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Willingness to undergo colonoscopy with virtual reality instead of procedural sedation and analgesia

Susanne J. Blokzijl^a, Kirsten F. Lamberts^c, Laurens A. van der Waaij^b and Jacoba M. Spikman^d

Objective This study explored the willingness of patients to start colonoscopy with virtual reality (VR) instead of procedural sedation and analgesia (PSA), as well as their motives and characteristics. There is a growing interest in colonoscopy without PSA. Offering VR as a distraction technique instead of PSA may increase the percentage of colonoscopies without PSA.

Patients and methods A survey with demographic, colonoscopy-related and psychology-related questions was completed by 326 adults referred for colonoscopy with PSA.

Results Overall, 25.7% reported to be willing to start with VR instead of PSA. Main reasons for this choice were receiving as little medication as possible, resuming daily life activities faster and participating in traffic independently afterwards. Logistic regression analysis showed that significant predictors of the willingness to use VR were male sex, higher educational level and absence of worries about the outcome of the colonoscopy.

Conclusion If VR turns out to be effective in the future, present results may be useful to customize patient information to help patients choosing VR. *Eur J Gastroenterol Hepatol* 31:334–339
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Introduction

Procedural sedation and analgesia (PSA) is standard used in many countries to manage colonoscopy-related pain and facilitate the procedure [1,2]. However, PSA involves costs and has disadvantages such as cardiopulmonary adverse effects and interruption of daily activities [3,4]. These disadvantages are frequently mentioned as reasons to refuse colonoscopy [5]. Colonoscopy without PSA, commonly referred to as unsedated colonoscopy, has increasingly been performed in the past decade [1,6]. Percentages of patients willing to undergo unsedated colonoscopy vary between 17 and 56% [5,7–9]. However, a part of these patients (2–23%) is not able to complete the colonoscopy without PSA and ask for PSA during the procedure [7–11].

To enable more patients to profit from the advantages of colonoscopy without PSA, it is relevant to seek for approaches that may facilitate this choice. Distraction methods as non-pharmacological pain relief during colonoscopy might be a promising alternative for PSA. Previous studies investigated audio distraction (music) and a combination of visual and audio distraction (video)

during colonoscopy. These distraction methods were associated with good patient satisfaction with the procedure but were inconclusive with respect to reduction of pain and need for PSA [12–17]. This suggests that these distraction techniques may probably not be powerful enough to replace PSA.

With growing evidence for virtual reality (VR) as an immersive distraction technique during other medical procedures, VR may be a powerful candidate to replace PSA during colonoscopy. The immersive effect of VR is realized by isolation from the external medical setting, by the provision of multisensory information and the eliciting of interactions in a three-dimensional simulated world [18]. A recent systematic review of randomized controlled trial studies on VR as pain relief in various medical settings, showed that ‘both physiological and psychological measures suggest that VR is a helpful clinical tool in pain distraction’ (p.19) [19]. Another review, on VR as pain distraction in burn care, yielded also evidence that the combination of VR and pharmacological pain relief resulted in significantly lower pain levels compared with pharmacological pain relief alone [20].

Before investigating whether VR is effective as a distraction technique during colonoscopy without PSA, this study aimed to explore the willingness of patients, who are scheduled for colonoscopy, to use VR with the possibility of PSA on demand. Furthermore, demographic, colonoscopy-related and general psychological factors predicting this willingness were identified.

Patients and methods

Study population

All patients of 18 years and older, who were referred for a nonemergent colonoscopy in the period of April 2013 to June 2014, were eligible. Indications for colonoscopy were

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Keywords: colonoscopy, distraction, pain management, unsedated colonoscopy, virtual reality

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(a) to examine gastrointestinal complaints (complaints colonoscopy), (b) to screen for possible colonic disease because of a positive fecal test in the population screening colon cancer (screening colonoscopy), or (c) to evaluate the colon because of polyps in the past (surveillance colonoscopy) [4]. Patients referred for colonoscopy in combination with a gastroscopy were excluded. This study was approved by the Hospital Medical Ethics Committee and registered in the Dutch Trial Registry (NTR4344). All procedures followed were in accordance with the standards of the Hospital Medical Ethics Committee. Informed consent was obtained from all individual participants included in the study.

Study procedure

This was a cross-sectional study using a survey. Together with the invitation for the scheduled colonoscopy, patients received a survey and an accompanying information letter at home. They were asked to complete the survey before the actual colonoscopy took place. By returning the survey, patients gave written informed consent for participation in this study. Participation did not influence the subsequent colonoscopy: all colonoscopies were performed as usual starting with or without PSA.

Materials

With the information letter, patients were informed about the background of this study, including the use of PSA as standard care to manage feelings of pain and discomfort and the disadvantages related to the use of PSA. It was mentioned that one of three patients can complete colonoscopy without PSA and is satisfied with this procedure. Moreover, the information letter states that because of positive effects of VR in burn care, VR can be introduced as alternative for PSA during colonoscopy. VR was described as a three-dimensional game, whereby screen and sound are integrated in video glasses. The aim being the redirection of attention from colonoscopy to this VR-game, resulting in a lower pain experience. In the information letter, it was also explicitly mentioned that patients choosing VR still had the option to receive PSA on demand at any moment during the procedure. Furthermore, it was made explicitly clear that participation in this survey study had no consequences for the scheduled colonoscopy.

The survey was created based on previous studies on factors associated with pain during colonoscopy [21], the willingness to undergo colonoscopy without PSA [1,5,7,8,10] and pain management in general [22–24]. The first question (Appendix 1, Supplemental digital content 1, <http://links.lww.com/EJGH/A375>) defined two groups: VR group (answer ‘yes’) and Non-VR group (answer ‘no’). The other questions investigated motives for the choice (Appendix 1, Supplemental digital content 1, <http://links.lww.com/EJGH/A375>), demographic information (age, sex and educational level), information related to the scheduled colonoscopy (Appendix 2, Supplemental digital content 2, <http://links.lww.com/EJGH/A376>) and general psychological information (Appendix 3, Supplemental digital content 3, <http://links.lww.com/EJGH/A377>).

Statistical analysis

The variables were described for the group in total as well as for the VR group and non-VR group separately. Group differences were analyzed with Mann–Whitney *U*-tests (continuous variables) or χ^2 -tests (categorical variables). Logistic regression analysis was used with ‘the willingness of patients to start colonoscopy with VR’ as dependent variable. All 14 independent variables were included, except the variable ‘preferring to use PSA during the scheduled colonoscopy’ because this question was only used to get an indication of the willingness percentage of the Dutch population to undergo colonoscopy without PSA. All analyses were performed with SPSS for windows version 20.0 (International Business Machines Corp., Armonk, New York, USA) [25]. The α levels were set at 0.05. Missing data were reported from 5 or more missing values per variable.

Results

The questionnaire was sent to 598 patients, of which 326 (55%) responded. A total of six returned questionnaires were excluded because the first question was not answered. Characteristics of the remaining 320 responders are presented in Tables 1–3.

Willingness and motives to use virtual reality

VR as an alternative for standard PSA during colonoscopy was a preferable option for 25% ($n=80$; VR group). The other 75% ($n=240$; non-VR group) preferred colonoscopy with PSA. Table 4 presents the motives of the VR group for preferring VR instead of PSA. The most frequently mentioned motives were receiving as little medication as possible, resuming daily activities sooner, participating in traffic independently afterwards and having confidence in the doctor. These motives were equally chosen by men and women. However, women chose the option ‘other reason’ more often than men ($P<0.05$). Frequently reported reasons were supporting research, believing in the efficacy of VR, staying in control and fear for PSA.

Table 5 presents motives of the non-VR group for preferring PSA, with two significant differences between men and women in the most frequently mentioned motives. These most frequently mentioned motives were having had a previous colonoscopy, having no interest in VR ($P=0.019$) and expected procedure-related pain ($P=0.025$). The option ‘other reasons’ include answers as wanting PSA during the first colonoscopy and not to experience the colonoscopy consciously.

Virtual reality group and nonvirtual reality group

The characteristics of both groups are presented in Table 1. The VR group was on average younger and had significantly more male and higher educated patients compared with the non-VR group.

Table 2 presents the results of both groups with respect to the questions about the scheduled colonoscopy. Regarding the medical indication, the VR group had significantly more indications for a screening colonoscopy, and the non-VR group had significantly more indications for a surveillance colonoscopy. The VR group had also significantly more patients who intended to undergo the scheduled colonoscopy without PSA. In particular, all

Table 1 . Patient characteristics

Variables	Total [n (%)]	VR group [n (%)]	Non-VR group [n (%)]	P value ^a
Age [mean (SD); range]	57.2 (11.3; 20–83)	54.3 (11.6; 20–77)	58.1 (11.1; 20–83)	0.007** [†]
Male sex	131 (41)	43 (54)	88 (37)	0.008*
Educational level				0.001*
Lower education	48 (15)	2 (3)	46 (19)	
Secondary education	107 (34)	26 (33)	81 (34)	
Higher education	161 (51)	51 (65)	110 (46)	

VR, virtual reality.

^a χ^2 -test.* $P < 0.01$, significant.[†]Mann–Whitney U -test.**Table 2 .** Colonoscopy-related variables

Variables	Total [n (%)]	VR group [n (%)]	Non-VR group [n (%)]	P value ^a
Indication for colonoscopy ^b				0.024*
Complaints	186 (62)	46 (60)	140 (63)	
Screening	44 (15)	18 (23)	26 (12)	
Surveillance	71 (24)	13 (17)	58 (26)	
Preferring to use PSA during the scheduled colonoscopy ^c	292 (93)	56 (73)	236 (100)	0.000**
Previous experience with colonoscopy	177 (56)	39 (49)	138 (58)	0.161
Worries about outcome colonoscopy	132 (42)	23 (29)	109 (46)	0.007*
Worries about procedure-related pain	47 (15)	13 (16)	34 (14)	0.668
Worries about adverse events	39 (12)	12 (15)	27 (11)	0.389
Expecting procedure-related pain ^c	171 (55)	48 (63)	123 (52)	0.099
Abdominal pain in preceding month	143 (45)	35 (44)	108 (46)	0.755

These results are based on the answers of the questions in Appendix 2 (Supplemental digital content 2, <http://links.lww.com/EJGH/A376>).

Regarding the question 'expecting procedure-related pain': the answer options 'yes' and 'a little' were merged in 1 option 'yes'.

VR, virtual reality.

^a χ^2 -test.^b19 missing values, including 14 values caused because multiple answers were given despite the restriction that only one answer should be given.^cSix to nine missing values.* $P < 0.05$, significant.** $P < 0.01$, significant.**Table 3 .** Psychology-related variables

Variables	Total [n (%)]	VR group [n (%)]	Non-VR group [n (%)]	P value ^a
Anxiety as a trait ^b	52 (17)	9 (11)	43 (18)	0.139
Need for control ^b	173 (56)	42 (53)	131 (57)	0.584
Coping, active ^b	262 (84)	72 (90)	190 (82)	0.077
Somatiform complaints	96 (30)	17 (21)	79 (33)	0.044*

These results are based on the answers of the questions in Appendix 3 (Supplemental digital content 3, <http://links.lww.com/EJGH/A377>).

VR, virtual reality.

^a χ^2 -test.^bSix to ten missing values.* $P < 0.05$, significant.

participants who intended to undergo the colonoscopy without PSA were also willing to use VR, and they account for 27% of the VR group. Regarding the outcome of the scheduled colonoscopy, the non-VR group had significantly more worries than the VR group.

The results regarding the general psychological characteristics are presented in Table 3. The non-VR group reported significantly more often physical symptoms in response to stress than the VR group.

Prediction of the willingness to choose for VR

Logistic regression analysis showed that sex, educational level and worries about the outcome had a significant contribution in the model predicting willingness to start

colonoscopy with VR instead of PSA (Table 6). The chance that patients were willing to use VR was lower for females, lower educational levels or presence of worries about the outcome of the colonoscopy. Nagelkerke's R^2 of 0.23 indicated that the predictive value of this model was low, whereby only 77.1% of the patients would be predicted correctly.

Discussion

This is the first study exploring the willingness of a large group of patients, scheduled for colonoscopy with PSA, to start colonoscopy with VR instead of PSA. More than a quarter of the patients reported to be willing to use VR. This willingness was predicted by male sex, higher educational level and absence of worries about the colonoscopy outcome.

Offering VR may increase the number of patients willing to start colonoscopy without PSA: at present, only 7% of the patients expected to start the scheduled colonoscopy without PSA (percentages of actual colonoscopies without PSA in the Dutch population are unknown. To get an indication, we asked our participants if they expected to ask for PSA during the scheduled colonoscopy). With VR, this percentage may increase to 25%, as this was the percentage of patients reporting to be willing to try VR. In addition to this, all participants who were expecting to start the scheduled colonoscopy without PSA were also willing to use VR, and this number of 7% of the total group, accounts for 27% of the VR group. Apparently, for

Table 4. The number of times each motive for choosing virtual reality was mentioned

Reasons	Total [n (%)]	Male [n (%)]	Female [n (%)]	P value ^a
Receiving as little medication as possible	56 (72)	30 (71)	26 (72)	0.938
Resuming daily activities sooner	34 (44)	21 (50)	13 (36)	0.218
Participating in traffic independently afterwards	23 (30)	13 (31)	10 (28)	0.759
Having confidence in the doctor	23 (30)	13 (31)	10 (28)	0.759
Other reasons (to be specified)	16 (21)	5 (12)	11 (31)	0.042*
Having had a previous colonoscopy	12 (15)	8 (19)	4 (11)	0.333
Having a relative who has had a previous colonoscopy	1 (1)	0 (0)	1 (3)	0.277

These results are based on the answers of question 2 of Appendix 1 (Supplemental digital content 1, <http://links.lww.com/EJGH/A375>).

^a χ^2 -test.

* $P < 0.05$, significant.

Table 5. The number of times each motive for choosing 'no virtual reality' was mentioned^a

Reasons	Total [n (%)]	Male [n (%)]	Female [n (%)]	P value ^b
Having had a previous colonoscopy	81 (35)	28 (33)	53 (37)	0.514
Having no interest in virtual reality	61 (26)	30 (35)	30 (21)	0.019*
Expecting procedure-related pain	44 (19)	10 (12)	34 (24)	0.025*
Other reasons (to be specified)	42 (18)	19 (22)	23 (16)	0.245
Having procedure-related anxiety	40 (17)	11 (13)	29 (20)	0.155
Having a relative who has had a previous colonoscopy	29 (12)	12 (14)	17 (12)	0.635

These results are based on the answers of question 3 of Appendix 1 (Supplemental digital content 1, <http://links.lww.com/EJGH/A375>).

^aNine missing values.

^b χ^2 -test.

* $P < 0.05$, significant.

Table 6. Prediction model of the willingness to use virtual reality by demographic, colonoscopy-related and psychology-related variables

Variables	OR	95% CI for OR		P value
		Lower	Upper	
Constant	0.54			0.351
Sex	0.52	0.28	0.97	0.038*
Age	0.98	0.95	1.01	0.108
Lower education	0.11	0.02	0.53	0.006**
Secondary education	0.82	0.44	1.53	0.525
Indication surveillance colonoscopy	0.97	0.39	2.43	0.953
Indication screening colonoscopy	2.07	0.87	4.93	0.102
Previous experience with colonoscopy	0.91	0.46	1.80	0.775
Worries about outcome	0.49	0.25	0.94	0.033*
Worries about procedure-related pain	0.89	0.37	2.17	0.802
Worries about adverse events	2.29	0.94	5.55	0.067
Expecting procedure-related pain	1.87	0.96	3.66	0.067
Abdominal pain in preceding month	1.22	0.62	2.41	0.571
Anxiety as a trait	0.82	0.31	2.14	0.686
Need for control	0.80	0.43	1.48	0.468
Active coping style	1.13	0.42	3.07	0.808
Somatoform complaints	0.58	0.27	1.22	0.150

Age (20–83 years) was a continuous variable and centered around the median. The other variables were categorical: 0 = no and 1 = yes, except sex: 0 = man and 1 = women. 'Educational level' and 'indication for colonoscopy' originally had three categories and were recoded into dummy variables. In 'educational level': 'higher educational level' became the reference and 'lower educational level' and 'secondary educational level' became dummy variables (0 = no; 1 = yes). In 'indication for colonoscopy': 'indication because of complaints' became the reference and 'indication surveillance colonoscopy' and 'indication screening colonoscopy' became dummy variables (0 = no; 1 = yes). The 'Enter Method' was used to include the variables in the model.

$R^2 = 0.15$ (Hosmer and Lemeshow), 0.16 (Cox and Snell), 0.23 (Nagelkerke). Model $\chi^2(16) = 48.57$; $P < 0.001$. 36 missing cases, $N = 284$.

CI, confidence interval; OR, odds ratio.

* $P < 0.05$, significant.

** $P < 0.01$, significant.

the other 73%, VR was the reason to change their minds about undergoing colonoscopy without PSA. Still, most patients in our study were not interested in VR as alternative for PSA.

Differences in patient characteristics between the VR group and non-VR group are broadly comparable with differences between patients willing versus those not willing to undergo colonoscopy without PSA as found in other studies [1,5,7,8,10]. Compared with the non-VR group, the VR group was characterized by male sex, higher educational level and absence of worries. Remarkably, the presence of anxiety was not related to the willingness to use VR although it was related to a preference for the use of PSA [1,5,7,8]. In our study, however, the influence of anxiety may partially be reflected in the variables representing health-related stress. The non-VR group reported increased health-related stress: they had more often worries about the colonoscopy outcome and 'somatoform complaints' compared with the VR group. Patients with somatoform complaints, which refers to physically unexplained complaints, are often prone to stress and, in particular, less able to cope successfully with health-related stress [26]. It should be noted that, despite the fact that commonly reported somatoform complaints refer to gastrointestinal sensations [27], we do not suggest that the abdominal complaints reported by our patients can be seen as somatoform.

In contrast to other studies, which found that patients preferring colonoscopy without PSA were significantly older than patients preferring PSA [1], we found that patients willing to use VR instead of PSA were significantly younger than patients not willing to use VR. This age difference might be explained by the greater interest and involvement of younger people in gaming [28,29]. Moreover, younger people report less concerns about the harmfulness of playing computer games [28]. Therefore, we presume that younger people rely more on the distractive-capacity and sedative power of VR because they are already familiar with this.

Important motives of patients not choosing VR instead of PSA were no interest in the VR technique and the idea that VR would not be able to relieve the expected level of procedure-related pain. Moreover, patients refused VR because they had a positive experience with PSA in a previous colonoscopy. However, the number of previous colonoscopies did not discriminate between the VR group and non-VR group. Patients were motivated to use VR instead of PSA because they had confidence in the doctor and appreciated the advantages of omitting PSA, as being allowed to drive a car and being able to resume daily activities afterwards. These advantages may be particularly relevant for patients who are working. With the implementation of the colon cancer screening the percentage of younger and working patients, in the total group undergoing a colonoscopy, increases [1]. Adverse effects of PSA, such as interruption of daily activities, will affect mainly younger people in the working age and actually turned out to be reasons to refuse participation in the screening [1]. As VR offers the possibility of undergoing the procedure without these adverse effects, this alternative may prove to be especially important for the acceptance and participation in the screening population.

The present results should be understood in the light of some limitations. First, this study was a first exploration and therefore, based on a hypothetical question. Although patients were scheduled to receive colonoscopy, VR was not actually offered during this colonoscopy. All scheduled colonoscopies were performed as usual starting with or without PSA. It is not certain that all patients who claim to choose for VR will stick to their choice when the time is there. Future studies will have to evaluate the number of patients that will actually undergo colonoscopy with VR. Secondly, to explore psychological variables, such as anxiety or coping style which were assumed to be associated with the willingness to undergo colonoscopy with VR, only single questions were used in our study to measure these constructs. This was done to keep the survey short and manageable and increase the response rate. However, this may have affected the reliability of these data. In more extensive research on the influence of such variables, it is preferable to use validated questionnaires. Third, the question referring to the indication for the colonoscopy did not allow patients to select more than one option, whereas, in the end, more than one indication proved to be possible. Consequently, we did not have a complete view of all the indications for colonoscopy.

In conclusion, the possibility of using VR may increase the percentage of patients willing to start colonoscopy without PSA in a setting in which PSA is the standard care. This may have several benefits for patients and health care settings. The percentage of patients choosing VR, however, was only 25%. Lack of evidence for VR as alternative for PSA may have contributed to this relatively low percentage. Future studies have to investigate the effect of VR on colonoscopy-related pain. Current results can be used to customize patient information to help patients choose VR, and if VR is proven to be beneficial as pain relief, it may increase the percentage of patients choosing VR instead of PSA.

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Conflicts of interest

There are no conflicts of interest.

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