomised trials showed no difference in procedure outcomes between warm and room temperature water arms, with the exception of abdominal compression rate<sup>13,14</sup> but the potential impact of warm water infusion in IBD patients deserves our further attention.

Water-aided colonoscopy seems to be a safe colonoscopy technique. Only a single case of perforation was reported and this occurred after endoscopic resection during withdrawal using air insufflation; we can only speculate about a potentially higher risk of perforation due to inflammation of the intestinal wall. In any case, water-aided colonoscopy in IBD patients should be performed cautiously and by experienced endoscopists.

We are aware of several limitations of our study. Patients were blinded to the colonoscopy technique, but the nature of the method does not allow blinding of the endoscopist and assisting nurse. Discomfort scores were collected by the unblinded assisting nurse and in the presence of endoscopist, but at irregular intervals, to avoid colonoscopy manoeuvres that could bias pain scores at predetermined intervals. Moreover, the endoscopists did not participate in the process of gathering the information. The patient population included in the study is quite heterogeneous, but that is the way in clinical practice. Another drawback is the single-centre design, and our findings should be supported by other, preferably multi-centre studies.

In conclusion, water-aided colonoscopy compared with standard air insufflation significantly reduced discomfort during the procedure in on-demand sedated patients with inflammatory bowel disease, achieving comparable procedural outcomes. Water-aided colonoscopy should be considered as an option to reduce intra-procedural pain in inflammatory bowel disease patients who prefer to undergo an on-demand sedation colonoscopy.

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Conflict of Interest
All authors disclose no conflict of interest relevant to this publication.
Author Contributions

PFA, conception and design of the study, acquisition of data, interpretation of data, drafting the article; VS, acquisition of data; PFO, conception and design of the study, drafting the article, and revising it critically for important intellectual content; MH, statistical analysis and interpretation of the data.

References