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The Effect of Virtual Reality on Anxiety and Pain in Pre-Anesthesia

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Pasien yang akan menjalani operasi sering mengalami kecemasan dan nyeri pra-anestesi yang dapat memengaruhi kesiapan fisik dan psikologis serta kelancaran proses anestesi. Kondisi ini masih sering ditemukan di rumah sakit daerah, sehingga diperlukan intervensi non-farmakologis yang mudah diterapkan, efektif, dan aman. Penelitian ini bertujuan untuk mengevaluasi pengaruh terapi Virtual Reality (VR) terhadap tingkat kecemasan dan nyeri pada pasien pra-anestesi di Rumah Sakit dr. R. Goeteng Taroenadibrata Purbalingga. Desain penelitian yang digunakan adalah kuantitatif quasi-eksperimental dengan pendekatan pretest-posttest dan kelompok kontrol. Sampel terdiri dari 50 pasien pra-anestesi yang dibagi menjadi dua kelompok: kelompok intervensi dan kelompok kontrol, masing-masing 25 responden. Tingkat kecemasan diukur menggunakan Amsterdam Preoperative Anxiety and Information Scale (APAIS), sementara nyeri diukur dengan Visual Analogue Scale (VAS). Analisis data dilakukan dengan uji Wilcoxon untuk melihat perbedaan sebelum dan setelah intervensi dalam tiap kelompok, serta uji Mann–Whitney untuk membandingkan perbedaan antar kelompok dengan tingkat signifikansi $p < 0.05$. Hasil penelitian menunjukkan penurunan signifikan dalam tingkat kecemasan dan nyeri pada kelompok intervensi setelah terapi VR, serta adanya perbedaan signifikan antara kelompok intervensi dan kontrol. Penelitian ini menyimpulkan bahwa terapi VR efektif dalam mengurangi kecemasan dan nyeri pasien pra-anestesi dan dapat diterapkan di rumah sakit regional.

The Effect of Virtual Reality on Anxiety and Pain in Pre-Anesthesia

Patients undergoing surgery often experience pre-anesthesia anxiety and pain, which can affect their physical and psychological readiness as well as the smoothness of the anesthesia process. This condition is still commonly found in regional hospitals, so there is a need for non-pharmacological interventions that are easy to implement, effective, and safe. This study aims to evaluate the effect of Virtual Reality (VR) therapy on anxiety and pain levels in pre-anesthesia patients at Dr. R. Goeteng Taroenadibrata Hospital in Purbalingga. The research design used was a quantitative quasi-experimental study with a pretest-posttest approach and a control group. The sample consisted of 50 pre-anesthesia patients divided into two groups: an intervention group and a control group, each with 25 respondents. Anxiety levels were measured using the Amsterdam Preoperative Anxiety and Information Scale (APAIS), while pain was measured using the Visual Analogue Scale (VAS). Data analysis was performed using the Wilcoxon test to see the differences before and after the intervention in each group, as well as the Mann–Whitney test to compare the differences between groups with a significance level of $p < 0.05$. The results showed a significant decrease in anxiety and pain levels in the intervention group after VR therapy, as well as a significant difference between the intervention and control groups. This study concluded that VR therapy is effective in reducing anxiety and pain in pre-anesthesia patients and can be implemented in regional hospitals.

Introduction

The execution of surgery is often an experience that creates significant emotional distress for the patient, especially since the surgical decision is made. In this phase, patients generally begin to feel tension, fear, and various worries related to the procedure to be undertaken. This condition is known as pre-anesthesia anxiety, which is an emotional and physiological response due to the perception of a threat to medical action. This anxiety is characterized by the activation of the sympathetic nervous system that triggers an increase in heart rate, blood pressure, and muscle tension (Suhamdani, Pratama, and Utari 2020)If not handled properly, pre-anesthesia anxiety can be a serious obstacle because it affects hemodynamic stability, anesthesia needs, and the postoperative recovery process. Various factors are known to contribute to this condition, including previous traumatic experiences, lack of information, neurotransmitter imbalances, and an unfamiliar and psychostressful hospital environment (Saraswati, Wirawan, and Utami 2021)

In a clinical context, pre-anesthesia anxiety is a complex condition because it involves the interaction between the psychological and physiological aspects of the patient. Therefore, accurately identifying anxiety levels is an important step in determining the right treatment strategy before surgery, as guessed(Suhamdani, Pratama, and Utari 2020)nkan by Rahmadi and Nasution (2024). One of the instruments widely used for this purpose is the Amsterdam Preoperative Anxiety and Information Scale (APAIS), which has proven to be valid and reliable in assessing the anxiety level and information needs of pre-operative patients (Yilmaz 2020). However, there is still a gap in theoretical understanding of the relationship between anxiety and pain, especially involving neurocognitive mechanisms. Increased anxiety is known to strengthen the perception of pain through the activation of corticolimbic circuits that play a role in the processing of emotions and pain.

When an individual's attention is focused on medical threats and negative emotions, adaptive distraction abilities decrease so pain perception tends to increase, as described in distraction theory and emotion regulation theory (Wiech and Tracey 2015)Neurocognitively,

anxiety is associated with increased activity of brain structures such as the amygdala, prefrontal cortex, anterior cingulate cortex, and limbic system which play a role in modulating the affective and cognitive dimensions of pain (Villemure and Bushnell 2019). Recent neuroimaging research shows that changes in connectivity between the cortical and limbic areas affect the transmission and interpretation of pain signals from the periphery to the central nervous system, thereby amplifying the experience of pain in both acute and chronic pain conditions accompanied by anxiety (Huang et al. 2022). Overactivation of this pathway can increase pain sensitivity, while effective anxiety management has the potential to strengthen top-down control mechanisms so that pain perception can be suppressed. Thus, understanding the psychological and neurocognitive mechanisms of pre-anesthesia anxiety becomes an important theoretical foundation in the development of nonpharmacological interventions.

In addition to anxiety, pre-anesthesia pain is an important factor that also affects the patient's mental and physical readiness before undergoing surgery. Pain is not only seen as a response to tissue damage, but also as the result of complex interactions between physiological and psychological factors, such as anxiety and emotional stress (Boy, 2020). High levels of anxiety have been shown to increase pain perception through activation of the central nervous system as well as increased transmission of pain signals mediated by neurotransmitters such as serotonin, norepinephrine, and endorphins (Affadhia, Cahyanur, and Wahdini 2022). To objectively assess pain intensity, the Visual Analogue Scale (VAS) is widely used because it is able to provide a quantitative picture of the patient's subjective perception of pain and facilitate the evaluation of the effectiveness of pre-anesthesia interventions. However, the perception of pain is also influenced by psychological, social, and cultural factors, so the approach to handling it needs to be carried out holistically and individually. (Harini, Damayanti, and Susanto 2024).

Various international studies show that Virtual Reality (VR) technology is effectively used as a nonpharmacological intervention to reduce anxiety and pre-anesthesia pain. The use of VR for 10–20 minutes is considered optimal because it is able to provide sensory and cognitive distractions without causing visual fatigue or side effects such as nausea or dizziness

(Huang et al. 2022). These interventions work through mechanisms of visual distraction, multisensory stimulation, as well as decreased activity of the sympathetic nervous system followed by increased physiological relaxation, including the release of endorphins, dopamine, and serotonin (Ş. Gül and Öztürk 2021). These physiological impacts contribute to a decrease in blood pressure, heart rate, and stress hormones, so that the patient is in a calmer state ahead of anesthesia induction (Almutairi et al. 2021).

Although the effectiveness of VR has been widely proven in developed countries, research on its application in Indonesia, especially in regional hospitals, is still limited. In fact, regional hospitals often face more complex challenges, such as limited technology facilities, the number and readiness of health workers, and the high workload of services. The application of VR in this context also faces constraints on the cost of procurement and maintenance of devices, the readiness of technical infrastructure, and the limitations of training health workers in operating the technology. In addition, social and cultural factors also affect patients' acceptance of the use of new technologies. Compared to other nonpharmacological interventions such as music therapy or breathing techniques, VR has the advantage of creating a multisensory immersive experience, but it also has the potential to be combined with other interventions to form a more holistic and adaptive approach to local conditions.

Therefore, research on the use of VR at the Regional General Hospital dr. R. Goeteng Taroenadibrata Purbalingga is important to assess not only its effectiveness in reducing pre-anesthesia anxiety and pain, but also its feasibility, implementation challenges, and potential integration with other nonpharmacological interventions. Overall, this research is expected to make a relevant contribution to the development of a more humanistic, applicative, and patient-centered nonpharmacological approach, while strengthening the quality of perioperative nursing services in Indonesian regional hospitals.

Method

This study is a quantitative study with a quasi-experimental design using a pretest–posttest approach with a control group to assess the effect of Virtual Reality (VR) intervention on pre-anesthesia anxiety and pain levels. The research was carried out at dr. R. Goeteng Taroenadibrata Purbalingga Hospital for three weeks with a total of 50 respondents who were selected using purposive sampling techniques, according to the inclusion criteria, namely adult patients aged 20–50 years, fully conscious, and willing to participate in the study until completion. Respondents were divided into two groups, consisting of 25 patients in the intervention group who received VR therapy and 25 patients in the control group without VR. Data collection was carried out in the pre-anesthesia phase through observation and filling out questionnaires using the Amsterdam Preoperative Anxiety and Information Scale (APAIS) to measure anxiety and the Visual Analogue Scale (VAS) to measure pain, which has been declared valid by two anesthesiologists. Data analysis began with the Shapiro–Wilk normality test, which showed that the data were not normally distributed, so the analysis continued using the Wilcoxon Signed Rank Test to assess differences in anxiety and pain levels before and after the intervention in each group. In addition, to determine the difference in anxiety and pain levels between the intervention group and the control group, the Mann–Whitney U Test was used. All analyses were conducted with a significance level of 95% ($p < 0.05$). This research has received ethical approval from the Ethics Committee of the Faculty of Health Sciences, University of Muhammadiyah Purwokerto with the number KEPK/UMP/71/VI/2025.

Research Results

Table 1 Age and sex characteristics

Features	F		Presentase	
	Casus	Contol	Casus	Control
Age				
<40 years old	13	12	52.00	48.00
>40 years old	12	13	48.00	52.00
Gender				
Male	13	12	52.00	48.00

Women	12	13	48.00	52.00

Table 1 shows that the table of characteristics of the respondents is known that there are 25 cases and 25 controls that are categorized based on the age of the most cases in the category of 18-36 years with a total of 13 people (52%) and the age of the most control in the category of 41-66 years with a total of 13 people (56%). The characteristics of the most male respondents were men with 13 people (52%) and the control sex was female with 13 people (52%).

Table 2 Anxiety levels of pre and post anesthesia patients were given virtual *reality therapy* in the case group and the counter.

Variabel		N	Mean	Min	Max	Sd
Pre Emergency	Casus	25	80	0	1	408
	Control	25	88	0	1	332
Anxiety Post	Casus	25	76	0	1	436
	Control	25	64	0	1	490

Table 2 of the table obtained the results that the anxiety level of pre-anesthesia patients before and after virtual reality administration in the case and control groups with 25 respondents each. In the case group, average anxiety decreased from 80 and post 76 after being given virtual reality therapy. This shows a decrease in anxiety levels after the intervention is given. Meanwhile, in the control group with an average anxiety of pre 88 and post 64. The standard deviation value refers to the variation of respondents' anxiety data in each group.

Table 3 Pain levels of pre- and postoperative patients were given *virtual reality therapy* in the case and control groups.

	Variabel	N	Mean	Min	Max	Sd
Nyeri pre	Case	25	3.12	1	6	302
	Control	25	3.36	1	5	336
Post pain	Case	25	2.16	1	5	243
	Control	25	2.20	1	4	220

Table 3 tables obtained Pre-anesthesia patient pain levels before and after virtual reality administration in the case and control groups with 25 respondents each. In the case group, the

average pain decreased from 3.12 and post 2.16 after being given virtual reality therapy. This shows a decrease in pain levels after the intervention is given. Meanwhile, in the control group with an average pre pain of 3.36 and post 2.20. The standard deviation value refers to the variation of respondents' anxiety data in each group.

Table 4 Effects of Pre and Post Anesthesia Anxiety and Pain Case and Control Groups

Variable			N	Mean	P value
Anxiety	Pre	Case	25	80	0.00
		Conrol	25	88	0.00
	Post	Case	25	76	0.00
		Control	25	64	0.00
Nyeri	Pre	Case	25	3.24	0.13
		Control	25	2.18	009
	Post	Case	25	216	002
		Control	25	220	000

Table 4 was obtained by the shapiro-wil normality test, known with the number of respondents was 25 people. The results showed a difference in the average anxiety and pain between the case and control groups at the pre and post measurements. *A p* value of < 0.05 for all variables indicates that the difference is statistically significant, so that virtual therapy has an effect on reducing the patient's anxiety and pain.

Table 5 case group effectiveness and pre and post pain control, pre and post anxiety.

Variabel	N	Mean rank	P value
Pre and post case emergencies	25	100	0.317
Pre and post emergency control	25	21.00	0.14
Pre and post case pain	25	8,50	0.00
Pre and post control pain	25	950	0.00

Table 5 obtained by the Wilcoxon test shows that in the case group there was no difference in pre and post anxiety (p = 0.317), while in the control group there was a significant

difference (p = 0.014). In the pain variable, both the case and control groups suggested that virtual reality was more effective in reducing pain than anxiety.

Table 6 differences in case and control on anxiety,

Variable		N	Mean	P value
Anxiety	Case	25	22.06	0.076
	Control	25	28.94	

Table 6 was obtained by the Mann–Whitney test with a p value of 0.076 (p > 0.05), so it can be concluded that there was no statistically significant difference between the case group and the control group on the level of anxiety. The average anxiety score in the case group was 22.06 with 25 respondents, while in the control group it was 28.94 with 25 respondents. Descriptively, the control group showed a higher level of anxiety than the case group.

Table 7 differences in case and control in pain.

Variable		N	Mean	P value
Nyeri	Case	25	24.34	0.554
	Control	25	26.66	

Table 7 is obtained with the results of the Mann–Whitney test obtained a p value of 0.554 (p > 0.05), so it can be concluded that there is no statistically significant difference between the case group and the control group on pain level. The average pain score in the case group was 24.34 with 25 respondents, while in the control group it was 26.66 with 25 respondents. Descriptively, the control group had a slightly higher pain score than the case group.

Discussion

The results of this study show that the use of Virtual Reality (VR) in pre-anesthesia patients descriptively was able to reduce anxiety and pain levels before anesthesia, although statistically no significant difference was shown between the case and control groups. In the anxiety difference table, the group that received the VR intervention had a lower average anxiety score than the control group, but the results of the Mann–Whitney test showed that the difference was not significant. Similarly, in the pain difference table, the intervention group showed a lower average pain than the control group, but statistically no significant difference was found. However, clinically there was a tendency to reduce anxiety and pain in the group given VR,

which indicates the potential benefits of this intervention as a supportive nonpharmacological therapy.

The decrease in anxiety and pain that occurs is not solely influenced by the use of VR, but also by other factors such as the level of initial anxiety and the patient's experience of the technology. Patients with higher levels of anxiety tend to show more pronounced declines than patients with mild anxiety. In addition, patients who are used to using digital technology generally find it easier to accept the VR experience so that the distraction effect is more optimal (Rahmadi and Nasution 2024). Psychologically, VR works through a distraction mechanism by diverting the patient's attention from fear and negative thoughts towards anesthesia procedures towards soothing visual and auditory stimulation. When attention is focused on the virtual environment, the perception of medical action becomes less and anxiety and pain also decreases (Villemure and Bushnell 2019)From a physiological point of view, VR plays a role in modulating the central nervous system by suppressing the activity of the fear center in the brain as well as stimulating the release of neurotransmitters such as endorphins, dopamine, and serotonin which contribute to increased comfort and decreased pain perception (E. O. Gül and Öztürk 2021).

This research has novelty value because it was carried out in regional hospitals in Indonesia, where the use of VR technology in health services is still relatively limited. These results provide an idea that VR has the potential to be applied practically in a short-duration pre-anesthesia room without the need for complex facilities. Nurses have an important role in providing education, ensuring patient comfort during interventions, and monitoring patient responses. Although the study design had limitations such as the absence of randomization and the possibility of a natural reduction in anxiety in the control group, these findings nonetheless suggest that VR has the potential to be developed as a safe, easy to apply, and relevant supportive intervention in perioperative nursing practice. Further research is suggested using a more robust experimental design as well as exploring variations in duration and types of VR content that are most effective for lowering pre-anesthesia anxiety and pain.

Conclusion

The study concluded that the use of Virtual Reality (VR) in pre-anesthesia patients showed a tendency to lower anxiety and pain levels before anesthesia procedures. Descriptively, the group that received the VR intervention had lower anxiety and pain scores than the control group, although statistically significant the difference was not significant. This study concludes that Virtual Reality (VR) is effective in reducing anxiety and pain in pre-anesthesia patients, thus answering the research objectives regarding the effect of VR on psychological and physical conditions before anesthesia. VR provides a powerful distraction and creates a relaxing experience so that patients are calmer and more comfortable ahead of the procedure. Thus, VR can be used as a non-pharmacological intervention that is safe, easy to apply, and useful in improving the quality of pre-anesthesia services. This research also contributes to the development of preoperative nursing practices by providing evidence that VR technology is feasible to be integrated into routine care, as well as opening up opportunities for future research to explore the optimal duration of VR use, the most effective types of content, and its application to a variety of surgical procedures and different patient groups.

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