

Improving the discomfort and satisfaction of colonoscopy by distraction with smartphones

A prospective randomized controlled study

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Abstract

Background: Colonoscopy is an uncomfortable procedure. Distraction is thought to reduce pain by decreasing the amount of attention a person spends on a painful stimulus. We aimed to assess the usefulness of smartphones on discomfort associated with the colonoscopy.

Methods: We designated 360 enrolled patients according to prospective randomized controlled study into two groups, including smartphone (SP) group (Relaxation by smartphones) and Control group (No relaxation). Measured outcomes included the discomfort, satisfaction, polyp detection rate and the willingness to repeat colonoscopy were analyzed between groups.

Results: The pain and distension scores of SP group patients were significantly lower than those of the Control group (2.18 ± 2.80 vs 3.55 ± 3.07 , $P < .001$; 4.15 ± 2.35 vs 4.79 ± 2.36 , $P = .011$, respectively). Importantly, patient-reported satisfaction scores of the SP group were significantly higher than those of the Control group (96.45 ± 7.17 vs 91.12 ± 10.49 , respectively; $P < .001$). Moreover, although there were no statistical differences, patients using smartphones were more likely to have shorter reach cecum times (09m:11s vs 07m:37s, $P = .116$) and more polyp detection rate (13.3% vs 9.4%, $P = .246$). In addition, more patients using smartphones were willing to repeat colonoscopy but no statistical difference (85.0% vs 81.7%, $P = .396$).

Conclusion: Patient using smartphone is a special manner to increase satisfaction during colonoscopy with a less discomfort and is more likely to be polyp detection rate.

Abbreviation: SP = smartphone.

Keywords: colonoscopy, discomfort, distraction, satisfaction, smartphones

1. Introduction

Un-sedated colonoscopy can be very uncomfortable for patients. Sedation for colonoscopy is the usual practice in

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many parts of the world.^[1,2] However, in China, non-sedated colonoscopy is widely used, as the cost of sedated colonoscopy is high. In addition, anesthesia assistance for outpatient colonoscopy was associated with a significantly increased risk of aspiration pneumonia, cardiopulmonary arrest, oxygen desaturation and many other risks.^[3,4] Therefore, it is imperative to find ways of reducing patients' discomfort during non-sedated colonoscopy. One possible solution is distraction technique.

In our observation during the clinical practice, we found some patients are addicted to smartphones so that they use them during non-sedated colonoscopy. Previous studies demonstrated that audio and visual distraction could reduce pain and discomfort in patients undergoing colonoscopy.^[5-7] Using smartphones was even more diverting, as smartphones include visual and audio distraction. Moreover, patients can also choose to play games, call others, or do something else. We speculate that using smartphones is beneficial to relieve discomfort associated with colonoscopy. To test the hypothesis, this prospective, randomized controlled study was designed.

2. Patients and methods

2.1. Study participants

The patients were recruited in this study from January 2019 to December 2020. The inclusion criteria for participants were:

- (1) Age was 16 to 60 years old;
- (2) Participants often use smartphones;

- (3) Participants agree to participate in the study and sign the informed consent.

The exclusion criteria were:

- (1) Contraindications of endoscopic operation;
- (2) Intestinal stenosis or tumor obstruction;
- (3) Dysphagia;
- (4) Patients with swallowing reflex or mental illness (depression, anxiety, hypochondriasis, hysteria, etc);
- (5) Severe gastroparesis or outlet obstruction;
- (6) Acute intestinal obstruction;
- (7) Intestinal perforation or acute peritonitis;
- (8) Severe chronic renal failure (creatinine clearance < 30 mL/min);
- (9) Severe cardiac insufficiency (New York Heart Association grade \geq grade III);
- (10) Hypertension patients with poor blood pressure control (systolic blood pressure \geq 170mm Hg, diastolic blood pressure \geq 100mm Hg);
- (11) Acute bacterial dysentery, acute severe colitis and acute severe ulcerative colitis;
- (12) Dehydration or electrolyte disorder;
- (13) Pregnant or lactating women;
- (14) Active hemorrhage of digestive tract;
- (15) Patients with moderate or severe ventilatory dysfunction;
- (16) Coagulation dysfunction;
- (17) The patient refused to undergo painless colonoscopy.

All enrolled outpatients were owners of a smartphone. The study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology and was registered in Chinese Clinical Trial Registry (ChiCTR1900027034). All patients provided written informed consent for colonoscopy operation and their information had been anonymized and de-identified.

2.2. Study design

A prospective, randomized, single center study was conducted. A computerized random number table was used. The scheduled study participants were randomized one hours before the colonoscopy. The primary endpoint was to assess overall comfort level including the abdomen pain, distention and satisfaction; the secondary endpoint was to inquire whether patients' willingness to repeat colonoscopy with same method or not. Patients were allocated to one of the following two groups: No relaxation (Control group) and relaxation by smartphones (SP) with instructions about how to relax themselves by using their smartphones. Patients in this group were able to do whatever they were interested in using their phones, including watching funny videos, real-time news, making phone calls and so on. All operations were performed by experienced gastroenterologists with a track record of more than 4000 colonoscopy per year.

2.3. Bowel preparation

All patients were instructed to start a low-fiber diet 3 days before the colonoscopy, were prescribed a standard split-dose preparation regimen based on 2L polyethylene glycol electrolytes powder and were asked to drink at least 2L of additional clear liquids after ingestion of the purgative. Standard instructions were given orally to all patients during the initial preparation appointment and were also provided in a written format. On the day of the

patient's colonoscopy, before colonoscopy, patients did not receive any kind of drug (including sedation) prior to the procedure except for anisodamine for the purpose of relieving gastrointestinal spasm. The experienced endoscopists performed the colonoscopy and scored the patient's bowel preparation using the Boston bowel preparation scale. The detail information was provided in Supplement Table 1, <http://links.lww.com/MD/F824>.

2.4. Questionnaire

Participants completed a questionnaire at study inception that assessed baseline characteristics, prior experience with colonoscopy, and so on. After the examination, participants also completed a post-study questionnaire that assessed overall comfort level including the abdomen pain, distention and satisfaction associated with colonoscopy, as well as the patients' willingness to repeat colonoscopy with same method. Patient responses to the questionnaire were categorical (yes, no or not sure) or visual scale answers by using scoring system ranging from very bad to very good. The detail information about questionnaire were provided in Supplement Table 1, <http://links.lww.com/MD/F824>.

2.5. Statistical analysis

Categorical variable results are presented as numbers and percentages, and continuous variables are presented as mean \pm standard deviation. The possible influence of variously categorical and non-categorical variance was conducted by Pearson chi-squared test and *t* tests respectively. Statistical analysis was performed using IBM SPSS Statistics software (version 22, IBM Corp, Armonk, NY). A significance level of $P \leq .05$ was used for all models (two-sided).

3. Results

3.1. General patient characteristics

In total, 487 patients were recruited. Among them, 36 patients didn't carry smartphones, 40 patients declined to participate, 39 patients had a history of abdominal surgery, and 12 patients had visual or hearing disabilities. Therefore, 360 patients were enrolled. 180 cases (mean age, 40.94 ± 10.96 y) were randomly allocated to the Control group and 180 cases (mean age, 38.88 ± 10.75 y) were allocated to the SP group. The Control group was slightly older than the SP group but no statistically significant ($P = .229$). There were also no significant differences between the groups with respect to age, body mass index, experience of colonoscopy, history of abdominopelvic surgery, Boston bowel preparation scale and main indication for colonoscopy ($P > .05$). No serious complications were occurred during colonoscopy. The demographic and clinical characteristics between two groups are summarized in Table 1.

3.2. Characteristic for the procedures

The cecal intubation rates were similar between Control group and SP group (97.2% vs 97.8%, $P = 1.000$) and total procedure time in minutes were also no significantly differ between the two groups: $13:09 \pm 09:54$ (min:s) for Control group, $12:12 \pm 07:37$ (min:s) for SP group, respectively ($P = .153$). Nevertheless, the cecal intubation time of SP group had shorter than that of Control group although there was no statistical difference (09:11

Table 1**Demographic and clinical characteristics of enrolled patients.**

Items/Groups	Control group (N=180)	SP group (N=180)	P-value
Age, yr	40.94 ± 10.96	38.88 ± 10.75	.229
Female, n (%)	77 (42.8)	60 (33.3)	.065
Height, cm	167.18 ± 8.38	167.54 ± 7.48	.563
Weight, kg	64.85 ± 11.98	65.17 ± 11.87	.734
Body mass index, kg/m ² , mean ± SD	23.42 ± 5.24	23.30 ± 4.51	.818
Previous colonoscopy, n (%)	40 (22.2)	31 (17.2)	.233
Abdominal or pelvic surgery, n (%)	52 (28.9)	51 (28.3)	.907
Main indication for colonoscopy, n (%)			.5
Symptom	154 (85.6)	158 (87.8)	
Surveillance	21 (11.7)	15 (8.3)	
Screening	5 (2.8)	7 (3.9)	

SP=smartphones. The data is expressed as mean ± standard deviation (SD) and percentage.

vs. 07:37, $P=.116$). Additionally, the polyp detection rates were also more likely to be positive in SP group (13.3% vs. 9.4%, $P=.246$). The Characteristic for the procedures is shown in Table 2.

3.3. The discomfort and satisfaction are improved

Pain scores of SP group patients were significantly lower than those of the Control group (2.18 ± 2.80 vs 3.55 ± 3.07 , $P < .001$). The distension scores were also lower in SP group (4.15 ± 2.35) compared with the scores in the Control group (4.79 ± 2.36) ($P=.011$). Patient-reported satisfaction scores of the SP group were significantly higher than those of the Control group (96.45 ± 7.17 vs 91.12 ± 10.49 , respectively; $P < .001$). Although there was no statistical difference, more patients in the SP group were willing to repeat colonoscopy with same method (85.0% vs 81.7%, $P=.396$). The results are summarized in Table 3.

4. Discussion

To the best of our knowledge, this is the first study that investigated the effects of using smartphones in reducing patient discomfort during colonoscopy. Our study shows that using smartphones had significant effects on improving pain, disten-

tion, and satisfaction during colonoscopy. Moreover, patients using smartphones were more likely to have shorter reach cecum times and more polyp detection.

Our study demonstrated that visual distraction can relieve discomfort associated with endoscopy. Visual distraction could improve satisfaction in patients undergoing colonoscopy and decreases anxiety and pain during the procedure among patients with a high pre-procedural anxiety score.^[8] Other studies also demonstrated that audio and visual stimulation reduces abdominal discomfort associated with flexible sigmoidoscopy.^[5,9] These effects might be due to the distraction. Using smartphones were even more diverting, as smartphones include visual and audio distraction. Moreover, patients can also choose playing game, calling others, or something else.

Actually, distraction techniques are widely used for management of acute^[10–12] and chronic pain.^[13,14] Distraction is thought to reduce pain by decreasing the amount of attention a person spends on a painful stimulus.^[15] Because attentional capacity is limited, drawing enough attention away from a painful stimulus results in less distress. Distraction appears to be particularly effective if it involves emotionally pleasant cognitions.^[16] Our results are consistent with this theory of how distraction reduces pain, as our results show that distraction from using smartphones was effective in relieving pain than no intervention. In this relaxed situation, we had a shorter cecum times and more polyp detection although there was no difference.

Our results suggest that using smartphone did not affect the willingness to undergo colonoscopy with the same method. There can be many explanations for this negative result. Besides the discomfort, the willingness to repeat colonoscopy was affected by many factors, such costs, defecation power, compliance and so on. In addition, some patients are inclined to conceal their real thoughts.

The current study has several limitations. First, this was a single-center study and more studies are necessary to assess the effects. Second, no data about whether different types of smartphone have different results or not. Moreover, the results may not be applicable to a more diverse population as availability and use of smartphones varies by different factors including age, socioeconomic status, and so on.

In conclusion, using smartphones might decrease pain, distention of patients and improve patient satisfaction with colonoscopy. Moreover, patients using smartphones were more likely to have shorter reach cecum times and more polyp detection. We strongly recommend using smartphones to improve discomfort during colonoscopy.

Table 2**Characteristic for the procedures.**

Items/Groups	Control group	SP group	P-value
Completing rate, n (%)	175 (97.2)	176 (97.8)	1.000
Time to reach cecum, min:s	09:11 ± 08:38	07:37 ± 06:43	.116
Total procedure time, min:s	13:09 ± 09:54	12:12 ± 07:37	.153
PDR, n (%)	17 (9.4)	24 (13.3)	.246

PDR=polyp detection rate; SP=smartphones. The data is expressed as mean ± standard deviation (SD) and percentage.

Table 3**The discomfort and satisfaction for the two groups.**

Items/Groups	Control group	SP group	P-value
Pain score	3.55 ± 3.07	2.18 ± 2.80	<.001
Distention score	4.79 ± 2.36	4.15 ± 2.35	.011
Satisfaction score	91.12 ± 10.49	96.45 ± 7.17	<.001
Willing to repeat colonoscopy, n (%)	147 (81.7)	153 (85.0)	.396

SP=smartphones. The data is expressed as mean ± standard deviation (SD) and percentage.

Author contributions

Chaoqun Han performed the literature search, data extraction and drafted of the manuscript; Liping Sheng and Tao Xu collected the data; Chi Nie, Jun Liu and Xiaohua Hou gave lots of suggestions; Zhen Ding designed the study and edited the manuscript as corresponding author.

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