Thieme

Computer-assisted instruction before colonoscopy is as effective as nurse counselling, a clinical pilot trial

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ABSTRACT

Background and study aims Better patient education prior to colonoscopy improves adherence to instructions for bowel preparation and leads to cleaner colons. We reasoned that computer assisted instruction (CAI) using video and 3D animations followed by nurse contact maximizes the effectiveness of nurse counselling, increases proportion of clean colons and improves patient experience.

Patients and methods Adults referred for colonoscopy in a high-volume endoscopy unit in the Netherlands were included. Exclusion criteria were illiteracy in Dutch and audiovisual handicaps. Patients were prospectively divided into 2 groups, 1 group received nurse counselling and 1 group received CAI and a nurse contact before colonoscopy. The main outcome, cleanliness of the colon during examination, was measured with Ottawa Bowel Preparation Scale (OBPS) and Boston Bowel Preparation Scale (BBPS). We assessed patient comfort and anxiety at 3 different time points.

Results We included 385 patients: 197 received traditional nurse counselling and 188 received CAI. Overall patient response rates were 99%, 76.4% and 69.9% respectively. Endoscopists scored cleanliness in 60.8%. Comparative analysis of the 39.2% of patients with missing scores showed no significant difference on age, gender or educational level. Baseline characteristics were evenly distributed over the groups. Bowel cleanliness was satisfactory and did not differ amongst groups: nurse vs. CAI group scores in BBPS: (6.54 ± 1.69 vs. 6.42 ± 1.62); OBPS: (6.07 ± 2.53 vs. 5.80 ± 2.90). Patient comfort scores were significantly higher (4.29 ± 0.62 vs. 4.42 ± 0.68) in the CAI group shortly before colonoscopy. Anxiety and knowledge scores were similar.

Conclusion CAI is a safe and practical tool to instruct patients before colonoscopy. We recommend the combination of CAI with a short nurse contact for daily practice.

Introduction

Colonoscopy is the gold standard for diagnosis, surveillance and removal of precancerous lesions like adenoma in the colon, which reduces colorectal cancer mortality [1]. The importance herein is well advocated [2]. On the other hand, the prospect of undergoing colonoscopy and the intensive preparation might have a negative effect on patient comfort and anxiety [3].

Adequate bowel preparation is crucial, so it is paramount to optimally inform and instruct our patients prior to a colonoscopy [4]. Poorly prepared colons lead to a higher miss-rate of neoplasms,[5] more complications and increased need for repeat examinations with increased costs and cumulative discomfort for patients [6, 7]. Therefore, to achieve adequate bowel cleanliness, patients have to adhere to prescribed use of laxative agents and dietary instructions [8]. Patient cleansing scores are influenced by ASA status, comorbidity, and treatment with gut motility modifying drugs. In our study, where these factors were unaffected by the intervention, we did not evaluate these further.

Patient education is obviously of key importance in achieving a well-prepared colon. Several educational tools are known

to be effective in various degrees; e. g. informative leaflets, cartoons, video and dedicated counselling sessions by a nurse or a physician [3, 9 – 13]. Better education overall establishes higher quality of bowel preparation [14]. In the Netherlands the most common strategy is to provide nurse counseling prior to endoscopy.

In recent years, advances in internet technology provide us with novel, web-based education programs, enabling us to combine the previously mentioned modalities. Computer-assisted instruction (CAI), available on desktop and smartphone, helps to raise patient satisfaction about the information provided [15]. Proper implementation, however, is important [16].

The evidence base that supports use of CAI for bowel preparation is lacking. We hypothesise that CAI using video and 3 D animations maximizes effectiveness of nurse counselling and therefore improves bowel cleanliness. Furthermore, CAI will positively influence the patient experience.

We conducted a pilot trial assessing the effectiveness of CAI for patient education prior to colonoscopy measuring bowel cleanliness and patient comfort and anxiety.

Patients and methods

We used a prospective, single center, endoscopist-blinded, controlled design to conduct our pilot study.

Patients

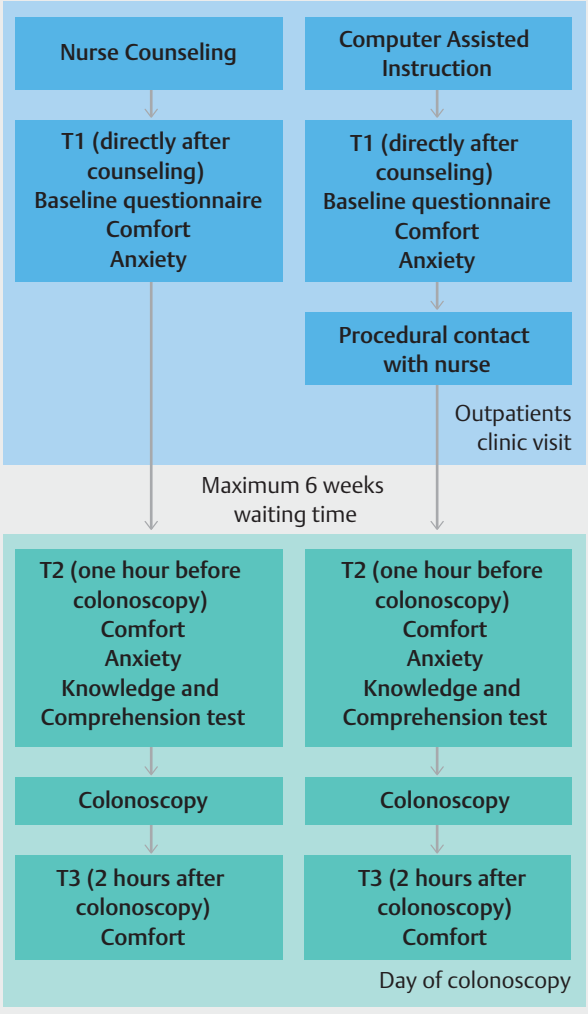
Consecutive patients older than 18 years referred for elective colonoscopy were included from March 2013 until November 2013 in a single, large-volume endoscopy center (over 4000 colonoscopies/year) in the upper Amsterdam Area in the Netherlands. Exclusion criteria were illiteracy in Dutch and significant audiovisual/mental handicaps. Patients were prescribed the same split-dose preparation regimen of picosulfate sodium and low-fiber dietary advice in the days preceding the colonoscopy.

Study design

After informed consent was obtained, patients were divided in 2 groups: the control group received nurse counselling and the intervention group received CAI. We administered 3 patient-questionnaires at 3 time points (See the flowchart in ▶ **Fig. 1**.)

In the first questionnaire, patients reported their baseline characteristics regarding age, gender, educational level, ethnicity, use of drugs, number of recent physician visits and experience in multimedia and Internet access. Patients rated comfort ("How do you feel after the received information?") and anxiety ("How anxious are you") on a 5-point Likert scale (T1). Subsequently the CAI group had contact with a trained endoscopy nurse for practical matters like bridging in anticoagulant therapy, insulin dosage calculation and scheduling of the colonoscopy. In addition, we also provided a unique hyperlink to the CAI with unlimited access. Next, patients were scheduled for colonoscopy, maximum 6 weeks after the counselling session.

After check-in at the endoscopy unit in the hour prior to colonoscopy, patients rated comfort and anxiety. Additionally patient knowledge and comprehension of the provided counselling information were tested in a 10-question survey (T2). Within 2 hours post-colonoscopy, patient comfort was again scored on the 5-point Likert scale (T3).



▶ **Fig. 1** Flowchart

During colonoscopy, the endoscopist assessed bowel cleanliness with the Boston Bowel Preparation Scale (BBPS); a cumulative score of 3 bowel segments, ranging from 0 – 1 "unsatisfactory", 2 – 3 "poor", 4 – 5 "fair", 6 – 7 "good", 8 – 9 "excellent" [17]. To detect subtle differences we applied the Ottawa Bowel Preparation Scale (OBPS). This scale is based on the combination of cumulative scores of 3 bowel segments (0 "excellent", 1 "good", 2 "fair", 3 "poor", 4 "inadequate"), with added points for the amount of residual fluid (0 "none", 1 "moderate" and 2 "large") [18].

Computer-assisted instruction

We designed interactive CAI, according to current best practices, such as good accessibility, plain language and a presentation that engaged the user [19]. We presented the information in a stepwise fashion. CAI consists of a web-based platform using video to mimic the patient journey with a voiceover sup-

▶ **Fig. 2** Several screenshots from the computer-assisted instruction (the people in these stills are actors).

ported by photo's, 3 D animation and instructive texts (▶ **Fig. 2**, CAI is available in Dutch via https://trials.medify.eu/cai-colonoscopy). The video was presented in short clips, maximum of 45 seconds, to maintain patient focus. Patient interaction was ascertained by a mandatory mouse-click after each item in the CAI.

All informative elements, especially mandatory for informed consent for colonoscopy (risks, alternatives) were included.

Outcomes

The primary outcome was cleanliness of the colon during examination as assessed by the OBPS and the BBPS. The secondary outcomes were patient comfort with the received information, anxiety and knowledge and comprehension.

Statistical analyses

A sample size of 322 provides 80 % power, with a 2-tailed α of 0.05, to detect an increase in the primary outcome measure (BBPS) from 6.0 in the control group to 6.5 in the experimental group, with a standard deviation of 1.6.

All analyses were performed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). We used descriptive statistics to describe baseline information including frequency count, percentage and mean ± standard deviation. Further analyses included the chi-square test, independent t-test and Mann-Whitney. P-values under 0.05 were regarded statistically significant.

Registration number

The trial was registered in ClinicalTrials.gov with number: NCT02656602

Ethical considerations

The study was approved by the institutional review board of the Medical Center Alkmaar.

Results

Patients

We included 385 patients, 197 in the nurse counselling group and 188 in the CAI group. Baseline characteristics regarding age, gender, educational level and ethnicity were equally distributed among both groups. Mean age was 57 years (range 18 – 83) in the nurse counselling group versus 59 years (range 18 – 89) in the CAI group. Educational levels were representative to the general Dutch population [20]. The majority of the participants were of Dutch ethnicity (87 %) (▶ **Table 1**).

Both groups were also similar in the number of drugs used and recent physician visits. Use of email was comparably high, over 90 % in both groups (90.9 % versus 94.1 % in the CAI group).

Overall scoring rate of data collection queries at the chosen time points was 99 % at T1, 76.4 % at T2 and 69.9 % at T3. Patients who did not score at T1, T2 or T3 were not included in the time point analysis.

The bowel preparation regimen prescribed was picosulfate sodium (99 %), in split dose. For clinical reasons, 2 patients received polyethylene glycol, sodium sulphate, sodium bicarbonate, sodium chloride, potassium chloride.

Primary outcome

Bowel cleanliness was equal in the 2 groups with mean total BBPS scores of 6.54 (± 1.69) in the nurse counselling group and 6.42 (± 1.62) in the CAI group. This is "good" according to the scale [17].

According to OBPS the nurse counselling group scored 6.07 (± 2.53) and the CAI group 5.80 (± 2.90). Here, the score is "good-fair" (▶ **Table 2**) [18]. Both scales were scored in 60.8 % of all cases. Comparative analysis of the 39.2 % of patients with missing scores showed no significant difference on age, gender or educational level.

▶ **Table 1** Baseline Characteristics.

	Nurse counseling	Computer Assisted Instruction	Nurse versus Computer Assisted Instruction (statistical test)
Gender (n, %)			
▪ **Male**	97 (49.2)	90 (47.9)	p = 0.789
▪ **Female**	100 (50.8)	98 (52.1)	(Chi-Square)
Age (mean, range)	57 years, 18 – 83	59 years, 18 – 89	p = 0.09619 (t-test)
Ethnicity (n, %)			
▪ **Native Dutch**	177 (89.8)	163 (86.7)	P = 0.384
▪ **Other**	20 (10.2)	25 (13.3)	(Chi-Square)
Educational level[1] (n, %)			
▪ **Low**	59 (29.9)	43 (22.9)	P = 0.131 (Mann-Whitney)
▪ **Middle**	68 (34.5	68 (36.2)	
▪ **High**	70 (35.5)	77 (41.0)	

[1] Highest completed educational level was split into 3 levels where "low" comprised no education through to lower secondary education, "middle" comprised upper secondary and middle vocational education, and "high" comprised higher vocational and tertiary education

▶ **Table 2** Primary outcome: Bowel Cleanliness during colonoscopy.

	Nurse counseling (n, % scoring rate)	Computer-assisted instruction (n, % scoring rate)	Nurse versus computer-assisted instruction (Mann-Whitney)
Ottawa Bowel Preparation Scale (mean, SD)	6.07, ± 2.53 (n = 115, 58.4 %)	5.80, ± 2.90 (n = 87, 46.3 %)	***P*** **= 0.418**
Boston Bowel Preparation Scale (mean, SD)	6.54, ± 1.69 (n = 129, 65.5 %)	6.42, ± 1.62 (n = 88, 46.8 %)	***P*** **= 0.576**

Secondary outcomes

Comfort with the received information

Patient comfort scores directly after counselling (T1) were 4.54 ± 0.56 in the nurse counselling group and 4.17 ± 0.51 in the CAI group (p < 0.0001). Patient comfort scores prior to colonoscopy (T2) were significantly higher in the CAI group compared to the nurse counselling group (4.42 ± 0.68 vs 4.29 ± 0.62, *P* = 0.039). Patient comfort scores after colonoscopy (T3) were not different between groups (▶ **Table 3**).

Anxiety

We found no significant differences between groups in the 5-point Likert anxiety scores at T1 (total mean 3.04 ± 1.27) and T2 (total mean 2.84 ± 1.30) (▶ **Table 3**).

Knowledge and comprehension

The scores for the 10-question survey did not differ between groups (7.31 ± 1.11 vs 7.08 ± 1.17, *P* = 0.12) (▶ **Table 3**).

Discussion

The current study shows that CAI before colonoscopy results in well-prepared colons, comparable to face-to-face nurse counselling. We found that patients who were informed through CAI achieved higher grades of comfort. Interestingly, at baseline this rating was higher for the nurse counselling group, suggesting the influence of the human factor.

Current research on patient education in colonoscopy has been focused on use of leaflets, video, phone intervention and nurse or physician counselling sessions [3, 9 – 13]. In this era of information technology with Internet, social media and open access sources, computers are anchored in the seeking and gathering behavior by patients for medical instructions as it is fast, easy to use and ubiquitously accessible. The threat is that the information may be experienced as incomprehensible, insufficient and even incorrect. CAI, as provided by the endoscopy unit, has the potential to combine the upsides of the above tools without drawbacks such as passive learning [21].

CAI empowers the patient in place, pace and moment of learning, known to have impact on patients satisfaction [22]. In addition, reviewing and sharing online information with relatives is comfortably facilitated. In our trial, some patients viewed the CAI up to 6 or 7 times after being provided the secured unique patient hyperlink (data not shown). It is tempting to believe that this contributes to higher grades of comfort before colonoscopy using CAI.

▶ **Table 3** Secondary outcomes: Comfort, anxiety and knowledge and comprehension

	Nurse counseling (n, % scoring rate)	Computer-assisted instruction (n, % scoring rate)	Nurse versus computer-assisted instruction (Mann-Whitney)
Comfort score after consult/CAI (T1) (1 = very low, 5 = very high)	Mean 4.54, ± 0.56 (n = 193, 98.0 %)	Mean 4.17, ± 0.51 (n = 188, 100 %)	**P = 0.000**
Comfort score before endoscopy (T2) (1 = very low, 5 = very high)	Mean 4.29, ± 0.62 (n = 162, 82.2 %)	Mean 4.42, ± 0.68 (n = 124, 66.0 %)	**P = 0.039**
Comfort score after endoscopy (T3) (1 = very low, 5 = very high)	Mean 4.16, ± 0.93 (n = 150, 76.1 %)	Mean 4.28, ± 0.84 (n = 117, 62.2 %)	**P = 0.322**
Anxiety score after consult/CAI (T1) (5 = very low, 1 = very high)	Mean 3.16, ± 1.30 (n = 193, 98.0 %)	Mean 2.92, ± 1.22 (n = 188, 100 %)	**P = 0.071**
Anxiety score before endoscopy (T2) (5 = very low, 1 = very high)	Mean 2.80, ± 1.32 (n = 162, 82.2 %)	Mean 2.90, ± 1.27 (n = 124, 66.0 %)	**P = 0.451**
Knowledge and comprehension 10-item test score before endoscopy	Mean 7.08, ± 1.17 (n = 164, 83.2 %)	Mean 7.31, ± 1.11 (n = 127, 67.6 %)	***P*** **= 0.112**

Familiarity with use of computers, notably among elderly patients, could be of concern. In our cohort, 40 % in the CAI group were older than 65 years. We did not find an age-dependent effect (data not shown). However, before drawing general conclusions from our results, we need to confirm this in larger studies.

Nurse counseling certainly provides personal contact and offers emotional support. Indeed, we observed higher comfort scores immediately after nurse counselling compared to CAI. On the other hand, limitations of this human factor in transferring information include distraction from the content, nuisances in the interpersonal domain and the non-uniformity by definition when different nurses or physicians are involved.

Limitations

A limitation of the current study is its non-randomized design. This was due to the unavailability of the CAI at the start of patient inclusion. However, this design did not affect the scoring by endoscopists as they were unaware of this information and therefore unaware of assignment over the groups while assessing the primary endpoint. The endoscopist scoring rate of 60 % is most probably due to the limited administrative time in daily practice. Also, use of patient-reported questionnaires restricts medical data collection as compared to chart review. Therefore we cannot exclude the possibility of selection bias (such as previous experience with colonoscopy) in assessing secondary endpoints.

Conclusion

We conclude that implementing CAI leads to a properly cleaned colon at colonoscopy, with a positive impact on patient experience. Given the above results, this impact may be further augmented when combining the practical side of CAI with the option of a personalized nurse contact. Computer-aided representation of the patient journey through the medical landscape will require constant feedback and further research should include updates of the current CAI.

Use of a larger randomized controlled, multicenter trial design with these added elements might also show non-inferiority and cost-effectiveness of such an approach. Macroeconomic effects of less short-absence sick leave might also be interesting.

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Competing interests

None

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