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Brief Report

Virtual Reality Use for Symptom Management in Palliative Care: A Pilot Study to Assess User Perceptions

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Abstract

In the past two decades, virtual reality (VR) technology has found use in a variety of clinical settings including pain management, physical medicine and rehabilitation, psychiatry, and neurology. However, little is known about the utility of VR in the palliative care setting. Moreover, previous investigations have not explored user perceptions of the VR experience in this population. Understanding user perceptions of the VR intervention will be critical for the development and delivery of effective VR therapies. To examine the utility of VR for palliative care patients, a pilot study of VR use was conducted with 12 adult patients diagnosed with life-limiting illness who were residents at a free-standing hospice facility. The intervention consisted of a one-time 30-minute VR experience. User perceptions were assessed through both quantitative and qualitative means, including participant responses to open-ended questions after the VR intervention. Acute changes in symptom burden were assessed using the revised Edmonton Symptom Assessment Scale. Participants found the VR experience to be both enjoyable and useful, and the intervention was well-tolerated overall. This study provides support for VR as a promising new therapeutic modality for patients undergoing palliative care.

Keywords: alternative therapies; palliative care; symptom management; virtual reality

Introduction

Virtual reality (VR) refers to the use of technology to create a simulated environment. Clinically, VR has found use in a variety of settings including acute pain management, psychiatry, physical medicine and rehabilitation, and neurology.[1–5] The literature on VR use for chronic pain is scarce, but includes investigations into complex regional pain syndrome, phantom limb pain, fibromyalgia, and cancer.[6–9] VR use by hospitalized cancer patients has shown increased emotional well-being and decreased levels of anxiety, depression, and fatigue.[10] The most commonly proposed mechanism by which VR provides therapeutic value in this wide range of clinical settings is distraction. However, additional mechanisms including neurophysiologic changes may also contribute to the clinical efficacy of VR, especially for chronic conditions.[11]

The immersive nature of VR is particularly promising for patients undergoing palliative care. As physical function declines, increased ''waiting time'' for the patient necessitates forms of diversion from stale environments and may result in greater levels of pain, anxiety, and depression.[12] In the palliative care setting, VR experiences could offer quality-of-life benefits while reducing dependence on pharmacotherapy. Additionally, the ever-expanding range of VR applications allows for personal tailoring of experiences, which expands the pool of potential users.

In the first study of its kind, Niki et al. demonstrated that a one-time VR intervention can bring significant reductions in pain, tiredness, drowsiness, shortness of breath, depression, and anxiety, as measured with the revised Edmonton Symptom Assessment Scale (ESAS-r).[13] More investigations are needed in this nascent application of VR for palliative care patients. This is especially important given that this population may have unique barriers to comfortable operation of the head-mounted device (HMD) and remote controller.

In this study we assessed for symptom reduction following a 30-minute VR intervention, similar to the design used by Niki et al. However, we are also the first to explore participant perceptions of the VR experience in this specific population.

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The results of this study will inform future studies and therapies to ensure the greatest comfort and ease-of-function for all VR users regardless of age or technological savvy.

Materials and Methods

A prospective single center, single-arm study was conducted with the approval of the associated institutional review board. The VR technology used in this study is the Samsung Gear VR, an HMD. This technology was chosen for its low cost, portability, and access to a variety of VR applications. The Gear VR works with a Samsung smartphone. The visual stimuli of the VR experience are first produced on the smartphone screen; lenses in the HMD magnify and modify the images to simulate a three-dimensional environment. The navigational ''Home'' and the specific applications that can be run on the Gear VR are software developed by Oculus.[14]

Data from 12 participants, who provided their written informed consent, were collected between July 2018 and February 2019. Participants were recruited from an inpatient palliative care service at a free-standing hospice facility in Kalamazoo Michigan. Eligible patients were adults diagnosed with life-limiting illness, defined as a condition in which death is an expected direct consequence of the illness. Exclusion criteria included significant psychopathology, legal incapacitation, and uncontrolled nausea. Potential participants were identified by a hospice social worker who had been informed of the study. These potential participants then met with a member of the research team to confirm eligibility, answer questions about the study, and complete the informed consent process if applicable. Demographic information was self-reported.

The VR intervention consisted of a one-time 30-minute session, during which the participant operated the Samsung Gear VR using one or more VR applications from the Oculus library. Before the intervention, participants were trained for approximately five minutes on the use of the HMD and hand-held controller. During the intervention, participants were the sole operators of the HMD and hand-held controller, but a research team member was seated nearby to answer questions if needed.

Participants chose their specific VR application(s) based on a ''menu'' of nine options that were pre-selected by the research team with a focus on low-cost, easy-to-learn applications representing a variety of genres. The menu contained screenshots and brief descriptions of the different applications. The nine applications were as follows: 360 Photos, Meditation, Apollo 11, Bait!, Feel: The Must of the Sea, Bear Island, theBlu, Coaster, and Hello Mars. All of these applications include auditory and visual components, with visual components ranging from photorealistic still images to animated videos. Some applications required minimal interaction (pointing and clicking with the remote control), while others could be operated without user interaction.

Participants were free to switch between VR applications and terminate the intervention at any time if desired. Participants that chose to terminate the intervention before 30 minutes were still asked to complete the post-intervention study measures. The HMD and hand-held controller were cleaned with alcohol wipes before and after each VR intervention.

After the intervention, participants were asked to complete a 10-question survey about their perceptions of the VR experience. The survey consisted of two quantitative questions on a 10-point scale and eight open-answer qualitative questions (Appendix A1). For all 10 items, the researcher read the question aloud and the participant gave a verbal response, either numerical or open-ended. The survey addressed topics such as how much the user enjoyed using the VR headset, how useful they found the experience, how easy or hard it was to operate, and potential adverse effects of the intervention.

Participants also completed the ESAS-r, a symptom assessment tool, before and after the 30-minute VR intervention. The ESAS-r measures the self-reported severity of nine symptoms that are common to patients with advanced cancer: pain, tiredness, nausea, depression, anxiety, drowsiness, lack of appetite, wellbeing, and shortness of breath. Each of the ESAS-r items is rated on an 11-point scale with 0 representing the best state (i.e., no pain, best well-being) and 10 being the worst state (i.e., worst pain, worst well-being). The ESAS-r has been proven reliable for symptom assessment in patients undergoing palliative care.[15]

Statistical methods

Power analysis was performed for a two-tailed paired *t*-test using SAS v9.4 to determine the minimum detectable difference between pre- and post-intervention ESAS-r rating. Power analysis assumed standard deviation (SD) of 3.3 based on Watanabe et al.,[15] and a correlation of 0.5 between the pre- and post-intervention responses. The anticipated sample size was $n = 20$. Power analysis indicated that there is sufficient power of 80% to detect a minimum difference between pre- and post-intervention ESAS-r item of 2.2 U.

Categorical demographic data were reported as frequencies, and numeric demographic data were reported as means with SDs. For each of the nine ESAS-r items, the means, SDs, and 95% confidence intervals (CIs) are reported for the pre- and post-intervention assessments. Quantitative data about participant perceptions are reported as means and SDs. Qualitative data from open-ended responses were analyzed for themes, and frequencies of the most common themes are reported.

Additionally, for each of the nine ERAS-r items, the change from pre- to post-intervention was assessed using a resampling-based permutation test utilizing 10,000 random samples. Resampling-based permutation tests were used because the sample was smaller than anticipated and the test does not require distribution assumptions. The resampling-based permutation test produces an exact *p*-value by comparing the observed difference to the null distribution of no difference. The null distribution is created through resampling permutations of the observed data. The exact *p*-values are reported.

Results

The sample consisted of 12 participants: four men and eight women. The average age was 72 years, with a SD of 16 years. Ten (83%) participants were white, and 2 (17%) were of color. Eight (67%) participants were diagnosed with cancer, 2 (17%) with heart failure, 1 (8.3%) with bronchiectasis, and 1 (8.3%) with pneumonia.

Eight (67%) participants used ''360 Photos,'' an application that includes still pictures of popular real-world destinations and landscapes. Four (33%) participants used ''Meditation,''

Table 1. Selected Themes from Participant Responses to Open-Ended Questions after Virtual Reality Intervention

Theme	*Frequency*
Found the VR technology easy to use	8/12 (67%)
Experienced no difficulties in operation	7/12 (58%)
Would recommend VR to a friend in a similar situation	10/12 (83%)
Experienced no adverse effects	10/12 (83%)

VR, virtual reality.

which involves still pictures of virtual landscapes combined with an audio experience that guides the user through meditative exercises. Two (17%) participants used ''Apollo 11'' and 1 (8.3%) used ''Hello Mars,'' both of which involve video simulations of rocket launches and space travel. Finally, 2 (17%) participants used ''Coaster,'' a video simulation of a roller coaster. Most participants (11/12, 92%) used the VR for at least 20 minutes, one participant (8.3%) terminated early due to nausea attributed to recently administered medication. All participants (12/12, 100%) completed the full set of quantitative and qualitative surveys.

To assess participant perceptions of the VR intervention, a 10-question survey was administered, with two quantitative items and eight qualitative items. From the quantitative items, participants ($n = 12$) moderately liked the VR headset, ranking it 5.75 (SD: 2.01) on a 10-point scale with 1 representing the least likeability and 10 representing the most likeability. Participants also found the 30-minute intervention to be moderately beneficial, ranking it 4.42 (SD: 2.31) on a 10-point scale with 1 representing the least beneficial and 10 representing the most beneficial.

For the qualitative items, themes were drawn from open-ended responses about the VR intervention and revealed both positive and negative perceptions of the VR experience. Selected high-frequency themes are listed in Table 1. In general, participants found the VR system easy to operate. Eight (67%) participants stated that it was easy to use, and 7 (58%) stated that they experienced no difficulties during the session. Additionally, the majority of participants seemed optimistic about the potential for VR therapy in the palliative care setting, with 10 (83%) participants stating they would recommend it to a friend going through a similar situation.

Several participants reported positive emotional responses during the VR intervention: 1 (8%) stated it was ''fun'' to see a Greek island that they had visited earlier in life; 1 (8%) remarked about how ''beautiful'' they found a particular scene in a forest; and 1 (8%) reported a satisfaction with ''knowing what it's like'' to use a VR headset, a favorite toy of their grandchild.

When difficulties with VR operation did arise, they were attributed primarily to unfamiliarity with the hardware. Specifically, 2 (17%) participants reported difficulty wearing the HMD comfortably, 2 (17%) reported difficulty using a nasal cannula with the HMD, and 2 (17%) reported difficulty learning the button configuration of the remote controller. One (8.3%) participant reported difficulty seeing the images clearly.

Adverse effects as an immediate result of the VR intervention were rare. Two (17%) participants reported sore shoulders attributed to repeated adjustments of the HMD, but the remaining 10 (83%) participants reported no adverse effects. Finally, a major theme in participant responses was that a single session of VR was insufficient to get the most benefits out of the intervention. Six (50%) participants reported that they would feel more ''involved'' with the VR if they were given multiple sessions.

To determine the impact of VR use on common symptoms experienced during palliative care, participants completed the ESAS-r immediately before and after the VR intervention. Table 2 displays the mean reported value for each ESAS-r item on the pre- and post-intervention symptom assessments, in addition to the mean (95% CI) for the change in these values from pre- to post-intervention and the exact p-value resulting from the permutation test.

There was a statistically significant change in pre- and post-intervention ESAS-r scores for lack of appetite since the parametric 95% CI does not include 0; participants rated the severity of this symptom 1.5 points less after the VR session. However, this result may be misleading because the data were not normally distributed and furthermore, the permutation test indicates that the change in lack for appetite was not significant ($p = 0.27$). While lack of appetite was the only item found to have a statistically significant change, there does appear to be an overall trend of improvement in the ESAS-r scores of several symptoms after the VR intervention, namely pain, tiredness, drowsiness, depression, and anxiety.

Discussion

This study explored whether a one-time, 30-minute VR intervention was helpful in symptom management of adult patients facing life-limiting illness, and most importantly assessed participant perceptions of the VR intervention. As

Table 2. Revised Edmonton Symptom Assessment Scale Results for the Pre- and Post-intervention Symptom Assessments

ESAS-r item	*Pre-intervention mean (SD)*	*Post-intervention mean (SD)*	*Delta (95% confidence interval)*
Pain	1.75 (1.96)	1.42 (2.02)	−0.33 (−0.96 to 0.29); $p = 0.766$
Tiredness	5.33 (3.47)	3.58 (3.09)	−1.75 (−4.13 to 0.63); $p = 0.227$
Drowsiness	3.67 (3.03)	2.25 (1.91)	−1.42 (−3.26 to 0.43); $p = 0.211$
Nausea	1.25 (1.71)	1.42 (1.68)	0.17 (−0.29 to 0.62); $p = 0.930$
Lack of appetite	5.08 (3.12)	3.58 (3.20)	−1.50 (−2.79 to −0.21); $p = 0.279$
Shortness of breath	3.33 (2.74)	3.42 (2.87)	0.08 (−1.17 to 1.34); $p = 1.000$
Depression	3.50 (3.37)	2.75 (3.22)	−0.75 (−1.77 to 0.27); $p = 0.618$
Anxiety	3.25 (2.80)	2.83 (3.19)	−0.42 (−2.01 to 1.17); $p = 0.786$
Well-being	5.00 (1.13)	5.00 (2.22)	0 (−1.46 to 1.46); $p = 1.000$

ESAS-r, revised Edmonton Symptom Assessment Scale; SD, standard deviation.

one of the first trials of VR for use in palliative care patients, this study is best viewed as a pilot, with a focus on identifying the perceptions of palliative care patients on use of VR to better guide future larger-scale studies.

Participants supplied a wealth of feedback about the VR intervention. Overall, participants moderately liked the VR session and found it to be moderately beneficial. The majority found it easy to use and did not have any adverse effects from the intervention.

While one study showed that HMDs were associated with greater motion sickness than stereoscopic displays (which require the user to peer into a fixed display), the fact that the VR intervention in this study was well-tolerated is supported by the findings of studies that utilized HMDs for participant samples with similar age ranges.[16–18] Additionally, the study comparing HMDs and stereoscopic desktop displays also found that some participants actually reported greater comfort with the HMD given that they did not have to sit in the same position for the duration of the VR intervention. This is a particularly relevant consideration for the palliative care population, where both primary (age-related) and secondary (disease-related) frailty can contribute significantly to patients' postural function.[19]

Many participants of the present study suggested that multiple sessions of the VR intervention would have been more useful than a single session. While the 30-minute duration of the VR session seemed long enough to allow for immersion without being so long as to induce fatigue or boredom, repeated VR sessions (e.g., three 30-minute sessions per week) may have provided more benefits. First, repeated sessions would mean greater total operational time, which could allow for greater physical comfort with the VR hardware. Physical comfort was one of the main concerns voiced by participants of this study; one example is that nasal cannula necessitated extra care when donning and doffing the HMD.

An additional benefit of multiple VR sessions is that participants may have become more proficient in their navigation and operation of the VR system and applications. Greater navigational and operational proficiency could bring greater interactivity and ultimately greater therapeutic benefit as measured by the ESAS-r.

Some of the difficulties experienced by participants may not have improved with additional VR sessions. Trouble seeing the images clearly could have been due to unfamiliarity with equipment but loss of visual acuity could also have contributed. This underscores the fact that loss of vision and hearing are significant factors limiting the current clinical application of VR systems. This is especially important when considering VR for older patients, as age-related changes in visual acuity and hearing are common.[21,22]

Additionally, there may be reasonable concerns that elderly populations would be hesitant to try newer therapeutic technologies such as VR. The present study did not record participation rates and did not explore why some patients declined to participate. However, VR can be expected to become increasingly mainstream, as HMDs such as that used in this study have been available to consumers at affordable price points for nearly a decade.[14] Finally, optimism may also be drawn from recent successes in the adoption of telemedicine for elderly patients undergoing palliative care, which have demonstrated the willingness of these patients to try novel treatment modalities.[20]

Despite positive trends in improved scores for most of the measurements from pre- to post-intervention ESAS-r scores, the only statistically significant change was seen in appetite scores (representing a decrease in anorexia). However, this statistical significance is only based on the 95% CI. The anticipated sample size of $n = 20$ was not achieved, and the observed distribution of each ESAS-r response item for the sample of $n = 12$ was not normally distributed. Due to the small sample size and the lacking distribution assumptions, the 95% CIs reported for the change in each ESAS-r item may be misleading. A greater sample size may allow for the use of parametric tests rather than the permutation hypothesis testing that was used in this study.

Nevertheless, anorexia—defined as the loss of appetite with or without weight loss—is a common symptom in this population and has been found to be significantly correlated with patient satisfaction in addition to carrying prognostic significance for survival in patients with advanced cancer.[23,24] The mechanism by which VR may reduce anorexia is currently unclear but may involve distraction or neurophysiologic changes, as these have been proposed to explain the benefits of VR in acute and chronic pain management.[2,11]

The only other study to examine VR in the palliative care setting found reductions in symptom severity for a different set of ESAS-r items, namely pain, tiredness, drowsiness, shortness of breath, depression, anxiety, and overall well-being. The sample size for this previous study was 20 participants, underlining the need for larger investigations before conclusions can be made about the benefits of VR for patients undergoing palliative care. Nevertheless, the use of a novel treatment modality such as VR for anorexia and other common symptoms of palliative care patients remains an exciting prospect, as current pharmacological treatments for anorexia are associated with increased risk of edema, thromboembolism, and mortality.[25]

There are several limitations to this study. There was no control group, which limits the conclusions that can be made about whether any effects of the intervention are unique to VR. However, the primary objective of the study was to assess user perceptions of the VR intervention, and the perceptual results remain valid despite the lack of control group. A limitation of the perceptual data is the inherent challenge of drawing general themes from transcribed patient responses, but bias was mitigated by using a standardized question set delivered by the same member of the research team for all 12 participants.

Another limitation was that long-term effects of the VR intervention were not assessed. In addition, the small sample size brings the potential of a false positive result for the reported decrease in anorexia. Finally, the VR intervention was not standardized; participants used VR applications from different genres and for varying lengths of time, and applications varied by content (some involved still pictures while others involved video).

Future studies may consider controlling for type (e.g., still picture, video, audio-guided) and genre (travel, meditation, action, religion) of the VR applications. The ideal frequency and duration of these interventions also remains to be determined.

Conclusion

This study explored whether a one-time 30-minute VR intervention was helpful in symptom management of adult

patients facing life-limiting illness; it also assessed participant perceptions of the VR intervention. There was a significant decrease in anorexia after the VR intervention. Perceptual data suggest that VR is well-tolerated by patients undergoing palliative care. Future research should focus on longitudinal VR interventions for this population.

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(Appendix follows →)

Appendix A1. Post-intervention Questions to Assess Perceptions of the Virtual Reality Experience

Quantitative

1. ''On a scale of 1 to 10, how much did you like using the VR headset?''
2. ''On a scale of 1 to 10, how beneficial do you think your experience with the VR headset was?''

Qualitative

3. ''How involved did you feel with the VR program during this session?''
4. ''How easy was it to learn how to operate this VR program?''
5. ''How confident would you be in recommending this VR program to a friend who is experiencing a similar situation?''
6. ''How useful do you think this program has been for you?''
7. ''Were there any difficulties you experienced during this session?''
8. ''Were there any negative side effects of this session?''
9. ''Were there any emotionally significant events for you during this session?''
10. ''Do you have any additional thoughts that you would like to add about this session?''

VR, virtual reality.