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Virtual Reality Training Intervention to Reduce Pain and Anxiety: A Quasi-Experimental Study

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ABSTRACT

This study was carried out to determine the effect of virtual reality training an patients who will undergo laparoscapic cholecystectomy an their vital sings, pain and anxiety. It is a quasi-experimental study planned with experimental and control groups. Brochure supported education was given to the control group (31 patients), and a visual musical education with virtual reality glasses was given to the experimental group (31 patients) before the surgery. Patient information form, Beck anxiety scale, vital sings form visual analogue scale and pain assessment form were used for data. The data of the patients in the control and experimental groups were collected before and After the operation 1th hour. It was found that the training given with Virtual Reality (VR) before the operation reduced pain and anxiety more than the brachure training in the 1st hour After the operation, and also positively affected vital sings such as respiration, blood pressure, pulse, temparature. These values were statisti cally significant. Training given with VR before or after surgery, and visual affects with music can positively affect patients pain, anxiety and vital signs. Other activities are recommended in this regord.

Ağrı ve Kaygıyı Azaltmaya Yönelik Sanal Gerçeklik Eğitimi Müdahalesi: Yarı Deneysel Bir Çalışma

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ÖZ

Bu çalışma, laparoskopik kolesistektomi ameliyatı geçirecek hastalara uygulanan sanal gerçeklik eğitiminin yaşamsal bulgular, ağrı ve kaygı durumlarına etkisini belirlemek amacıyla yapıldı. Deney ve kontrol gruplarıyla planlanmış yarı deneysel bir çalışmadır. Ameliyat öncesi kontrol grubuna (31 hasta) broşür destekli eğitim, deney grubuna (31 hasta) ise sanal gerçeklik gözlükleriyle görsel müzik eğitimi verildi. Veriler için hasta bilgi formu, Beck anksiyete skalası, vital bulgular görsel analog skala ve ağrı değerlendirme formu kullanıldı. Kontrol ve deney grubundaki hastaların verileri operasyon öncesi ve sonrası 1. saatte toplandı. Ameliyat öncesinde sanal gerçeklik (VR) ile verilen eğitimin, ameliyat sonrası 1. saatte verilen braşür eğitimine göre ağrı ve kaygıyı daha fazla azalttığı, ayrıca solunum, tansiyon, nabız, ateş gibi hayati değerleri de olumlu etkilediği belirlendi. Bu değerler istatistiksel olarak anlamlıydı. Ameliyat öncesi veya sonrası VR ile verilen eğitim ve müzikle görsel efektler hastaların ağrı, anksiyete ve yaşamsal belirtilerini olumlu yönde etkileyebilmektedir. Bu bağlamda başka faaliyetler de önerilmektedir.

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INTRODUCTION

Gallbladder surgeries are operations that create a surgical burden on hospitals and an economic burden on individuals (1). In developing countries, gallbladder stones are more common in females at a rate of 10-40% in adult patients. In Turkey, studies on this prevalence are limited, but according to a study, cholelithiasis is a very common surgical disease with a rate of 10.3%. Until recently, surgical interventions for gallstones were performed with conventional methods, but laparoscopic cholecystectomy is now used more than open cholecystectomy (2). It has been stated that especially laparoscopic cholecystectomy reduces postoperative pain compared to open cholecystectomy (3). The fact that there is less deterioration in body integrity in patients who have undergone laparoscopic cholecystectomy, and the absence of any drains after discharge may have a positive effect on the level of pain and anxiety of patients during the recovery period. Nevertheless, pain and anxiety are present in every surgical process (4).

Visceral pain and shoulder pain experienced after laparoscopic cholecystectomy are mostly due to CO_2 delivered into the abdominal cavity. This method may increase postoperative visceral pain, shoulder pain, and distension, and increased intra-abdominal pressure with gas irritates the diaphragm (5,6). The insertion of trocars into the abdominal region increases somatic pain, and surgical interventions cause visceral pain (7). The pain experienced after surgery also increases due to anxiety and stress (8). Inadequate pain management in the early period after laparoscopic cholecystectomy may cause patients to have shallow and rapid breathing because they are afraid of experiencing pain. Thus, pulmonary dysfunction may occur (9). Pain that cannot be managed with treatment in postoperative procedures and opioid drugs used accordingly cause nausea and vomiting. Thus, an increase in blood pressure and an increase in pulse and respiratory rate occur in patients. In addition, pain negatively affects the oxygenation of cells (8,10). Inadequate pain and anxiety management in the early postoperative period prolongs recovery time, adversely affects vital signs, and increases the risk of complications. Therefore, simultaneous management of acute pain and anxiety is recommended (11,12). Pharmacological and non-pharmacological complementary therapies can be used to manage postoperative pain and anxiety (13,14).

Providing comprehensive information about laparoscopic cholecystectomy in the training and counseling services provided to patients can minimize pain, by reducing stress and anxiety in the patient. In the training given to patients, information such as cough, deep breathing and exercises, pain management, nausea and vomiting, and nutrition can reduce anxiety. Therefore, it is important to make patient training effective with visual and auditory dialogue (10).

One of the new techniques to reduce pain and anxiety by ensuring that the information given to patients is visual and auditory, is training given with virtual reality glasses (15). Virtual reality (VR) is a technology that has become widely used in recent years in educational applications and VR learning environments (16,17). There are studies showing that VR applications are effective in pain management as a method of diverting the attention of patients (10,18). There are also other studies in the literature showing that the level of pain is decreased and the level of comfort is increased with the VR glasses used in VR applications (19,18).

This study was conducted to determine the effects of virtual reality training on the vital signs, pain, and anxiety of patients who were to undergo laparoscopic cholecystectomy.

Research Hypotheses

H1: Virtual reality training given to patients undergoing laparoscopic cholecystectomy would have a positive effect on vital signs.

H2: Training given with virtual reality to patients undergoing laparoscopic cholecystectomy would have an effect on reducing postoperative pain.

H3: Training given with virtual reality to patients undergoing laparoscopic cholecystectomy would have an effect on reducing the anxiety of patients.

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This study was conducted to determine the effects of virtual reality training on the vital signs, pain and anxiety of patients who will undergo laparoscopic cholecystectomy.

MATERIALS AND METHODS

Study Design

This research was conducted as a semi-experimental study with a non-randomised pre-test-final test control group.

Location and Time of the Research

The study was conducted in the surgical department of a public hospital.

Setting and Sample

In the year before the study, 72 patients were admitted to this hospital for this surgery. When the sample size was calculated taking the confidence interval as 95% and margin of error of 2.15, it was determined to be necessary to include 62 patients in the study for one year. The control group, provided with brochure education, was formed of 31 of the 62 patients, and the experimental group that received VR comprised 31 patients. Post-hoc power analysis was applied to the mean anxiety points of both groups after the training. The non-centrality parameter was calculated as δ=4.2303117, Critical t=1.6719296, Df=57.2056388, and Power (1-β err prob) = 0.9943730. The study was completed with a total of 62 patients, 31 in the intervention group and 31 in the control group.

The patients in the experimental and control groups who would undergo laparoscopy were included in the study in such a way as to ensure homogeneity of the sociodemographic characteristics. When a difference arouse between the groups while conducting the experiment, the groups were separated as homogeneously as possible so that this difference could be attributed to the applied factor (In Table 1, the variables of age, gender, educational status, marital status, employment status, and income status were evaluated by comparing the experimental and control groups, and the p value for homogeneity in both groups was found to be > 0.05).

Randomization: Randomisation was not applied in this study. The pre-test-post-test data were collected first for the control grouup then for the experimental group patients.

Inclusion Criteria: The following patients were included in the study: patients with no auditory, visual, or communication difficulties who could express themselves; patients who could be operated on under general anesthesia; patients aged 18-65 years; patients who volunteered to participate in the study; patients who did not use antipsychotic, antidepressant, mood stabilizers or sedative drugs; and patients who did not have a psychiatric diagnosis.

Exclusion Criteria: The following patients were not included in the study: patients with any sensory or visual impairment; patients who had a psychiatric diagnosis; patients aged <18 years or >65 years; patients who could not express themselves; patients who did not voluntarily agree to participate in the research; patients who used antipsychotic, antidepressant, mood stabilizers or sedative drugs; and patients who did not have the conscious ability for clear discernment. The Flow Chart of Research Plan is shown in Figure 1.

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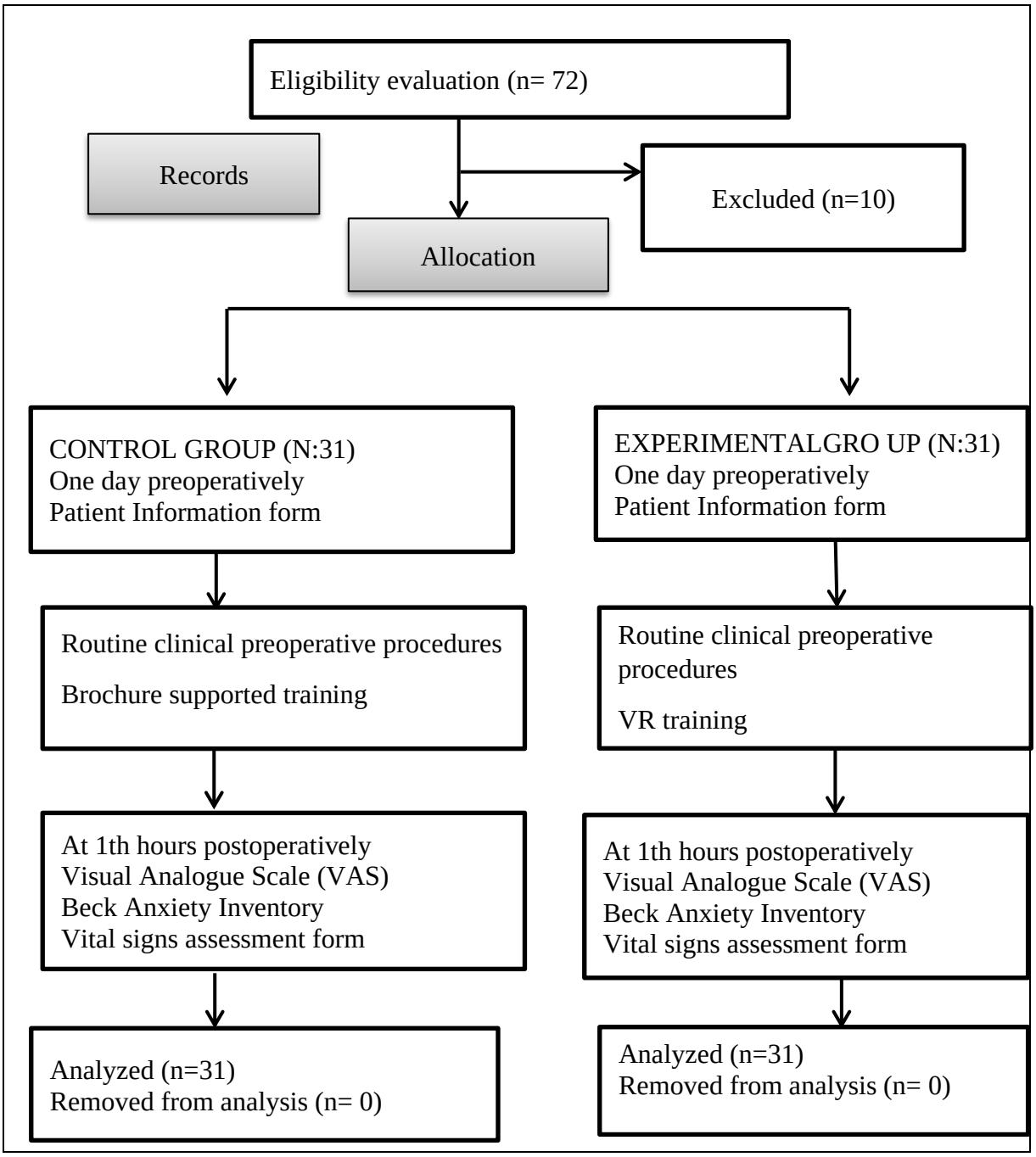

Figure 1. Flow Chart of the Research Plan

Data Collection

The researcher collected all the data on the forms in face-to-face interviews. The forms used in the research were as follows:

Patient Information Form

This form included a total of 12 questions. The first section comprised 7 questions to determine the patient age, gender, marital status, education level, economic status, place of residence, and employment status in order to evaluate the preoperative sociodemographic data of the patients. A further 5 questions elicited information regarding the diagnosis and treatment of the patients, the presence of any chronic disease, what medications were being taken, familial history of gallstones, the patient's body mass index, and the consumption of fatty foods.

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Beck Anxiety Inventory (BAI)

This inventory, which was was developed by Beck et al. (1988)(20) to determine the risk of anxiety in the person and to measure the level of anxiety, was developed for screening rather than diagnosis. It consists of a total of 21 items about the signs and symptoms of anxiety experienced in the previous week. The responses are in the form of the options of "none, mild, moderate, severe", scored as 0 point - none, 1 point - mild, 2 points - moderate, and 3 points - severe. The total points are interpreted as 8-17 points representing mild anxiety, 18-24 points indicating moderate anxiety, and ≥ 25 points indicating severe anxiety. The validity and reliability of the BAI in Turkish was determined by Ulusoy (1998) (21). The Cronbach's alpha value of this scale was 0.77.

Vital Signs Assessment Form

With reference to the relevant literature, this form was created by the researchers to determine the vital signs of the patients before surgery and at 1 hour, 8 hours, and 24 hours after the surgery. Blood pressure, pulse, respiration, body temperature, and saturation findings were evaluated as vital signs.

Pain Assessment Form

Following a scan of the relevant literature, a Visual Analogue Scale (VAS) including facial expressions, was used to assess postoperative pain. The VAS consists of a 10 cm long line drawn on the horizontal or vertical axis, marked as 0=no pain, and 10 = the worst pain imaginable or possible. The patient is asked to mark the place on this line that corresponds to the severity of the pain to give a numerical value of the pain intensity.

Data Collection of the Control and Intervention Groups

The patients admitted to the surgical ward were informed about the research and informed consent for participation was obtained from all the patients. Preoperatively, and at 1 hour postoperatively, blood pressure, temperature, pulse, respiration, and oxygen saturation were evaluated, and the BAI and VAS forms were applied.

In addition to the routine clinical procedures preoperatively, brochure-supported education was given to the control group patients. This training was given to the patients within 15 minutes.

In addition to the routine clinical procedures preoperatively, VR training was given to thepatients in the intervention group. Immediately after the training, the patients listened to visual cultural music with VR. All the applications were applied to the intervention group patients within 30-45 minutes.

Training with Virtual Reality Glasses

The 31 patients in the experimental group were given information using VR glasses about the outcomes which can be experienced in laparoscopic gallbladder surgery, home care, and the management of this surgery. In this virtual video, a nurse gave information. The virtual environment had a 180 degree detection area. At the end of this training video, which was watched with virtual reality glasses, cultural music was played with the image of nature. The cultural music included instrumental folk songs. The patients in the experimental group watched this training video for 20 minutes with VR glasses.

The patients in the control group were given an informative brochure about laparoscopic gallbladder surgery.

Training Brochure

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The training brochure included information about how laparascopic cholecystectomy is performed, training for deep breathing exercises, the importance of early mobilisation, nutritional education, pain control, and drugs. Information is also given about situations to which attention must be paid in the first month of nutrition, postoperative complications, hygiene, and wound care.

Evaluation of the vital signs of patients in the experimental and control groups

The pulse was measured with a pulse-oximeter device. Blood pressure was measured with a blood pressure monitor. Respiratory depth was evaluated by counting the respiratory rate. Body temperature was measured with a thermometer. Oxygen saturation was measured with a pulse oximeter device.

Data Analysis

The data obtained in the study were analyzed statistically using SPSS Windows version 23.0 software. Descriptive statistics were presented as percentage, frequency, mean and standard deviation values. The conformity of the data to normal distribution was examined with the Kolmogorov-Smirnov test and were found to be normally distributed. The Data-free t-test, one-way analysis of variance (ANOVA), and chi-square tests were used. ANOVA was used for repeated measures of vital signs, and the Bonferroni test was used to determine from which group the significance originated. Cronbach's alpha was used for internal consistency. The level of statistical significance was taken as $p < 0.05$ when interpreting the results.

Ethical approval

Approval for the study was given by the SANKO University noninvasive ethics committee (decision no: 2021/03, dated: 22.03.2021). Written and verbal consent was obtained from the patients. Institutional permission was obtained from the hospital where the research data were collected.

Limitations of the research

Limitations of the study can be said to be that the patients included were only those in the 18- 65 years age range and that the study was conducted only in one private hospital.

RESULTS AND DISCUSSION

The sociodemographic data of the patients in the study are presented in Table 1. Of the patients in the control group, who received brochure training only, 67.7% were aged ≤ 60 years, 67.7% were male, 93.5% had an education level above secondary school, 100% were married, 90.3% were unemployed, 100% had an income level equal to expenses, and for 100% the place of residence was Gaziantep. Of the patients in the intervention group, who received VR training, 48.5% were aged ≤ 60 years, 41.9% were female, 90.3% had an education level above secondary school, 100% were married, 90.3% were unemployed, the income of 100% was equal to their expenses, and for 100%, the place of residence was Gaziantep. No statistically significant difference was found between the two groups in terms of age, education, marital status, employment, and income ($p > 0.05$) (Table 1).

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Tablo 1. Comparisons of the Sociodemographic Characteristics of Patients Given Brochure Training Only, or VR Training

		Brochure Training		VR Training		* Statistics
		n	%	n	%	
Age	≤ 60 years	21	67.7	15	48.4	x^2=2.367 p=0.523
	> 60 years	10	32.3	16	51.6	
Gender	Female	10	32.3	13	41.9	x^2=1.245 p=0.371
	Male	21	67.7	18	58.1	
Education level	≤Primary school	2	6.5	3	9.7	**x^2=2.067 p=0.246
	≥Secondary school	29	93.5	28	90.3	
Marital status	Married	31	100	31	100	
	Single	0	0	0	0	
Working Status	Yes	3	9.7	2	6.5	**x^2=1.401 p=0.119
	No	28	90.3	29	93.5	
Income status	Income less than expenses	0	0	0	0	
	Income equal to expenses	31	100	31	100	
	Income more than expenses	0	0	0	0	
Place of residence	City	31	100	31	100	
Total		31	100.0	31	100.0	
		Mean ±SD		Mean ±SD		
Average age (years)		60.96±4.00		62.38±1.02		***F=3.657 p=0.061

*n: Sayı, %: Yüzde, SD: Standard deviation. *Chi-square (x2) test. **Fisher's Exact test. ***F= ANOVA test.*

In the control group who received brochure training only, 100% of the patients were determined to have a chronic disease, 83.9% had diabetes, 100% were constantly taking medication, 48.4% used Biguanid metformin constantly, 100% ate fatty foods, and 45.2% ate mostly fried foods. In the intervention group, who received VR training, 100% of the patients were determined to have a chronic disease, 64.5% had hypertension, 100% were constantly using drugs, 64.5% used antihypertensives constantly, 100% ate fatty foods, and 45.2% ate mostly barbecue-type foods among fatty foods. No statistically significant difference was found between the groups in respect of the presence and type of chronic disease, the drugs in constant use, and the frequency and type of fatty foods consumed ($p > 0.05$).

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In the control group, the mean pain scores were recorded as 7-8 points for 54.8% of the patients and 5-6 points for 32.3%. In the intervention group following VR training, 48.4% of the patients had a pain score of 1-2 points and 38.7% had a pain score of 3-4 points (Table 2). A statistically significant difference was determined between the groups in terms of pain scores (p=0.001) (Table 2).

Table 2. Comparisons of Patient Pain Scores (at 1hours) after Brochure and VR Training

		Brochure Training		VR Training		Statistics
		n	%	n	%	
Pain Score	0 point	0	0	0	0	*x^2=36.175 **p=0.001**
	1-2 points	0	0	15	48.4	
	3-4 points	4	12.9	12	38.7	
	5-6 points	10	32.3	2	6.5	
	7-8 points	17	54.8	2	6.5	
	9-10 points	0	0	0	0	
Total		**31**	**100.0**	**31**	**100.0**	

**Fisher's Exact test*

Preoperatively, no statistically significant difference was found between the brochure and VR training patient groups in terms of heart rate, systolic and diastolic blood pressure, saturation, respiratory rate, and temperature (p>0.05). At one hour postoperatively, a statistically significant difference was determined between the groups in terms of heart rate and diastolic blood pressure (p<0.05) (Table 3).

Table 3. Comparisons of the Preoperative and Postoperative (at 1hours) Vital Findings of Patients After Brochure and VR Training

		Brochure Training	3D (VR) Video Training	* Statistics
		Mean ±SD	Mean ±SD	p
Before surgery	Pulse	95.61±17.61	103.38±16.12	0.075
	Systolic blood pressure (mmHg)	128.06±14.47	130.64±15.04	0.494
	Diastolic blood pressure (mmHg)	74.12±7.15	75.48±8.50	0.500
	Saturation (SaO2)	95.61±2.34	95.96±1.76	0.503
	Respiratory rate	19.56±2.32	20.45±1.70	0.086
	Body temperature (°C)	36.92±0.37	36.97±0.33	0.616
1 hour after surgery	Pulse	95.77±11.57	88.93±8.37	0.010
	Systolic blood pressure (mmHg)	121.29±8.46	120.00±6.83	0.511
	Diastolic blood pressure (mmHg)	86.29±8.08	82.03±7.70	0.038
	Saturation (SaO2)	94.61±1.47	94.67±1.13	0.848
	Respiratory rate	18.29±0.97	18.54±0.67	0.230
	Body temperature (°C)	36.81±0.39	36.73±0.12	0.248

*SD= Standard Deviation. *F= ANOVA test.*

The mean Beck Anxiety Inventory scores were 2.06±0.67 for the brochure training group and 1.41±0.50 for the patients who received VR training. A statistically significant difference was determined between the groups in terms of mean Beck Anxiety Scale scores (p<0.05) (Table 4).

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Table 4. Comparisons of the Postoperative (at 1hours) Beck Anxiety Inventory of Patients After Brochure and VR Training

	Brochure Training	VR Training	*Statistics
	Mean ±Sd	Mean ±Sd	p
Beck Anxiety Inventory	2.06±0.67	1.41±0.50	**0.001**

*Sd= Standard Deviation. * Independent Samples t-test*

Inadequate pain and anxiety management in the early postoperative period prolongs recovery time, adversely affects vital signs, and increases the risk of complications. Therefore, simultaneous management of acute pain and anxiety is recommended (12), (11).

The results of this study showed the mean Beck Anxiety Inventory score to be 2.06±0.67 for patients who received brochure training visually, and 1.41±0.50 for the patients who received VR training, and the difference was statistically significant ($p<0.05$). The fact that the vital signs of the patients who received training with VR were more positive than those of the patients who received brochure training may have been affected by the low anxiety level of the patients. One of the non-pharmacological methods that can be used is to divert the patient's attention. As VR applications can attract the attention of patients, the use of these applications to provide information and training to patients can reduce anxiety levels. There are also previous studies in literature showing that VR reduces anxiety, and time spent thinking about pain (22). The data obtained from the current study are similar to the findings of Das et al.(22). Another study also showed that patients playing VR games felt good, that VR reduced pain ratings, and that an enjoyable game reduced anxiety (23). This can be explained as a new and advanced approach to the integration of VR with a pre-existing evidence-based treatment to reduce anxiety. Procedurally, VR is implemented by presenting the patient with a sound recording of the hypnotic induction and pain relief suggestions, and then taking the patient into a virtual world (24). The findings of those two studies also support the current research. Patients are distracted by VR, and therefore, VR is used as a distraction technique in coping with pain and anxiety (25). It has been previously reported that the distraction feature of VR may have been effective in reducing preoperative and postoperative pain and anxiety in patients (10).

In the current study, a statistically significant difference was determined between the patient groups who received brochure training and VR training in respect of diastolic blood pressure and pulse rate at the 1^{th} hours after surgery ($p<0.05$). In both groups, there was no statistically significant difference in terms of heart rate, systolic blood pressure, saturation 1th hours after surgery ($p>0.05$). The physiological changes seen in patients 1 hour after surgery may be related to the anxiety and pain scores, which may also affect vital signs in the first hours after surgery.

Hudson and Ogden (2016) conveyed similar information in 2016 and stated that physiological and psychological negativities and distress may negatively affect the vital signs of patients (26). Significant differences between the 1^{th} hour physiological changes of the patients and the negative or positive correlation between the pain and anxiety scores cannot be said to be the effect of the brochure or VR training given before surgery. These differences can be attributed to individual characteristics, such as the unfamiliarity of the hospital environment and discomfort. As long as there is a system that supports the comfort of patients undergoing surgery physically, socioculturally and emotionally, the pain and anxiety levels of patients will also change. There can be considered to be a need for research on this point (27). In a previous study, brain activity was evaluated in thermal pain simulation of opioids with VR, and it was determined that VR with

opioids significantly reduced pain-related brain activity in the insula and thalamus. However, other cognitive tasks were also demonstrated to alleviate pain during experimental pain simulation of brain activity in classical pain areas (23). Therefore, it is thought that VR application alone will not have an effect on pain, anxiety and vital signs at the 1th hours after surgery.

CONCLUSIONS AND RECOMMENDATIONS

Training given by nurses with brochures or VR before laparoscopic cholecystectomy can reduce the pain and anxiety scores of patients and positively affect vital signs. The effect of the preoperative brochure or VR-assisted training on patient pain, anxiety and vital signs at 8 and 24 hours after surgery could not be fully understood. It may be appropriate for nurses to provide training with VR before surgery or to use VR glasses as a complementary method to distract patients

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