

Utilization of virtual reality to diminish preprocedural anxiety in patients undergoing cardiac interventions: A systematic review

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Utilization of virtual reality to diminish preprocedural anxiety in patients undergoing cardiac interventions: A systematic review

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Abstract

Background: Patients undergoing cardiac intervention often experience high levels of anxiety, whether related to the procedure itself, uncertainty about the results, or the stressful clinic atmosphere. This can impact the patient's physiological and psychological well-being. The role of nurses is very important in overcoming preprocedural anxiety levels, one of which is by utilizing virtual reality (VR) technology as an educational medium and non-pharmacological therapy in overcoming anxiety.

Purpose: To analyze the effect of utilization of virtual reality to diminish preprocedural anxiety in patients undergoing cardiac interventions.

Method: This research uses a systematic review approach, which focuses on utilization of virtual reality to diminish preprocedural anxiety in patients undergoing cardiac interventions. The researcher adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for the selection and assessment of research articles. Articles were sourced from databases such as EMBASE, ClinicalKey Nursing, Springer Link, Science Direct and Scopus, covering publications from 2013 to 2023.

Results: The literature search found 7 articles that were eligible to be research subjects. According to the findings from the reviewed articles, there are significant effect on anxiety level between patients who received VR therapy compared to other groups. The VR content used is in the form of images of cardiac intervention procedures or natural views as relaxation therapy. This analysis suggests that VR interventions can be used to reduce anxiety in patients undergoing cardiac intervention.

Conclusion: The use of virtual reality as an preprocedural education or as a guided imagination relaxation therapy can be given before the patient undergoing a cardiac intervention procedure.

Keywords: Anxiety; Cardiac; Preprocedural; Virtual Reality.

INTRODUCTION

Preprocedural anxiety is a problem that is often found in patients who will undergo invasive procedures or heart surgery. The anxiety experienced was associated with the procedure itself, uncertainty about the results, or the stressful atmosphere of the clinic (Lewis, Bucher, Heitkemper, Harding, Kwong, & Roberts, 2016). This anxiety can not only impact a patient's emotional well-being, but it can also negatively impact treatment outcomes and the patient's overall recovery (Potter, Perry, Stockert, &

Hall, 2021). The prevalence of anxiety in patients undergoing cardiac intervention reaches 70.4% which is associated with the Preprocedural information provided not being sufficient to overcome existing anxiety problems (Afrassa, Kassa, & Legesse, 2022).

Apart from that, anxiety in patients undergoing cardiac intervention can be caused by several things, including long waiting times for the procedure, no companion when the patient is being treated, previous experience when undergoing the procedure and lack

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of information about the action to be carried out. (Buzatto & Zanei, 2010). A study found that patients who were going to undergo cardiac intervention experienced psychosocial problems where patients felt anxious due to lack of information regarding the catheterization procedure that would be carried out and fear of death. Fear of death arises when the patient experiences symptoms resulting from a heart attack or chest pain (Atallah, El-Ashry, & Elganzory, 2019; Herawati, Keiliat, & Waluyo, 2019).

The negative consequences of anxiety in patients with heart problems are physiological and psychological. Anxiety stimulates the sympathetic nervous system and adrenal medulla to stimulate the release of catecholamines, epinephrine and norepinephrine, in the blood. The physiological response to the release of catecholamines is an increase in systolic and diastolic blood pressure and an increase in heart rate. It cause increased endothelial injury and platelet aggregation resulting in greater myocardial oxygen demand and risk of ischemia during cardiac intervention (Henein, Vancheri, Longo, & Vancheri, 2022; Lewis, Bucher, Heitkemper, Harding, Kwong, & Roberts, 2016).

Psychological responses to anxiety in patients undergoing elective cardiac intervention include feelings of anxiety, fear, discomfort, insecurity, narrowed perception, non-compliance with the stages of cardiac intervention and delays in cardiac intervention procedures. This will have an impact on lengthening the length of stay and increasing treatment costs. It is important to prevent the negative effects of anxiety by responding to anxiety according to the patient's needs, so that the intervention that will be given can help reduce the anxiety level of patients undergoing cardiac intervention (Moradi, & Adib, 2015; Videbeck, 2020).

The role of nurses as caregivers is very important in creating care strategies that emphasize efforts to express feelings and fears and identify sources of patient anxiety. Prioritizing treatment of patient anxiety can help improve adaptive coping abilities to the situation that will be experienced. Study shows that several methods can be applied to overcome anxiety in patients, one of which is by providing preoperative preparation videos and guided imagery relaxation therapy (Wang, Huang, Wang, & Akbari, 2022). These two things can be provided

simultaneously using virtual reality media. Virtual Reality (VR) is a technology that allows users to interact with computer-simulated environments. This technology produces experiences that resemble the real world and allows users to interact with objects and environments in a virtual environment (Javaid, Khan, Suman, & Khan, 2023).

The general introduction of virtual reality (VR) for the large number of patients undergoing invasive cardiac procedures should be considered to reduce anxiety. However, research on the use of VR, especially in heart patients, is still limited, so this study aims to analyze the effect of using virtual reality on preprocedural anxiety levels in patients undergoing cardiac interventions.

RESEARCH METHOD

The method used in this writing is a systematic review, namely by synthesizing the use of virtual reality on the preprocedural anxiety level of patients undergoing cardiac intervention. The research question that forms the basis of the author is "Can virtual reality affect the preprocedural anxiety level of patients who will undergo cardiac intervention?" In this systematic review, the effectiveness of virtual reality in overcoming the anxiety of patients who will undergo cardiac interventions is the main focus. A search was conducted on 5 databases namely EMBASE, ClinicalKey Nursing, Springer Link, Science Direct and Scopus to find journals that contain the effectiveness of virtual reality in overcoming the anxiety of patients who will undergo cardiac interventions. The keywords used in this search were 'Virtual Reality' AND 'Anxiety' AND 'Coronary' OR 'Cardiac'. The approach taken in this systematic review is to use the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) approach.

The inclusion criteria for this systematic review use the PICO (Population, Interventions, Comparisons, Outcomes) framework with research articles published in the last 10 years (2013-2023), using English, are journal articles and open access and full text, involving patient respondents with coronary heart disease. The exclusion criteria were encyclopedia, book chapter, conference, correspondence, editorial, news, practice guideline, protocol, systematic review, literature review and meta analysis.

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The article selection process was carried out by screening independently by analyzing the abstract in accordance with the criteria and PICO set as well as the suitability of the content of the article. The next stage analyzed eligible articles, independently checked and extracted data from the study in the form of authors, year and country of origin, number of intervention and control respondents involved in the study, intervention and control details (time, intensity

and frequency), implementation method, duration or session and location of intervention, anxiety measurement instruments, main results of anxiety and other results. Articles were assessed for bias using the Joanna Briggs Institute (JBI) for RCTs. Risk of bias was assessed according to the selection and allocation domain, intervention delivery domain, outcome assessment, detection and measurement domain and participant retention domain.

RESEARCH RESULTS

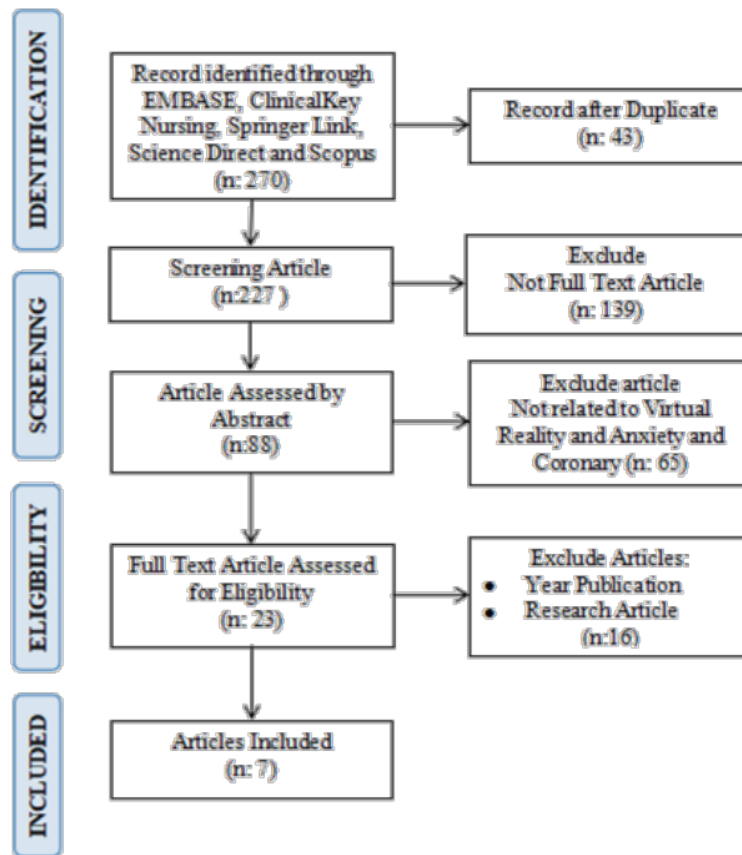


Figure 1. Diagram of PRISMA Flow

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The results of the literature search found 7 articles that were eligible to be the subject of the study. According to the findings, 6 (85.7%) of them were studies with Randomized Controlled Trial research design and 1 (14.3%) article using Prospective Cohort research design. The research was conducted over a period of 4 years, between 2019-2022 with research locations in The Netherlands, Iran, China, France, United Kingdom and Germany. The total number of participants studied was 609 patients from seven studies who were subjects with the inclusion criteria of patients over 18 years of age who would undergo cardiac intervention. Research analysis was conducted using the Joanna Briggs Institute (JBI) for RCT and Cohort designs.

The intervention used in the research study was virtual reality. This non-pharmacological therapy was conducted to assess its effect on anxiety levels. The virtual reality used is a natural landscape such as mountains, beaches, sea and is equipped with soft sounds to reduce the patient's anxiety level. (Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021 ; Larsson, Cabassut, Peretout, Marliere, Vautrin, Piliro, Salvat, Riou, Vanzetto, Vilotitch, Bosson, & Barone, 2023). In addition, educational materials that utilize VR as an interactive medium have been shown to control and reduce anxiety in patients undergoing cardiac interventions (Chang, Kuo, Lin, Chen, Chen, Yang, Yang, Kao, Shulruf, & Lee, 2021; Grab, Hundertmark, Thierfelder, Fairchild, Mela, Hagl, & Grefen, 2023; Hermans, Betz, Verhaert, Clerx, Debie, Lahaije, Vernooy, Linz, & Weijs, 2023; Pool, Hooglugt, Kraaijeveld, Mulder, Winter, Schijven, Robbers, Boekholdt, Bouma, & Winter, 2022). The provision of VR can be done when the patient enters until before being escorted to the action room. The intervention takes about 5-10 minutes (Chang, Kuo, Lin, Chen, Chen, Yang, Yang, Kao, Shulruf, & Lee, 2021; Grab, Hundertmark, Thierfelder, Fairchild, Mela, Hagl, & Grefen, 2023; Hermans, Betz, Verhaert, Clerx, Debie, Lahaije, Vernooy, Linz, & Weijs, 2023; Pool, Hooglugt, Kraaijeveld, Mulder, Winter, Schijven, Robbers, Boekholdt, Bouma, & Winter, 2022).

In this systematic review, the most widely used anxiety measurement instrument is Spielberger's situational anxiety questionnaire or STAI (Morgan, Nana, Phillips, & Gallagher, 2021) and in combination with other parameters such as vital signs (Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021a). The VAS Anxiety instrument in combination with a heart rate monitor was used in one study (Larsson, Cabassut,

Peretout, Marliere, Vautrin, Piliro, Salvat, Riou, Vanzetto, Vilotitch, Bosson, & Barone, 2023). Combination of STAI and VAS A instruments used in other studies (Grab, Hundertmark, Thierfelder, Fairchild, Mela, Hagl, & Grefen, 2023). The Amsterdam Preoperative Anxiety and Information Scale (APAIS) instrument was used in another study (Chang, Kuo, Lin, Chen, Chen, Yang, Yang, Kao, Shulruf, & Lee, 2021; Hermans, Betz, Verhaert, Clerx, Debie, Lahaije, Vernooy, Linz, & Weijs, 2023a). A combination of APAIS and STAI was found in one other study (Pool, Hooglugt, Kraaijeveld, Mulder, Winter, Schijven, Robbers, Boekholdt, Bouma, & Winter, 2022).

The State-Trait Anxiety Inventory research instrument is used to measure a person's subjective level of fear and anxiety when faced with certain situations. The Test Anxiety Inventory is used to determine how a person feels, regardless of the situation and circumstances (Spielberger, Gonzalez-Reigosa, Martinez-Urrutia, Natalicio, & Natalicio, 1971). The APAIS is a specific instrument used to measure preoperative anxiety. Broadly speaking, there are two things that can be assessed through filling out the APAIS questionnaire, namely anxiety and information needs. The APAIS questionnaire consists of 6 short questions, 4 questions evaluate anxiety related to anesthesia and surgical procedures while the other 2 questions evaluate the need for information (Moerman, Dam, Muller, & Oosting, 1996).

Each study provides a different review of the timing of anxiety measurement after VR intervention in patients undergoing cardiac intervention. There are assessment times such as (Larsson, Cabassut, Peretout, Marliere, Vautrin, Piliro, Salvat, Riou, Vanzetto, Vilotitch, Bosson, & Barone, 2023) Before the intervention, anxiety and heart rate were measured. After the intervention, assessment started from the time the patient received the intervention in the waiting room until before arterial puncture. In the study of (Morgan, Nana, Phillips, & Gallagher, 2021) Anxiety assessment was conducted for the first time when the patient was admitted to the hospital, before and after cardiac intervention. While the other three studies (Chang, Kuo, Lin, Chen, Chen, Yang, Yang, Kao, Shulruf, & Lee, 2021; Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021a; Pool, Hooglugt, Kraaijeveld, Mulder, Winter, Schijven, Robbers, Boekholdt, Bouma, & Winter, 2022) anxiety was measured immediately after the intervention was completed.

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Table 1. The Main Characteristics of Included Studies

Author, Year, Country	Purpose	Method	Result
(Larsson, Cabassut, Peretout, Marliere, Vautrin, Piliro, Salvat, Riou, Vanzetto, Vilofitch, Bosson, & Barone, 2023) (France)	This study aims to determine whether the use of VR programs before Invasive coronary angiography (ICA) objectively reduces anxiety assessed by Heart Rate Variability (HRV), namely SD normal to normal (SDNN).	Design: A randomized controlled clinical trial Sample: 156 patients referred to ICA, 76 in the intervention group and 80 in the control group. 3 dropouts in the control group (n:77), and 14 dropouts in the intervention group (n:62).	6 Intervention: The Healthy Mind company (Company, Ville, Pays, Paris, France) provided learning materials, namely 2 VR head-sets and audio headphones and VR programs. A total of 5 themes were proposed to patients (Zen garden, forest, mountain, beach, diving). 13 Instruments: VAS-Anxiety and heart rate monitors. 23 results: A total of 156 patients referred to ICA after a positive noninvasive test for coronary disease were included room before ICA, while the control group benefited from the use of a VR mask in the transfer room before ICA, while the control group underwent the procedure as usual. In both groups, SDNN was measured before 2A . No statistical difference in SDNN was observed between the VR group and the control group (45.5 § 17.8 vs 50.6 § 19.5, p = 0.12). Conclusion: The use of a VR mask before surgery for anxiolytic purposes in the setting of ICA does not result in a decrease in anxiety.
(Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021) (Iran)	This study aimed to investigate the effect of virtual reality on anxiety before coronary angiography.	Design: A randomized clinical trial study Sample: 80 Prospective patients for diagnostic coronary artery angiography through the radial artery with intervention group (n: 40), and control group (n:40)	Intervention: 5-minute nature scenes filmed in various locations and natural landscapes such as beaches, mountains, waterfalls, rivers with pleasant sounds by VR cameras. The sounds include soft music, birdsong, and waterfall sounds. Instruments: Short form of Spielberger state trait anxiety inventory (STAI) and blood pressure, respiratory frequency, and heart rate. 13 results: The majority of participants were male (71.25%) and their mean SD age in the intervention and control groups was 50.95±4.120 and 52.08±4.002 years, respectively. The mean anxiety score (p<0.01), heart

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Design: A Blinded Randomized Clinical Trial
Sample: A total of 80 patients undergoing elective cardiac intervention were divided into 2 groups. Intervention group (n:40), and control group (n:40).
Intervention: Standard preprocedural care (information provided included a BHF information booklet, verbal explanation of the procedure by a preprocedural assessment nurse, and then an opportunity to watch a BHF cardiac intervention video) and preprocedural care with an immersive VR experience (information provided included a BHF information booklet, verbal explanation of the procedure by a preprocedural assessment nurse, and then an opportunity to watch a locally produced immersive VR video on a dedicated VR head-set). The VR group watched a 10-minute VR video describing the preprocedural and procedural experiences on the day of their cardiac intervention.
Instruments: The State Trait Anxiety Inventory (STAI)

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rate ($p=0.001$), and systolic blood pressure ($p=0.016$) decreased significantly after the intervention in the intervention group.

Conclusion: This study shows the application of VR distraction protocol to patients can effectively reduce perioperative anxiety and its indices. This suggests that VR is a safe method without device-related complications and with good acceptance.

Intervention: Standard preprocedural care (information provided included a BHF information booklet, verbal explanation of the procedure by a preprocedural assessment nurse, and then an opportunity to watch a BHF cardiac intervention video) and preprocedural care with an immersive VR experience (information provided included a BHF information booklet, verbal explanation of the procedure by a preprocedural assessment nurse, and then an opportunity to watch a locally produced immersive VR video on a dedicated VR head-set). The VR group watched a 10-minute VR video describing the preprocedural and procedural experiences on the day of their cardiac intervention.
Instruments: The State Trait Anxiety Inventory (STAI)
Results: Sixty-four patients completed the trial (33 in the VR group and 31 in the control group). The VR group experienced a significantly greater decrease in anxiety levels from baseline to post-procedure than the control group (-5.1 vs -4.0, respectively; $P=0.03$). In addition, the VR group had better procedural understanding (3.88 vs 3.23, respectively; $P<0.01$) and higher overall satisfaction than the control group (9.35 vs 8.97, respectively; $P=0.04$).
Conclusion: VR improves patient-centered outcomes for cardiac intervention. This study highlights the importance of improving patient understanding of routine procedures. VR has been shown to improve holistic care in this patient population.

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(Hermans, Betz, Verhaert, Clerx, Debie, Lahajje, Vermoo, Linz, & Weijis, 2023) (The Netherlands)
To evaluate the effects of virtual reality (VR) and preprocedural patient education videos on information provision, procedure-related knowledge, satisfaction, and anxiety levels in patients planned for atrial fibrillation (AF) ablation.

Design: a prospective observational cohort study

Sample: 134 patients who will undergo AF Ablation, 1:1 ratio to control or VR group.

Intervention:

Controls received standardized preprocedural information (n:67). The VR group received standardized information and a short (4:18 min) educational VR video recording in Dutch (via a VR headset in the hospital and a disposable carton) (n:67).

Instruments:

Amsterdam Preoperative Anxiety and Information Scale (APAIS).

Results:

134 patients [38.1% female, aged 66 (58-72) years] were included. The number of patients who were anxious about the ablation procedure was lower in VR patients than control patients (19.1% vs. 40.9%, $P = 0.006$). Females were more anxious than males about the VR procedure (34.8% vs. 11.1%, $P = 0.026$). The number of VR patients who were satisfied with the provision of Preprocedural information was higher post-ablation than pre-ablation (83.3% vs. 60.4%, $P = 0.007$).

(Oudkerk Pool, Hooglugt, Kraaijeveld, Mulder, Winter, Schijven, Robbers, Boekholdt, Bouma, & Winter, 2022) (The Netherlands)
To assess the effect of Virtual Reality (VR) as a means to educate patients to reduce preprocedural anxiety in adult patients undergoing closure of percutaneous closure of patent foramen ovale (PFO) or atrial septal defect (ASD).

Intervention:

The control group received preprocedural education by a cardiologist and the intervention group received additional education through a VR information movie depicting the procedure.

Instruments:

The State Trait Anxiety Inventory (STAI) and the Amsterdam Preoperative Anxiety and Information Scale (APAIS).

Results:

1) baseline anxiety assessment patients in both groups experienced similar levels of anxiety (STAI state anxiety: control 40 ± 10 vs. intervention 39 ± 9 ; $p = 0.70$). During follow-up, anxiety increased in the control group, but remained unchanged in the intervention group (45 ± 11 vs. 38 ± 7 , $p = 0.02$). No differences were found for the APAIS anxiety scale.

Conclusion:

Patient education using Virtual Reality is effective in reducing preprocedural anxiety in patients undergoing percutaneous PFO or ASD closure. The general introduction of VR for large numbers of patients undergoing invasive cardiac procedures should be considered to reduce anxiety in this already vulnerable population.

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<p>(Chang, Kuo, Lin, Chen, Chen, Yang, Yang, Kao, Shulruf, & Lee, 2021) (Republic of China)</p> <p>This study compared the effectiveness of using newly developed virtual reality (VR) materials (VR group) or paper-based materials (paper group) in providing AF preprocedure education.</p>	<p>Design: a randomized control study Sample: 33 patients who were to undergo AF ablation, paper (n=22) and VR (n=11) groups</p> <p>Intervention: Introduction to the environment, tools and materials and procedures for AF catheter ablation. Instruments: Amsterdam Preoperative Anxiety and Information Scale (APAIS). Results: Compared to the initial stage, at the post-education stage, the level of improvement in patient self-efficacy in AF ablation knowledge was higher in VR group patients than paper group patients. At the post-education stage, patient satisfaction with the preprocedural education and materials used was higher in the VR group than in the paper group. In addition to meeting their needs and providing accurate medical information, VR group patients reported that the VR materials increased the effectiveness of the education, improved their readiness for AF catheter ablation, achieved the paperless goal, and were willing to recommend the VR materials to others.</p>
<p>(Grab, Hundertmark, Thierfelder, Fairchild, Mela, Hagl, & Grefen, 2023) (Germany)</p> <p>To assess new perspectives in cardiac surgery patient education using 3D printing and virtual reality</p>	<p>Design: A randomized controlled trial Sample: 99 patients participated in the study and received pre-treatment education using standard paper-based methods (n = 34), 3D printed models (n = 34) or virtual reality models (n = 31). Intervention: Education using virtual reality media describes the surrounding environment and procedures carried out using virtual reality goggles. Instrument: Visual Analog Scale (VAS) and the State-Trait-Anxiety-Inventry (STAI) Results: Significant reduction in anxiety measured with the Visual Analogue Scale was achieved after patient education with the virtual reality model (5.00 to 4.32, Δ-0.68, $p < 0.001$). Procedural knowledge increased significantly for each group after patient education, while visualization and satisfaction were rated best for patient education with virtual reality. Patients rated the quality of patient education using both visualization methods individually [3D model and virtual reality (VR) higher compared to the control group using conventional paper sheets (control paper sheets: $86.32 \pm 11.89\%$, 3D: $94.12 \pm 9.25\%$, $p < 0.0095$, VR: $92.90 \pm 11.01\%$, $p < 0.0412$).</p>

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DISCUSSION

Analysis of seven studies showed that VR interventions can significantly reduce the anxiety level of patients undergoing cardiac interventions. VR is able to stimulate physical relaxation responses, such as a decrease in heart rate and blood pressure, which also contributes to reducing patient anxiety. The mechanism of action of VR in reducing anxiety can be explained through the concepts of distraction and relaxation. By using VR, patients can engage in an engaging virtual environment, thereby distracting them from the anxiety they feel towards a stressful medical situation (Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021a). VR can also help patients to be more mentally and emotionally prepared for cardiac interventions in catheterization laboratory environment and the procedure itself, thus reducing anxiety levels before the procedure is performed (Morgan, Nana, Phillips, & Gallagher, 2021).

This systematic review showed that the VR group was more influential in reducing anxiety in patients about to undergo cardiac intervention compared to the control group, but with high heterogeneity. Study (Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021a) showed that the number of respondents between groups was divided evenly, namely 1: 1 with a total sample of 80 people. The same intervention was given to the VR group, namely natural scenery (beach, mountain, waterfall) with soft sounds (chirping birds, waterfall sounds, soft background music) while the control group received standard care. This proves that VR intervention compared to standard care is able to reduce anxiety subjectively as measured by the STAI instrument and validated objectively by measuring vital signs. Average anxiety, heart rate, systolic blood pressure decreased significantly.

The results of this study are also in line with the study conducted by (Hermans, Betz, Verhaert, Clerx, Debie, Lahajje, Vernooy, Linz, & Weijs, 2023a) which proved that the anxiety of the VR group was lower than the standard care group. The VR intervention provided is brief education before the atrial fibrillation ablation procedure. Hermans et al, found that satisfaction with the Preprocedural information obtained by patients was higher in the VR group compared to the control group. This is due to the use

of Virtual Reality (VR) technology can provide a new dimension in education because patients can directly experience hospital wards and operating rooms, and receive step-by-step explanations of the course of hospitalization and procedures (Hermans, Betz, Verhaert, Clerx, Debie, Lahajje, Vernooy, Linz, & Weijs, 2023).

Changes in anxiety levels in patients who receive education through VR occur due to neurocognitive stimulation by presenting an immersive and controlled environmental picture that is able to convey information in a clear and interactive way so as to stimulate brain activity to process information, improve patient cognition, and respond to existing situations by visualizing, recognizing and understanding the procedure and the environment in which the procedure will be performed. This will increase patient confidence by generating a more positive experience. VR technology allows for more effective education at a lower cost and in less time than traditional methods, thereby increasing the patient's incentive to engage and improving their readiness for the procedure (Hermans, Betz, Verhaert, Clerx, Debie, Lahajje, Vernooy, Linz, & Weijs, 2023; Jung, Wolff, Wernly, Bruno, Franz, Schulze, Silva, Silva, Bhatt, & Kelm, 2022).

The mechanism of action of guided imagery with VR in reducing anxiety can be explained through the concepts of distraction and relaxation. VR helps engage patients in an engaging virtual environment, thereby distracting them from their perceived anxiety towards a stressful medical situation. VR can also create a relaxation experience by allowing patients to experience a calm and pleasant atmosphere, thus helping to reduce patients' anxiety levels. In addition, VR can stimulate physical relaxation responses, such as decreased heart rate and blood pressure, which also contribute to reducing patient anxiety. Thus, the mechanism of action of VR in reducing anxiety can be explained through the concepts of distraction, relaxation, and stimulation of positive physical responses in the patient's body (Keshvari, Yeganeh, Paryad, Roushan, & Pouralizadeh, 2021; Potter, Perry, Stockert, & Hall, 2021; Stucky & Vortman, 2022).

On the other hand, in (Larsson, Cabassut, Peretout, Marliere, Vautrin, Piliero, Salvat, Riou,

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Vanzetto, Vilotitch, Bosson, & Barone, 2023) the use of VR with nature scenes did not show an objective decrease in anxiety. This assessment was measured using heart rate variability (SDNN) while using virtual reality (VR) in patients before invasive coronary angiography procedures. Although VR has been shown to reduce anxiety in several previous studies, this study shows that VR does not produce an objectively significant reduction in anxiety in patients before invasive coronary angiography procedures. Factors such as the choice of VR program, the clinical state of the patient, or the characteristics of the patient may have influenced the results, but this study did not provide a specific explanation as to why there was no significant reduction in anxiety.

Further analysis found that the short duration of the intervention and the lack of follow-up were limitations of some of these studies. The flow of participants who were not completed or followed up was not described in the outcomes studied. This is important as it will influence the risk of bias related to participant retention. In addition, no blinding method was used in this study, which may affect the risk of bias related to assessment, detection and measurement of outcomes. Overall, however, VR can create a relaxing experience by allowing patients to experience a calm and pleasant atmosphere, thus helping to reduce their anxiety levels. VR has been shown to be effective in providing distraction and relaxation, which can help reduce anxiety and stress in various medical environments.

CONCLUSION

This analysis shows that VR interventions can be used to reduce anxiety in patients undergoing cardiac interventions. The use of VR with guided imagery in the form of natural scenery and education on the actions to be performed can be provided before the patient undergoes the procedure. However, further research is needed on the convenience and safety of its implementation, as well as the combination of education and relaxation using VR on anxiety levels.

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