JGH Open Open Access An open access journal of gastroenterology and hepatology

JGHF Journal of Gastroenterology and Hepatology Foundation

doi:10.1002/jgh3.13046

ORIGINAL ARTICLE

Use of virtual reality in patient education program to reduce anxiety in upper gastrointestinal endoscopy: A randomized controlled trial

Surachet Siripongsaporn,* Karn Yongsiriwit,† Kittithat Tantitanawat* and Sakkarin Chirapongsathorn*

*Division of Gastroenterology, Department of Medicine, Phramongkutklao Hospital and College of Medicine and †College of Digital Innovation Technology, Rangsit University, Bangkok, Thailand

Key words
EGD, patient education, virtual reality.

Accepted for publication 18 February 2024.

Correspondence
Dr Sakkarin Chirapongsathorn, Division of Gastroenterology and Hepatology, Phramongkutklao Hospital and College of Medicine, 315 Ratchawithi Rd, Ratchathewi, Bangkok 10400, Thailand. Email: sakkarin.chi@pcm.ac.tph

Declaration of conflict of interest: "No competing interests declared for either author".
Author contribution: Surachet Siripongsaporn and Karn Yongsiriwit: study management, research implementation, data analysis and interpretation, and drafting the article. Surachet Siripongsaporn and Sakkarin Chirapongsathorn were vital as implementers, data collectors, data interpretation, and manuscript revising. Sakkarin Chirapongsathorn and Karn Yongsiriwit: study design, data interpretation, and final approval of the version. All authors: final approval of the version to be published.
Financial support: The present study was supported by a grant from Department of Medicine, Phramongkutklao Hospital and The Gastroenterological Association of Thailand (GAT).

Funding support: Department of Medicine, Phramongkutklao Hospital and The Gastroenterological Association of Thailand (GAT)

Abstract

Background and Aim: Virtual reality (VR) provides an immersive image-viewing experience that has recently been expanding its use in clinical medicine. We aimed to examine a patient education program by VR to reduce anxiety in patients undergoing esophagogastroduodenoscopy (EGD).
Methods: We conducted a randomized controlled trial and consecutively enrolled patients who had an indication for unsedated EGD with topical anesthesia. Patients were randomly assigned to use Oculus GO with three-dimensionally specific software content (a stand-alone VR headset) for patient education or standard patient education using oral information (the control group) before EGD. The primary outcome was the variation in anxiety scores before and after patient education programs.
Results: A total of 107 patients underwent EGD and received a VR ($n = 58$) and control ($n = 49$) patient education program. The mean anxiety score before starting the patient education program was 41.4 9.6 in the VR group and 41.9 7.7 in the control group. The mean anxiety score after the patient education program was 37.1 10.8 in the VR group and 38.9 8.07 in the control group (P-value = 0.354). The anxiety score in the VR group decreased more than in the control group but was not significant. The recall questionnaire scores were higher in the VR group (4.70.4) than the control group (3.91, P-value 0.001).
Conclusion: A virtual reality-assisted patient education program before EGD did not significantly reduce anxiety but may provide more memory and understanding about the procedure to patients who underwent unsedated EGD.

Introduction

Esophagogastroduodenoscopy (EGD) is the standard test for the diagnosis and treatment of upper gastrointestinal symptoms. Despite being a common and simple procedure for gastroenterologists, EGD is still considered an invasive and unpleasant procedure that may lead to anxiety, fear, abdominal fullness, and pain from most patients' perspectives.[1,2]

Previous data showed that interventions before endoscopy, such as patient education by healthcare providers, brochures, and video media, could reduce anxiety and decrease the time of the procedure.[3] These interventions were well validated by standardized anxiety evaluation tools but this briefing's focus is on human factors that could lead to such errors.[4,5] Virtual reality (VR) is an interactive simulation that makes use of pose tracking

and 3D near-eye displays to give the user an immersive feel of a virtual world. Numerous studies have shown that using VR to teach medical students enhances learning and understanding of physical structures. However, there was no prior well-validated study evaluating the implementation of VR in a patient education program to reduce anxiety in upper gastrointestinal endoscopy, even though there was evidence showing that the use of VR intervention in patient education is more effective compared with control (i.e. standard care) for anxiety, depression, fatigue, and pain in other patient groups.[6,7]

In an effort to research the use of VR for patient education, we aimed to elaborate on existing evidence by examining the anxiety of VR and standard patient education before EGD.

Materials and method

Study design and study population. This is a randomized controlled trial study. We consecutively recruited outpatients who had an indication for EGD with topical anesthesia at Phramongkutklao Hospital, which is a tertiary care referral center in Bangkok, Thailand, from November 2021 to January 2023. The inclusion criteria were as follows: (1) aged 18 years or over; (2) scheduled for routine, diagnostic, non-advanced EGD; (3) unseated; and (4) undergoing EGD for the first time. The exclusion criteria were as follows: (1) blindness; (2) deafness; (3) claustrophobia; and (4) achluophobia.

Randomization and interventions. Patients were randomly assigned to use either a standalone VR headset (Oculus Quest 2) with three-dimensionally specific software content for patient education (Supplementary Fig. 1) or standard patient education using oral information as a control group before EGD (Supplementary Fig. 2).

In both groups, the patient education program dialog included an explanatory leaflet about the upcoming examination, including what EGD is, how the procedure is performed, what the purpose of the procedure is, the adverse event risks of EGD, and how to observe complications after the procedure. The difference is the message delivery method.

We used a validated self-answered questionnaire called the State–Trait Anxiety Inventory (STAI) Form X-1 to evaluate anxiety before and after the patient education session. The range of scores is 20–40 points for low anxiety, 41–60 points for moderate anxiety, and 61–80 points for high anxiety. After the EGD, we would use another questionnaire to evaluate the recall of patient education program information. Data about patients' vital signs, pain scores, and both patients' and doctors' satisfaction scores would also be collected.

Statistical analysis. The sample size calculation was derived from the Testing Two Independent Means Formula. The mean and SD for the calculation were referenced from a previous study evaluating the effect of information and behavioral training on endoscopy patients' clinical outcomes.[4] The total number of required participants was at least 70, and we allocated these people equally into two groups: group 1 (VR) and group 2 (control). Thus, at least 35 participants were required in each group of the study.

Results were summarized as means (standard deviation) and medians (interquartile range) for continuous data and as frequencies and proportions for categorical data. Because of the paired study design, the chi-square test was used for the comparison of categorical data, whereas the paired t-test was used to compare continuous data. Statistical significance was determined at $P < 0.05$.

Outcomes. The primary outcome was the variation of anxiety scores, before and after patient education programs. The secondary outcome was the recall of patient education program information after education programs by using questionnaires (full score = 5 points), pain score by using the 10-point Visual Analogue Scale (VAS), and patients' and doctors' satisfaction scores (1 = extremely dissatisfied, 2 = dissatisfied, 3 = undecided; 4 = satisfied, and 5 = extremely satisfied). Adverse events were also collected.

Results

This prospective study included 107 patients (38 men, 69 women; median age 58 years) who were eligible according to study protocol and consented to undergo non-sedated EGD with topical anesthesia using lidocaine spray for pharyngeal anesthesia (Fig. 1). All patients successfully completed EGD with no complications during endoscopy. The 58 patients received VR, and the 49 patients received standard patient education programs. Demographics and baseline characteristics were similar between the VR group and the control group (Table 1).

Primary outcome. The mean anxiety score before starting the patient education program was 41.4 ± 9.6 in the VR group

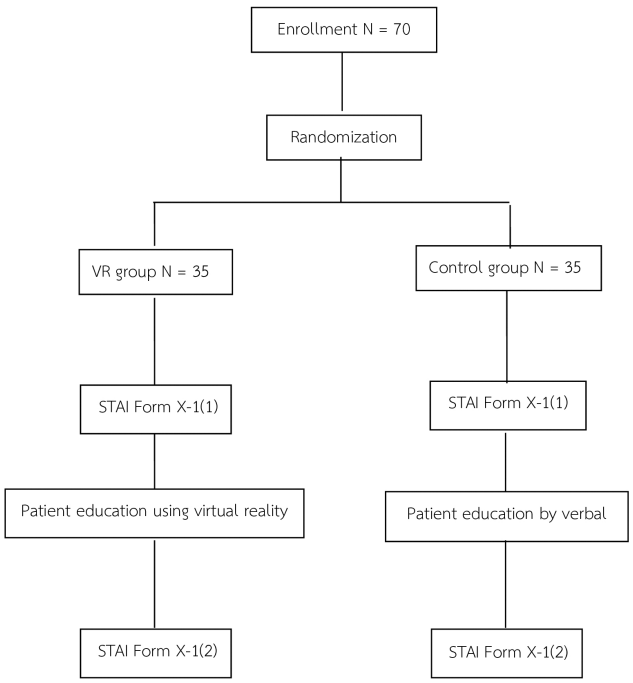

Figure 1 Patients' flowchart.

Table 1 Baseline characteristics of study participants

	VR ($n = 58$)	Control ($n = 49$)	*P*-value
Sex, *n* (%)			
Female	34 (58.6%)	35 (71.4%)	0.168
Male	24 (41.4%)	14 (28.6%)	
Age, year (SD)	55.67 ± 13.41	60.96 ± 12.89	0.041*
Body Weight, kg (SD)	62.19 ± 12.7	58.98 ± 12.7	0.196
Height, cm (SD)	161.62 ± 8.68	160.24 ± 9.18	0.428
BMI, kg/m^2 (SD)	23.73 ± 3.95	22.92 ± 4.32	0.315
NSAID, *n* (%)	2 (3.4%)	3 (6.1%)	0.514
Antiplatelet, *n* (%)	8 (13.8%)	4 (8.2%)	0.358
Anticoagulant, *n* (%)	1 (1.7%)	3 (6.1%)	0.232
Education, *n* (%)			
No study	1 (1.7%)	3 (6.1%)	0.678
High school	20 (34.5%)	16 (32.7%)	
Bachelor's degree	33 (56.9%)	28 (57.1%)	
Master's degree	3 (5.2%)	2 (4.1%)	
Ph.D.	1 (1.7%)	0 (0%)	
Underlying diseases, *n* (%)			
Diabetes	12 (20.7%)	10 (20.4%)	0.971
Hypertension	24 (41.4%)	24 (49%)	0.431
Dyslipidemia	25 (43.1%)	23 (46.9%)	0.691
Liver disease	10 (17.2%)	8 (16.3%)	0.900
Chronic kidney disease	4 (6.9%)	2 (4.1%)	0.528
Coronary arterial disease	1 (1.7%)	1 (2%)	0.904
Pulmonary disease	0 (0%)	1 (2%)	0.274
Neurology disease	2 (3.4%)	4 (8.2%)	0.291
Indication for EGD, *n* (%)			
Dyspepsia	22 (37.9%)	18 (36.7%)	0.902
Gastroesophageal reflux disease	15 (25.9%)	14 (28.6%)	
Upper GI bleeding	3 (5.2%)	2 (4.1%)	
Dysphagia	0 (0%)	1 (2%)	
Iron deficiency anemia	10 (17.2%)	6 (12.2%)	
Abdominal pain	3 (5.2%)	2 (4.1%)	
Esophageal varices	5 (8.6%)	6 (12.2%)	

Independent t-test and chi-square test.

Table 2 Analysis of the primary outcome

	VR ($n = 58$)	Control ($n = 49$)	*P*-value
Anxiety score before patient education (SD)	41.48 ± 9.65	41.92 ± 7.73	0.800
Anxiety score after patient education (SD)	37.19 ± 10.87	38.94 ± 8.07	0.354
Anxiety score before–after (SD)	4.22 ± 5.62	2.96 ± 5.12	0.230
P-value (pre *vs* post)	<0.001*	<0.001*	

and 41.9 ± 7.7 in the control group. The mean anxiety score after the patient education program was 37.1 ± 10.8 in the VR group and 38.9 ± 8.07 in the control group (*P*-value = 0.354). The variation in decreasing anxiety score before and after the patient education program was 4.2 ± 5.6 in the VR group and 2.9 ± 5.1 in the control group (*P*-value = 0.230; Table 2).

Secondary outcome. The anxiety score in the VR group decreased more than in the control group but did not reach statistical significance (Fig. 2). The recall questionnaire scores were higher in the VR group (4.7 ± 0.4) than in the control group (3.9 ± 1, *P*-value 0.001; Fig. 3). Patients' and doctors' satisfaction in both groups was extremely high, but the VR group had higher percentages than the control group (37% *vs* 26%, 39% *vs* 24%; Table 3). No significant difference was observed in pain scores between groups. Gastritis is the most common diagnosis in this journal (Table 4).

Discussion

VR has been studied for patient education before procedures such as radiation therapy and coronary procedures, but there has been no prior study of VR for patient education before

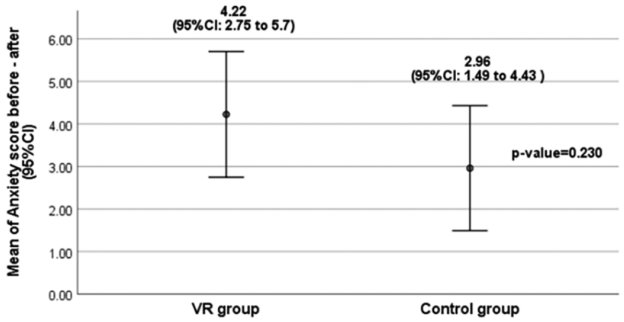

Figure 2 Anxiety score before–after endoscopy.

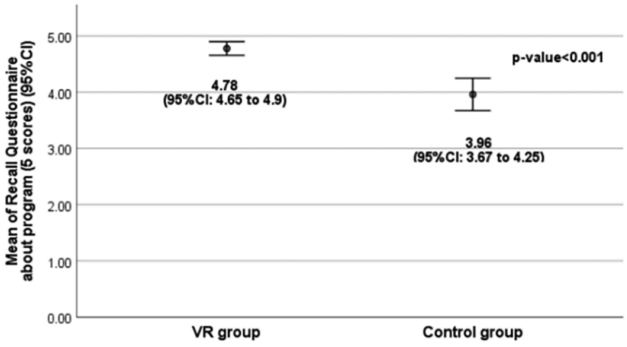

Figure 3 Recall Questionnaire about the program.

undergoing EGD. This article is the first randomized control trial comparing VR and standard patient education by physician counseling in terms of anxiety reduction. The anxiety score before patient education is 41.48 ± 9.65 points in the VR group and 41.92 ± 7.73 points in the control group. About 41 points is a lower limit of moderate anxiety. The anxiety score after patient education is 37.19 ± 10.87 points in the VR group and 38.94 ± 8.07 points in the control group. Although not statistically significant, there was a trend toward better anxiety reduction in the VR group compared to the control group (4.22 ± 5.62 *vs* 2.96 ± 5.12, *P*-value = 0.230).

We use a questionnaire after the intervention to check the recall memory. The VR group has more points than the control group (4.78 ± 0.46 *vs* 3.96 ± 1 *P*-value = <0.001). VR might potentially make patients more focused compared to standard care. Thus, they could remember more information after the procedure. This study was collected during the COVID-19 outbreak in Thailand. VR for patient education reduced close contact from person to person and reduced the workloads of healthcare workers. This new technology could help us deliver patient care much more efficiently. VR is also regarded as a well-established and powerful tool in reducing autonomic response pain and has been demonstrated in procedures.[8,9] However, in recent, a randomized controlled trial found that VR-assisted anesthesia during EGD did not significantly reduce patient pain during esophageal intubation. Additionally, there is no advantage to adopting VR distraction over normal EGD without VR in terms of patient and endoscopist satisfaction.[10]

There were some limitations in our study. First, the interventions in both arms could not be blinded. However, the

Table 3 Analysis of the secondary outcome

	VR ($n = 58$)	Control ($n = 49$)	*P*-value
Recall Questionnaire about the program (total score of 5) (SD)	4.78 ± 0.46	3.96 ± 1	<0.001*
Pain score 0–10 points (SD)	0.45 ± 1.19	0.67 ± 1.43	0.376
Patient satisfaction, *n* (%)			
Undecided	7 (12.1%)	5 (10.2%)	0.366
Satisfied	14 (24.1%)	18 (36.7%)	
Extremely satisfied	37 (63.8%)	26 (53.1%)	
Doctor satisfaction, *n* (%)			
Undecided	10 (17.2%)	5 (10.2%)	0.013*
Satisfied	9 (15.5%)	20 (40.8%)	
Extremely satisfied	39 (67.2%)	24 (49%)	

Table 4 Post-EGD diagnosis

	VR ($n = 58$)	Control ($n = 49$)	*P*-value
Post-EGD diagnosis, *n* (%)			
Normal	2 (3.4%)	1 (2%)	0.775
Gastritis	46 (79.3%)	35 (71.4%)	
Gastroesophageal reflux disease	4 (6.9%)	4 (8.2%)	
Peptic ulcer disease	5 (8.6%)	6 (12.2%)	
Esophageal varices	1 (1.7%)	2 (4.1%)	
Gastric cancer	0 (0%)	1 (2%)	

outcomes were measured by self-reported questionnaires, and all the patients were independent of the study results. Second, external validity when applying different VR devices might be of concern. Still, any standalone VR headset would have basic functions similar to the Ocular GO.

Conclusion

Our randomized controlled trial showed that VR-assisted patient education program before EGD did not significantly reduce anxiety but may provide more memory and understanding about the procedure to patients who underwent non-sedated EGD. Further studies are required to detect any true clinical advantage of VR in patient education.

Acknowledgments

The authors thank Mr. Thomas Mc Manamon from the Office of Research and Development Phramongkutklao College of Medicine for English Language Editing.

The author would like to express sincere gratitude to Dr. Ekapong Nopawong and the team from College of Digital Innovation Technology, Rangsit University, Bangkok, Thailand, for creating virtual reality (VR) content for the patients in this study.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website:

Supplementary Figure 1. Virtual reality (VR).
Supplementary Figure 2. Patient education program.