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The Effect of Video Streaming with Virtual Reality on Anxiety and Physiological Parameters During Chemotherapy Treatment in Hematologic Malignancy Patients

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ABSTRACT

Aim: The aim of this study is to determine the effect of using virtual reality glasses (VRG) on anxiety and physiological parameters in patients diagnosed with hematologic malignancies who are receiving chemotherapy for the first time.

Methods: This randomized study was conducted with 100 patients receiving chemotherapy for the first time in the adult hematology clinic of a tertiary university hospital. The Patient Identification Form, State Anxiety Scale, and Physiological Parameters Monitoring Form were administered to patients in both groups before chemotherapy. After chemotherapy, only the State Anxiety Scale and Physiological Parameters Monitoring Form were reapplied. During chemotherapy treatment, the patients in the experimental group watched videos for 30 minutes using VRG.

Results: Intergroup analysis has shown that the post-chemotherapy state anxiety mean scores are higher in the control group than in the experimental group (p=0.026). The post-chemotherapy state anxiety mean scores were found to be significantly lower than the pre-chemotherapy state anxiety mean scores in the experimental group (p=0.029). There was no statistically significant difference between the groups in terms of the pre-chemotherapy state anxiety mean scores (p>0.05) or in physiological parameters before and after chemotherapy.

Conclusion: VRG were shown to be effective in reducing chemotherapy-related anxiety in our study; however, did not affect physiological parameters.

Keywords: Virtual reality glasses, chemotherapy, anxiety, physiological parameters, effect

Introduction

Cancer is an important health problem that negatively affects the quality of life of individuals all over the world [1]. Hematological malignancies are a heterogeneous group of neoplasms that affect the blood, bone marrow, and lymph nodes [2]. Chemotherapy, radiotherapy, immunotherapy, and stem cell transplantation are the most used methods in the treatment of hematological malignancies [3]. Chemotherapy treatment may cause many physical and psychological side effects such as nausea, vomiting, oral ulcers, fatigue, skin reactions, anxiety, depression, hopelessness, and anger [4]. Like other cancer patients, the great majority of hematological cancer patients experience anxiety undergoing chemotherapy treatment [5]. Anxiety is usually defined as a feeling of restlessness and tension caused by factors that are unknown and incomprehensible [5]. This anxiety can complicate adherence to treatment and prolong hospital stays [5]. It is well known that anxiety levels are generally high during chemotherapy. For example, a study conducted with patients undergoing treatment for hematological cancer found a high prevalence of anxiety and depression [6]. In another study conducted in Australia, anxiety was reported in 27% of 304 patients [7]. Additionally, anxiety was observed in 23% of 319

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patients with hematological cancer [8]. These data indicate that anxiety is a common issue during chemotherapy and that it affects patients' overall health both physiologically and psychologically.

Physiological parameters play a critical role in assessing treatment processes by providing an objective measure of patients' overall health and body functions [9]. During stressful and intensive treatments such as chemotherapy, changes in these parameters reveal both the direct effects of the treatment and the patient's psychological and physiological responses [10]. Variations in fundamental parameters like heart rate, blood pressure, and respiratory rate help determine the response to treatment, the severity of potential side effects, and possible complications [11]. It is important to develop interventions that help patients better tolerate chemotherapy, improve their quality of life, and increase their chances of survival [12,13].

Currently, pharmacological and/or non-pharmacological methods are used to control anxiety [14]. However, it is known that the pharmacological methods may cause various side effects such as agitation, amnesia, and hyperactivity [14]. Therefore, mostly in recent years, non-pharmacological methods are being used to control anxiety [15]. Virtual reality (VR) is one of the non-pharmacological methods known to be effective in reducing anxiety [14,16].

VR is an advanced form of human-computer interaction that allows people to hear the sounds and stimuli accompanying the visual scene through headphones, enabling them to experience an immersive environment outside the hospital setting [17]. The basis of VR are mainly computers, tablets, and VR glasses (VRG) [16]. VRG are a computer simulation technology consisting of a pair of video glasses and headphones connected to a video player via a connection cable, which, creates a three-dimensional environment [16]. As one of the methods of diverting attention, VRG offers the possibility of creating therapeutic environments for the treatment of medical conditions; it is widely used in clinical practice to relieve symptoms [18,19]. What makes VR a powerful distraction is its ability to engage different senses simultaneously with visual images, spatial sounds, and sometimes synthetic stimuli such as tactile and olfactory feedback [20,21]. It has shown effectiveness as a distraction instrument to relieve pain and anxiety, especially during medical procedures [20-26].

VR is emerging as a promising instrument for supporting cancer patients and monitoring neurophysiological and biological feedback during intervention [27]. Since we could not find any study in the literature examining the effect of VRG on anxiety during chemotherapy treatment in patients with hematological malignancies, the aim of this study was to determine the effect of VRG on anxiety and physiological parameters in patients with hematological malignancies receiving chemotherapy for the first time.

Methods

Study Design

It was conducted as a randomized controlled experimental study. Randomization was applied using the http://www.randomizer.org, a computer program, to determine the patient groups. The research was carried out between 15 November 2021 and 15 July 2022 at the hematology outpatient chemotherapy unit of a tertiary hospital, located in the city center of Kayseri. This unit has a capacity of 20 beds and provides diagnostic, treatment, and follow-up services for patients with hematological malignancies such as leukemia, lymphoma, and multiple myeloma. The hematology unit is equipped with the necessary infrastructure and healthcare personnel to administer chemotherapy and monitor patients regularly.

Study Participants

The sample comprised patients who were receiving their first cycle of chemotherapy, met the research criteria, and agreed to participate in the study. The population of the study consisted of patients diagnosed with hematological cancer and receiving their first cycle of chemotherapy at the outpatient chemotherapy unit between November 15, 2021, and July 15, 2022. To determine the sample size, a comparison of two groups (VR and control) was conducted using the G*Power 3.1 software. Based on the results of similar studies [21,28], it was decided to include 50 patients in the control group and 50 patients in the VR group, for a total of 100 patients. A post-hoc power analysis using the G*Power program revealed an effect size of 0.86, type 1 error (α)=0.05, and power (1-β) of 95%. These results indicated that the sample size was sufficient for the study.

Hypotheses

H0. VRG applied to patients with hematological malignancies during chemotherapy treatment have no effect on anxiety and physiological parameters.

H1. VRG applied to patients with hematological malignancies during chemotherapy treatment reduce state anxiety levels.

H2. VRG applied to patients with hematological malignancies during chemotherapy treatment have an effect on increasing or decreasing physiological parameters.

The inclusion criteria were as follows:

- Patients over 18 years old,
- Patients with a diagnosis of hematological cancer,
- Patients receiving chemotherapy treatment for the first time,
- Clinically stable and well communicated patients,
- Patients with no psychiatric, mental, vision and hearing problems.

The exclusion criteria were as follows:

- Patients who are clinically unstable during chemotherapy,
- Patients using anxiolytic and/or sedative drugs,
- Patients who did not agree to participate in the study.

Data Collection Instruments

Patient identification form, state anxiety inventory (SAI), physiological parameters follow-up form, and VRG were used to collect data.

Patient identification form: This form included 10 questions to determine the sociodemographic characteristics of the study participants such as age, gender, marital status, educational status, occupation, and residence.

State-Trait Anxiety Scale: This inventory was developed by Spielberger [29]. The scale consists of 40 items. The validity and reliability studies of the scale in Turkish were conducted by Öner and Le Compte [30]. The Cronbach's alpha value for the state anxiety scale ranges from 0.94 to 0.96. In our study, the SAI was used. The SAI consists of 20 items (items 1-20) that evaluate the respondent's feelings at that moment. Each item is graded on a 4-point Likert scale from 1 (none) to 4 (too much). The subscale scores range from 20 to 80, and higher scores indicate the presence of a high level of anxiety [30]. In this study, the Cronbach's alpha reliability coefficient of the State Anxiety Scale was found to be 0.74.

Physiological parameters follow-up form: It was created to evaluate and record blood pressure, heart rate, respiratory rate, and oxygen saturation.

VRG: In this study, the VRG (support V5 VR Headset for 4.7-6.8 inch iPhone and Android) was used in the experimental group to watch videos during the chemotherapy regimen. The device divides the image into two equal windows and easily provides the viewfinder display required for panoramic viewing. VRG consists of a smartphone application compatible with the VRG title. After the title is attached to the individual, it can be adjusted according to the person. By downloading a suitable program that allows viewing 360° VR images on a compatible mobile phone, users can monitor the relevant content through the program. VRG application was started just before the chemotherapy treatment and applied for 30 minutes during chemotherapy. When determining the duration of VR glasses usage, practices from the literature were taken into consideration. It is known that prolonged use of VR glasses can lead to side effects such as headaches, dizziness, and nausea. Therefore, a 30-minute period was established based on existing literature [28,31]. The patient's desired videos, which were a licensed product with an atmospheric musical background containing relaxing underwater, museum, park, nature images, and nature sounds, were played.

Data Collection

Control group: The patient information form and SAI were completed by the responsible researcher 15 minutes before the chemotherapy treatment by the face-to-face interview method. In addition, the physiological parameters of the patients were evaluated 5 minutes before the start of chemotherapy treatment, and recorded in the follow-up form. Finally, the SAI was applied and recorded 30 minutes after the start of chemotherapy treatment, and again the physiological parameters of the patients were evaluated and recorded in the follow-up form at this same time point.

Experimental group: The patient information form and SAI were completed by researchers 15 minutes before the chemotherapy treatment using the face-to-face interview method. In addition, the physiological parameters of the patients were evaluated 5 minutes before the start of chemotherapy treatment and recorded in the follow-up form. VRG was placed over their eyes and they watched videos from the beginning of the chemotherapy regimen for 30 minutes. One of the relaxing videos with nature sounds, including underwater, museum, park, and hiking images, was shown for 30 minutes, based on each participant's preference. VRG was removed immediately after 30 minutes had elapsed. At the 30th minute of chemotherapy treatment, the patient's physiological parameters were re-evaluated and recorded in the follow-up form. Then, the SAI was administered again. The research implementation flowchart is summarized in Figure 1.

Ethical Approval

The research was approved by the relevant Ethics Committee of the Kayseri City Hospital (decision number: 503, date: 04.11.2021), and the consent of the volunteers included in the study and institutional permissions were obtained.

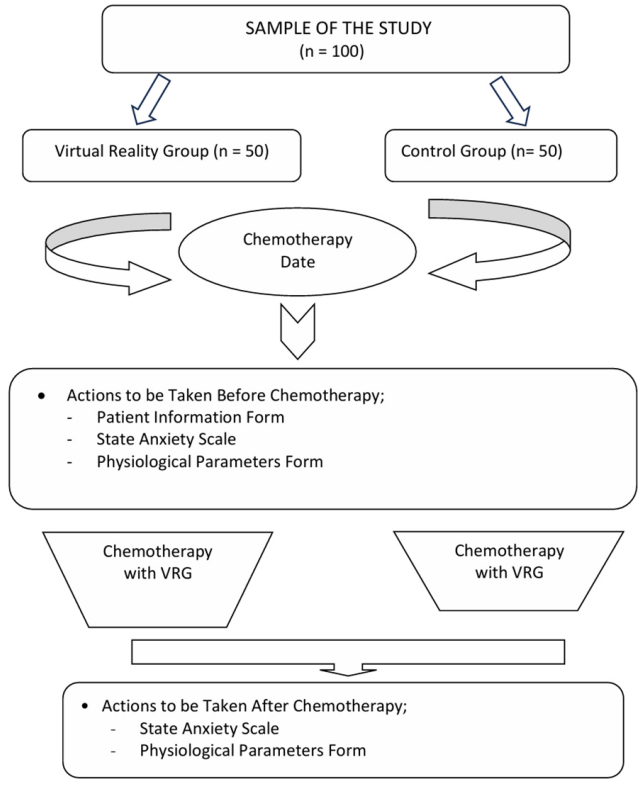

Figure 1. Research implementation flowchart
VRG: Virtual reality glasses

Statistical Analysis

The data were analyzed using Statistical Package for the Social Sciences (SPSS) 25.0 statistical software (IBM SPSS statistics for Windows, version 25.0. Armonk, NY: IBM Corp., USA). The normality of the distribution of the variables was assessed using the Kolmogorov-Smirnov test. Since the data did not follow a normal distribution, non-parametric tests were used. The Mann-Whitney U test was employed for comparisons between two groups, and the Wilcoxon signed-rank test was used for within-group comparisons. The data were summarized using frequency, percentage, median, and interquartile range. Chi-square analysis was used for categorical variables. The differences in anxiety levels between the groups were examined by comparing the pre- and post-treatment anxiety scores. For physiological parameters (blood pressure, pulse, respiratory rate, and oxygen saturation), the changes between pre- and post-treatment measurements were analyzed using the Wilcoxon signed-rank test. $P<0.05$ was considered statistically significant.

Results

The descriptive characteristics of the patients are given in Table 1. It was determined that the individuals in the control and VR groups were similar in terms of demographic characteristics such as age, gender, marital status, educational background, place of residence, and preferred video styles. There was no statistically significant difference between the groups ($p>0.05$) (Table 1).

It was determined that the average age of the individuals in the control group was 50.18 years, (50.18±16.26), 48% were male, 88.0% were married, 78% had primary education level, 82% lived in a metropolitan area, and 36.0% liked to watch nature videos. It has been determined that the average age of the individuals in the VRG was 57 years (49.86±15.63), 50% were male, 90% were married, 80% had primary education level, 84% lived in metropolitan cities, and 40% liked to watch videos with park content.

Table 1. The descriptive characteristics of the patients

Parameters	Experimental group (n=50)		Control group (n=50)		Total (n=100)		Test statistics
Age, median (range)	57 (18-77)		56 (18-77)		56 (18-77)		p=0.76 z=0.3
	n	%	n	%	n	%	
Gender							
Male	25	50	24	48	49	49	p=1.00 X^2=0.00
Female	25	50	26	52	51	51	
Marital status							
Married	45	90	44	88	89	89	p=0.75 X^2=0.102
Single	5	10	6	12	11	11	
Educational status							
Elementary	40	80	39	78	79	79	p=0.64 X^2=1.679
High school	7	14	7	14	14	14	
University	2	4	4	8	6	6	
Graduate	1	2	0	0	1	1	
Location							
Village	5	10	1	2	6	6	p=0.41 X^2=2.858
Town	1	2	1	2	2	2	
City	6	12	7	14	13	13	
Metropolis	38	76	41	82	79	79	
Favorite video type							
Park	20	40	18	36	38	38	p=0.95 X^2=0.334
Hiking	17	34	18	36	35	35	
Underwater	11	22	11	22	22	22	
Museum trip	2	4	3	6	5	5	
Do you know your diagnosis?							
Yes	50	100	50	100	100	100	p=1 X^2=0
No	0	0	0	0	0	0	

Table 2 shows the comparison of the intra-group and inter-group SAI averages of individuals in the VRG group and control groups. In the intra-group comparison of patients in the control group, it was determined that the mean post-chemotherapy state anxiety score was 43 (34-50), increased from the mean pre-chemotherapy state anxiety score of 41.5 (33-58); and the difference was not statistically significant (p=0.14). In contrast, patients in the VRG exhibited a mean post-chemotherapy state anxiety score of 40 (33-50), which decreased compared to their mean pre-chemotherapy state anxiety score of 42 (33-49), and the difference was statistically significant (p=0.029). In our study, while there was no statistically significant difference in the pre-chemotherapy state anxiety scores between the control and VR groups, the post-chemotherapy state anxiety score of the control group was found to be significantly higher at 42 (33-49) compared to the post-chemotherapy state anxiety score of the VR group at 40 (33-50) (p=0.026).

The comparison of physiological parameters between groups is displayed in Table 3. No statistically significant difference was found between the groups in terms of blood pressure, heart rate, respiratory rate, and oxygen saturation variables before and after chemotherapy.

Discussion

The most striking finding of our study was that the post-chemotherapy average state anxiety score was found to be lower in the VR group, compared to the control group, and this difference was statistically significant (p=0.026) (Table 2). Another important finding of our study was that the post-chemotherapy state anxiety mean scores in the experimental group were significantly lower than the pre-chemotherapy state anxiety mean scores (p=0.029). The reason for this may be that VRG allows patients to focus their attention on another area both visually and auditorily. It reduces their negative emotions and anxiety, increases their positive emotions, and provides satisfaction and relaxation [31]. Therefore, the results of our study confirm hypothesis H1: "Watching videos with VR during chemotherapy has an effect on reducing state anxiety levels".

It has been reported that 35% of patients with hematological cancers develop anxiety and depression during treatment, and these conditions continue throughout the treatment period [5]. In our study, although the anxiety levels were higher in the VR group before chemotherapy, both groups had similar rates of moderate anxiety, and there was no statistically significant difference between the groups (p=0.52). This may be attributed to the fact that the patients were receiving their first cycle of chemotherapy the prognosis of the disease, and their recent diagnosis.

In the study of Dutucu et al. [32], it was reported that watching videos with VRG during mammography did not have a statistically significant effect on the anxiety levels of the patients in the experimental and control groups, but the average anxiety scores of the experimental group were lower than those of the control group. In another study, it was reported that VRG was effective in reducing anxiety and depression levels in patients with metastatic breast cancer, positively affecting their physical and mental well-being [33]. In a randomized controlled study conducted with 94 breast cancer patients receiving chemotherapy treatment in Italy, the experimental group watched nature- and sea-themed videos with VRG for 20 minutes during chemotherapy, and the anxiety levels of the patients after chemotherapy were found to be lower than the control group [21]. In another study, although there was no statistical difference between the pre-procedural state anxiety scores of the patients in both groups, the post-procedural state anxiety mean scores of the experimental group were found to be statistically significantly lower than those of the control group [28]. Therefore, our results show consistency with other studies in the literature.

Anxiety has physiological effects on the human body such as high blood pressure and high blood sugar, rapid breathing, rapid pulse, dizziness, dry mouth, nausea, and excessive sweating [34]. In particular, it has been reported that anxiety increases blood pressure, heart rate, respiratory rate, and body temperature [34]. There is only one study in the literature examining the effect of VRG application on the physiological parameters of anxiety in adult cancer patients [35]. Menekli et al. [36] reported that VR reduces pain, anxiety, systolic and diastolic blood pressures, heart and respiratory rates, and increases SpO_2 levels in oncology patients. In a study examining the effects of VR on anxiety and vital signs in patients undergoing colonoscopy, it was found that the use of VR headsets had a positive effect on respiratory rate and peripheral oxygen saturation during the procedure. Additionally, the average systolic blood pressure of patients in the experimental group was significantly lower than that of the control group post-procedure. In this study, an examination of the physiological parameters of patients

Table 2. The comparison of state anxiety scores between groups

Parameters	Control group (n=50)	Experimental group (n=50)	Intergroup test statistics
Pre-chemotherapy state anxiety (mean±SD)	41.5 (33-58)	42 (33-49)	Z=0.647 p=0.52
Post-chemotherapy state anxiety (mean±SD)	43 (34-50)	40 (33-50)	Z=-2.221 p=0.026*
Intragroup test statistics	Z=-1.473 p=0.14	Z=2.185 p=0.029*	

*Statistically significant.
SD: Standard deviation

Table 3. The comparison of physiological parameters between groups

Parameters	Experimental group (n=50)	Control group (n=50)	Intergroup test statistics
Systolic blood pressure	Median (min-max)	Median (min-max)	
1st measurement pre-chemotherapy	115.1 (100-150)	110.1 (100-150)	Z=0.214 p=0.83
2nd measurement post-chemotherapy	110.0 (100-140)	110.0 (100-136)	Z=0.575 p=0.57
Intragroup test statistics	Z=-1.151 p=0.25	Z=-1.525 p=0.12	
Diastolic blood pressure			
1st measurement pre-chemotherapy	70.3 (60-90)	70.0 (60-89)	Z=0.495 p=0.62
2nd measurement post-chemotherapy	70.1 (60-82)	69.5 (60-88)	Z=0.442 p=0.66
Intragroup test statistics	Z=-0.829 p=0.4	Z=-0.762 p=0.45	
Heart rate			
1st measurement pre-chemotherapy	92.0 (70-110)	91.0 (70-106)	Z=1.183 p=0.24
2nd measurement post-chemotherapy	92.0 (72-102)	92.0 (72-102)	Z=0.393 p=0.7
Intragroup test statistics	Z=-1.701 p=0.09	Z=-0.818 p=0.41	
Respiration rate			
1st measurement pre-chemotherapy	20.0 (18-22)	20.0 (18-22)	Z=0.946 p=0.34
2nd measurement post-chemotherapy	20.0 (18-22)	20.0 (18-22)	Z=-0.561 p=0.58
Intragroup test statistics	Z=-1.091 p=0.28	Z=-0.728 p=0.47	
Peripheral oxygen saturation			
1st measurement pre-chemotherapy	95.0 (92-99)	95.0 (92-99)	Z=-0.49 p=0.96
2nd measurement post-chemotherapy	95.1 (91-100)	95.1 (91-100)	Z=0.537 p=0.59
Intragroup test statistics	Z=0.666 p=0.51	Z=-0.1 p=0.92	

min-max: Minimum-maximum

revealed that the median difference in systolic blood pressure decreased in the VR group after chemotherapy compared to before chemotherapy; however, this difference was not statistically significant ($p>0.05$). In the inter-group evaluation, it was determined that the median differences in systolic blood pressure after chemotherapy were similar. Additionally, there was no statistically significant difference intra-group and inter-group evaluations based on the median differences in diastolic blood pressure, heart rate, respiratory rate, and oxygen saturation before and after chemotherapy in both the VR, and control groups. In our study, we found that systolic blood pressure decreased post-chemotherapy in the VRG group, but the difference was not statistically significant. There was no statistically significant difference between the groups in terms of heart rate, respiratory rate, and oxygen saturation variables before and after chemotherapy. From the perspective of our study, the participants' experience of their first invasive procedure and the variability in individual responses to the procedure may have slightly influenced their physiological parameters.

Study Limitations

The study has some limitations. First, it was a study with a small sample size. A larger sample size in a general clinical setting might have elucidated the differences between groups. Second, wearing a standard size VRG in the study might have been uncomfortable for some participants and might have led to an inability to experience the full VR scene. Third, VRG was used only for 30 minutes in the study. Using it for a longer duration might have gotten significant differences in terms of physiological parameters.

Conclusion

VRG was shown to be successful in reducing chemotherapy-related anxiety in our study; however, it did not affect physiological parameters. Since VRG is a painless, safe, effective and easy-to-apply method, it can be considered to be included in nursing practices for aiming anxiety relief. Nonetheless, randomised controlled studies with a larger sample size are needed to externally validate our results.

Ethics

Ethics Committee Approval: The research was approved by the relevant Ethics Committee of the Kayseri City Hospital (decision number: 503, date: 04.11.2021).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.K., Concept: E.K., S.K., Design: E.K., Data Collection or Processing: E.K., Analysis or Interpretation: E.K., S.K., Literature Search: E.K., Writing: E.K., S.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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