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Evaluation of the Effect of Virtual Reality Glasses on Preoperative Surgical Anxiety in Adult Patients

Effect of VR on Preoperative Anxiety

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Abstract: Objective: Patients often experience varying levels of anxiety before surgery. It is essential to assess and address preoperative anxiety for each patient to ensure optimal outcomes. This study aims to evaluate the effectiveness of virtual reality (VR) glasses in reducing preoperative anxiety in patients undergoing laparoscopic cholecystectomy.

Method: This prospective, observational cohort study included 84 patients aged 18–65 scheduled for elective laparoscopic cholecystectomy with an American Society of Anesthesiologists (ASA) physical status of I or II. Participants viewed a 30-minute VR video using a smartphone and VR headset. Oxygen saturation and heart rate were recorded before and after the VR session. Additionally, patients completed the "Anxiety Specific to Surgery Questionnaire" both before and after the VR intervention.

Results: The study included 84 patients undergoing laparoscopic cholecystectomy. The VR intervention significantly reduced preoperative anxiety, as indicated by the questionnaire results ($p < 0.001$), with a moderate effect size. Although heart rate decreased after the VR session, the change was not statistically significant.

Conclusion: The use of VR significantly reduced preoperative anxiety in patients scheduled for laparoscopic cholecystectomy.

Keywords: preoperative anxiety, laparoscopic cholecystectomy, virtual reality

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INTRODUCTION

Millions of people undergo surgical procedures each year, and this number has been steadily increasing over time (1). To ensure optimal outcomes, patients must be well-prepared for surgery, have their needs addressed, be informed about the process, remain vigilant regarding potential complications, and have their anxiety effectively managed (2). Despite comprehensive preoperative services and preparations, many patients still struggle with surgical anxiety (3).

It is well-documented that a significant proportion of patients experience varying levels of anxiety before surgery. Studies indicate that approximately 60–80% of patients report preoperative anxiety (4-7). Inadequate psychological preparation during this period can impair a patient's ability to cope with stress and lead to a sense of inadequacy or loss of control (8-11). Therefore, it is essential to assess and manage preoperative anxiety for each patient individually.

Pharmacological methods are commonly used to reduce anxiety during the perioperative period. However, these medications may delay postoperative recovery due to their lingering effects on the central nervous system. As a result, non-pharmacological interventions—such as music therapy, hypnosis, acupuncture, progressive muscle relaxation, and virtual reality (VR)—are gaining popularity for managing perioperative anxiety (6,12).

Virtual reality technology allows patients to view and hear immersive digital content through a headset, which blocks out their surroundings and helps reduce environmental stressors. These headsets typically deliver calming audio—such as music or natural sounds—while eliminating ambient hospital noise. By simulating relaxing virtual environments, VR technology enables patients to become absorbed in an interactive world, providing a powerful distraction from anxiety-inducing stimuli. Several studies have shown that VR can effectively reduce both preoperative and postoperative anxiety and pain through this distraction mechanism (13-18).

This study aims to evaluate the effectiveness of VR glasses in reducing preoperative anxiety in adult patients undergoing laparoscopic cholecystectomy.

METHOD

This study was conducted between 2019 and 2020 at the University of Health Sciences Haydarpaşa Numune Training And Research Hospital, following approval from the institutional ethics committee (HNHAH-KAEK 2019/155).

The study included voluntary patients aged 18 to 65 years, scheduled to undergo laparoscopic cholecystectomy under general anesthesia, with no additional systemic diseases and classified as ASA physical status I or II.

Exclusion criteria included age under 18 or over 65, a history of congestive heart failure, chronic kidney or liver disease, adrenal insufficiency, hormonal disorders, diabetes, chronic alcohol or substance abuse, a Glasgow Coma Scale score below 15, cerebrovascular disease, psychiatric or cognitive impairment, and cardiopulmonary resuscitation within the past year.

A total of 84 patients were visited in their hospital rooms 24 hours before surgery, provided with detailed information about the study, and included after obtaining written informed consent.

Demographic and clinical data were collected using a questionnaire that included variables such as age, sex, educational level, financial status, and physical activity level.

On the day of surgery, patients were taken to the preoperative holding area, where the procedure was re-explained. Baseline oxygen saturation (SpO2) and heart rate were recorded using a fingertip pulse oximeter.

Preoperative anxiety levels were assessed using the "Anxiety Specific to Surgery Questionnaire," a 10-item Likert-type scale developed in 2003 (Table 1) (19). Each item is rated from 1 (strongly disagree) to 5 (strongly agree), except for item 8, which is reverse-scored. Total scores range from 10 to 50, with higher scores indicating greater anxiety regarding pain, the possibility of death, and postoperative complications (19).

Table 1. Anxiety Specific to Surgery Questionnaire

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I often think about the possibility of death.	1	2	3	4	5
2. I worry that something might happen to me and my family and children would be left behind.	1	2	3	4	5
3. I fear not waking up after being put to sleep for the surgery.	1	2	3	4	5
4. I think I might die due to bleeding or another complication during the operation.	1	2	3	4	5
5. I believe I will not fully recover due to postoperative wound infection or another issue.	1	2	3	4	5
6. I fear being unable to walk or take care of myself as before after the surgery.	1	2	3	4	5
7. I think I will experience severe pain after the surgery.	1	2	3	4	5
8. I believe all pain and problems will be resolved after the surgery.	1	2	3	4	5
9. I am afraid of becoming disabled.	1	2	3	4	5
10. I think I will feel pain during the surgery.	1	2	3	4	5

Patients were informed that they would watch a 30-minute video designed to provide a visual and auditory experience. They were told that the anxiety scale would be re-administered after the video.

Patients were placed in a comfortable position, and the VR headset was adjusted for optimal visual and auditory alignment. After ensuring patient comfort and obtaining verbal consent, the video session began. Upon completion, the headset was removed, and SpO2 and heart rate were measured again. The anxiety questionnaire was re-administered.

All patients then underwent surgery under standardized general anesthesia protocols. Intraoperative heart rate and SpO2 monitoring were continued in all cases.

The VR headset used in the study was "VRBOX." The video content consisted of 30 minutes of nature-themed visuals accompanied by relaxing zen music, providing a 360-degree immersive experience. The video was sourced from a publicly available online platform (https://www.youtube.com/watch?v=xskH6VEWV28).

Statistical analysis

Before starting the study, the sample size analysis was performed using a 95% confidence interval and 80% power as reference (group 1: 39.1±4.7, group 2: 34.3±5.7) (20) and found that the minimum sample size to be achieved was 38.

Data were analyzed using the SPSS version 22.0 statistical software. The Kolmogorov-Smirnov test was employed to assess the normality of data distribution.

Qualitative variables were expressed as frequencies and percentages, while quantitative variables were reported as mean, standard deviation, and median values.

For comparisons of non-normally distributed data, the Mann-Whitney U test and Wilcoxon signed-rank test were utilized. Effect sizes were calculated with "effect size calculator". $P<0.05$ was considered significant.

RESULTS

A total of 84 patients undergoing laparoscopic cholecystectomy were included in the study. The mean age was 42.1±9.3 years (range: 24–66). Among the participants, 61.9% were female and 38.1% were male. Additionally, 58.3% were over the age of 40, 41.7% were university graduates, and 54.8% reported earning a minimum wage or less. Regarding ASA classification, 66.7% of patients were ASA I, and 33.3% were ASA II. Based on body mass index (BMI), 96.4% of patients were within the 18–29 range, while 3.6% had a BMI ≥30.

There was a decrease of 1.036 beats per minute in heart rate after the VR intervention, although this reduction was not statistically significant. The mean anxiety scores and their changes before and after VR application are shown in Table 2.

Table 2. Anxiety scores and changes before and after VR

	Anxiety Scores				
	Mean	**SD**	**Median**	**Effect Size (d)**	**p**
Before VR	**33.6**	**4.3**	**34.0**	**0.68**	**<0,001**
After VR	**30.9**	**3.6**	**30.0**		

SD: standard deviation, **VR:** Virtual reality

Analysis of pre- and post-intervention mean anxiety scores revealed that VR significantly reduced anxiety ($p<0.001$), with a moderate effect size ($d = 0.68$).

Female patients demonstrated significantly higher preoperative anxiety levels compared to males, both before and after VR exposure. Nevertheless, VR significantly reduced preoperative anxiety in both sexes, with moderate effect sizes observed in each group (Table 3).

Table 3. Anxiety scores according to depending on sex

Sex		**Before VR**	**After VR**	**p**	**Effect Size**
Female	Mean	34,94	31,83		
	SD	4,30	3,62	**<0,001**	0.78
	Median	36,00	32,00		
Male	Mean	31,41	29,41		
	SD	3,39	3,29	**<0.001**	0.59
	Median	31,50	30,00		
	p	**<0.001**	**0.004**		

SD: standard deviation, **VR:** Virtual reality

No statistically significant differences in preoperative anxiety scores were found based on educational background. Regardless of educational status, VR application significantly reduced preoperative anxiety scores. The intervention showed a moderate effect size in the non-university graduate group and a large effect size in the university graduate group (Table 4).

Table 4. Anxiety scores according to depending on educational background					
Educational Background		**Before VR**	**After VR**	**p**	**Effect Size**
Non-University Graduate	Mean	33,33	30,78		
	SD	4,53	3,91	**<0.001**	0.60
	Median	34,00	30,00		
University Graduate	Mean	33,97	31,09		
	SD	4,04	3,37	**<0.001**	0.77
	Median	34,00	31,00		
	p	0.491	0.717		

SD: standard deviation, **VR:** Virtual reality

Similarly, income level did not yield a significant difference in anxiety scores before and after VR intervention. However, VR significantly reduced anxiety levels in both income groups—those earning below and above the minimum wage—with a moderate effect size observed in each group (Table 5).

Table 5. Anxiety scores according to depending on income levels					
Income Levels		**Before VR**	**After VR**	**p**	**Effect size**
Below minimum wage	Mean	33,89	30,91		
	SD	4,50	3,48	**<0.001**	0.74
	Median	34,00	30,00		
Above minimum wage	Mean	33,24	30,89		
	SD	4,12	3,95	**<0.001**	0.58
	Median	33,50	31,00		
	p	0.539	0.740		

SD: standard deviation, **VR:** Virtual reality

There was no significant difference in preoperative anxiety scores between age groups before and after the use of VR glasses. However, the use of VR glasses prior to surgery significantly reduced anxiety scores in both the 0–39 and over-40 age groups. In both age groups, the preoperative application of VR glasses appeared to have a moderate effect in reducing preoperative anxiety (Table 6).

Table 6. Anxiety scores according to depending on age					
Age group		**Before VR**	**After VR**	**p**	**Effect Size**
0-39	Mean	33,69	31,23		
	S.D.	3,763	3,049	<0.001	0.71
	Median	34,00	31,00		
Over 40	Mean	33,53	30,67		
	S.D.	4,722	4,084	<0.001	0.64
	Median	34,00	30,00		
	p	0.920	0.514		

SD: standard deviation, **VR:** Virtual reality

DISCUSSION

Preoperative anxiety is a common psychological condition observed in patients prior to surgery and may adversely affect the anesthetic and surgical process by enhancing the physiological stress response. This anxiety can be influenced by various factors such as age, gender, previous surgical experience, level of knowledge, and personality traits. This study assessed the effectiveness of virtual reality (VR) in reducing preoperative anxiety among patients undergoing laparoscopic cholecystectomy. The findings demonstrated that VR significantly decreased anxiety scores, with a moderate effect size (d = 0.68). Although a decrease of 1.036 beats per minute in heart rate was observed following the VR intervention, this change was not statistically significant.

Virtual reality is an emerging tool in healthcare with applications in medical education, rehabilitation, and the management of psychological and pain-related conditions (21). It creates an immersive environment that limits the brain's processing of distressing stimuli and has been shown to reduce pain scores more effectively than standard distraction techniques, sometimes by as much as 30%. Previous studies have shown VR to be effective in alleviating pain and anxiety in various clinical contexts, including upper gastrointestinal endoscopy, dental surgery, burn wound care, and labor (22-26).

Pharmacologic agents are frequently used to manage preoperative anxiety and pain, but these drugs can lead to complications such as excessive sedation, hypotension, impaired airway reflexes, and postoperative apnea. These risks underscore the potential value of non-pharmacologic interventions such as VR in minimizing sedative use and reducing adverse outcomes (27-28).

Distraction is a strategy to redirect attention away from the stressor and towards other thoughts and behaviors that are unrelated to the stressor (29). It has been shown that they are effective during medical procedures (30). Virtual Reality is a paradigm shift in how people interact with computers. Instead of looking at a handheld or desk-mounted computer screen, computer screens are mounted on the head. The user wears a VR headset where miniature computer screens are located close to the patients' eyes. Lenses are used to focus images on the patients' eyes to make them feel as if they are inside a 3D computer-generated environment. Immersive VR directly focuses on the patient's individual perception of stressful stimuli and reduces their negative experiences through distraction (31). VR immerses the user in an interactive virtual environment; while allowing the user to actively see the surroundings in 360 degrees, noise-canceling headphones provide suitable film music.

According to the results of our study, using VR application was found to be effective in reducing preoperative anxiety, and there were no differences based on factors such as sex, education, income, and risk group, with anxiety significantly decreasing in each group. In the study by Karancı et al., which aimed to predict the predictors of preoperative anxiety, it was observed that anxiety levels were higher in women. Additionally, the expectation of surgery and the individual's feeling of helplessness have also been found to be significant predictive factors of anxiety (19). In another study, a higher level of education was found to be a factor that increases preoperative anxiety (32).

In a study by Raja et al. investigating the effectiveness of VR application on preoperative anxiety in patients undergoing hernia, appendectomy, tonsillectomy, and hysterectomy surgeries, it was found that patients who experienced an immersive experience before surgery had reduced anxiety levels (33). Additionally, this study emphasized that the increase in preoperative satisfaction provided several benefits and that the virtual reality-based solution is one of the easiest ways for hospitals to adopt.

In a study by Noben et al. involving 97 pregnant patients scheduled for cesarean section, the effect of watching a preoperative VR video on preoperative anxiety was investigated. It was found that the VR application was generally not effective in reducing

anxiety, but it did lower anxiety in women who had previously undergone a cesarean section (34).

In a study by Şahin et al. investigating the effects of progressive muscle relaxation and virtual reality goggles on patient satisfaction and anxiety levels, it was found that both groups showed an increase in satisfaction and a decrease in anxiety compared to the control group (35). In a systematic review examining the effectiveness of audiovisual interventions in reducing preoperative anxiety in children, it was found that in 14 out of the 18 studies reviewed, such interventions reduced children's preoperative anxiety (36).

In a study by Rousseaux et al., where VR applications and VR hypnosis methods were used in cardiac surgery patients and changes in pain and anxiety were investigated, it was found that both techniques were effective in reducing pain and anxiety. It has been stated that the use of these applications in medicine will increase over the years (37). In a study by Ganry et al. investigating the effect of VR applications on preoperative anxiety in maxillofacial plastic surgery patients, it was found that there was a significant reduction in the patients' anxiety levels and salivary cortisol levels after the intervention (38). In a study where surgical simulation was performed using VR applications on children scheduled for surgery, it was observed that the application reduced the children's anxiety levels and was effective (39).

In a meta-analysis study, the effectiveness of VR applications before various types of surgeries in the pediatric group was examined. Pediatric VR research has primarily focused on distraction. It has been stated that VR is an effective distraction intervention for reducing pain and anxiety in pediatric patients undergoing a wide range of medical procedures (40). A VR theater application was performed on 191 pediatric patients the day before surgery. It was observed that there was no significant decrease in anxiety levels during surgery, but there was a significant decrease in postoperative pain levels compared to the control group (41).

Faruki et al. found that VR applications reduced the need for postoperative medication and anxiety level (42). In a randomized controlled prospective study by Ryu et al. investigating the effect of playing games with VR goggles on preoperative anxiety in children, it was found that VR game playing application significantly reduced preoperative anxiety (43). Batuman et al. demonstrated that informative video viewing was effective in reducing preoperative anxiety in the pediatric age group (44). Robertson et al. found that VR applications reduced preoperative anxiety in patients undergoing atroscopic knee surgery (29).

Overall, the findings of our study align with the broader literature, supporting the use of VR as an effective non-pharmacologic intervention for reducing preoperative anxiety.

Our study had some limitations. First, we did not perform psychiatric consultation and mood assessment before surgery. Our study is based on a patient-reported scale. The absence of objective physiological measurements, such as salivary cortisol concentration, and the lack of investigation into the long-term postoperative effects of VR constitute additional limitations of our research.

CONCLUSION

In conclusion, the application of virtual reality (VR) glasses was found to be effective in significantly reducing preoperative anxiety among patients undergoing laparoscopic cholecystectomy. Given its non-invasive and non-pharmacologic nature, VR may serve as a valuable adjunct in preoperative preparation, enhancing patient comfort and potentially reducing the need for sedative medications.

Considering its effectiveness across diverse demographic groups and ease of implementation, VR has the potential to become a widely adopted tool in clinical practice. Further research is warranted to evaluate its long-term benefits and applicability across different surgical populations and clinical settings.

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