Can Virtual Reality Improve Pain Thresholds While Reducing Pain and Anxiety?

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Background

Hospitalized patients frequently report distress, with surgical interventions being particularly anxiety-provoking[1,2].

Current standards of care involves **pharmacologic** options that have **adverse side effects** with misuse having led to a **national opioid epidemic[3].**

Virtual reality (VR) is a **promising alternative** that has demonstrated to be an **effective analgesic** and **anxiolytic[4].** However**, quantitative data** evaluating it's effectiveness is **limited.**

Methods

Primary Aim: Assess differences in **heat pain threshold** (**HPT**) between VR and control group.
Secondary Aim: Assess differences in **pressure pain threshold** (**PPT**) between VR and control group.
Secondary Aim: Evaluate initial and recalled pain and anxiety perceptions.

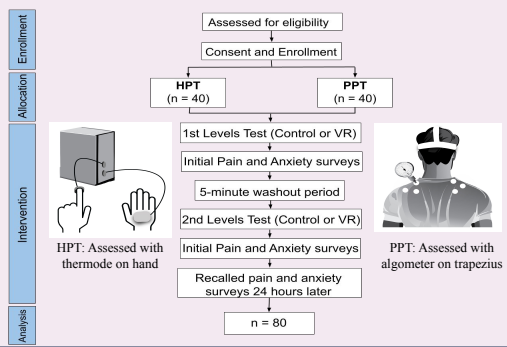

Figure 1. Participant Flow Diagram
Using a randomized, crossover study design with one cohort for HPT and one for PPT, participants underwent VR and control conditions to assess differences in their pain thresholds and pain and anxiety perceptions.

Figures

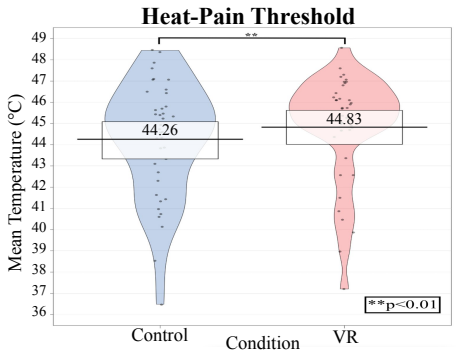

Figure 2. Mean Differences in Heat Pain Thresholds.
The VR condition resulted in increases in HPT** compared to the control condition.

HPT	Control	VR	Difference (VR-Control)	p-value
Average response temperature	44.26	44.83	0.57	0.002
Initial Pain	4.97	4.85	-0.12	0.43
Recalled Pain	4.48	4.73	0.25	0.851
Initial Anxiety	1.9	1.22	-0.68	0.006
Recalled Anxiety	2.05	1.28	-0.78	0.002
PPT	**Control**	**VR**	**Difference (VR -Control)**	**p-value**
Average response pressure	9.6	10.06	0.46	0.044
Initial Pain	6.05	5.75	-0.3	0.24
Recalled Pain	5.83	4.98	-0.85	0.003
Initial Anxiety	2.43	1.5	-0.93	0.01
Recalled Anxiety	3.18	1.83	-1.4	0.002

Table 1. Results for Mean Differences in Pain Thresholds, Pain, and Anxiety for HPT and PPT.

Results

- Participants reported an **increase** in their **HPT**** and **PPT*** during the **VR** condition compared to when they were not using VR.
  - Pain thresholds increased without an increase in participant pain perception for both HPT and PPT.
- For HPT, VR had no effect on recalled pain perception.
- For **PPT***, VR **reduced recalled pain perception**.
- **VR reduced initial** and **recalled anxiety** compared to when participants were not using VR in the control condition for both **HPT**** and **PPT****.

*p ≤ 0.05
** p ≤ 0.01

Discussion

Why is this important?	VR is a promising non-pharmacologic alternative with this study demonstrating VR's potential to enhance patient experiences during medical interventions and long-term health outcomes by optimizing memories during stressful events.
Limitations & Future Directions	• Single-site recruitment • Analgesic and anxiolytic effects evaluated over a single session • Future studies: investigate how different VR software attributes vary cognitive load, such as passive compared to active gameplay
Conclusions	Immersion in **VR increased pain thresholds** while **simultaneously modulating recalled pain** and **anxiety** perceptions.

References

1. P.K. Palmer, K. Wehrmeyer, M.P. Florian, C. Raison, E. Idler, J.S. Mascaro, The prevalence, grouping, and distribution of stressors and their association with anxiety among hospitalized patients, PloS One 16 (2021) e0260921. https://doi.org/10.1371/journal.pone.0260921.
2. C.J. Wilson, A.J. Mitchelson, T.H. Tzeng, M.M. El-Othmani, J. Saleh, S. Vasdev, H.J. LaMontagne, K.J. Saleh, Caring for the surgically anxious patient: a review of the interventions and a guide to optimizing surgical outcomes, Am. J. Surg. 212 (2016) 151–159. https://doi.org/10.1016/j.amjsurg.2015.03.023.
3. J. Lyden, I.A. Binswanger, The United States opioid epidemic, Semin. Perinatol. 43 (2019) 123–131. https://doi.org/10.1053/j.semperi.2019.01.001.
4. F.Q. Tas, C.A.M. van Eijk, L.M. Staals, J.S. Legerstee, B. Dierckx, Virtual reality in pediatrics, effects on pain and anxiety: A systematic review and meta-analysis update, Paediatr. Anaesth. 32 (2022) 1292–1304. https://doi.org/10.1111/pan.14546.

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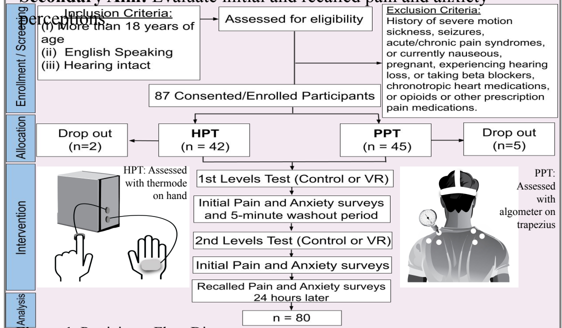
Enrollment / Screening
Allocation
Intervention
Analysis
Inclusion Criteria:
(i) More than 18 years of age
(ii) English Speaking
(iii) Hearing intact
Assessed for eligibility
Exclusion Criteria:
History of severe motion sickness, seizures, acute/chronic pain syndromes, or currently nauseous, pregnant, experiencing hearing loss, or taking beta blockers, chronotropic heart medications, or opioids or other prescription pain medications.
87 Consented/Enrolled Participants
Drop out (n=2)
HPT (n = 42)
PPT (n = 45)
Drop out (n=5)
HPT: Assessed with thermode on hand
1st Levels Test (Control or VR)
Initial Pain and Anxiety surveys and 5-minute washout period
2nd Levels Test (Control or VR)
Initial Pain and Anxiety surveys
Recalled Pain and Anxiety surveys 24 hours later
n = 80
PPT: Assessed with algometer on trapezius

Figure 1. Participant Flow Diagram

With one cohort for HPT and one for PPT, participants underwent VR and control conditions to assess differences in their pain thresholds and pain and anxiety perceptions.

Figures

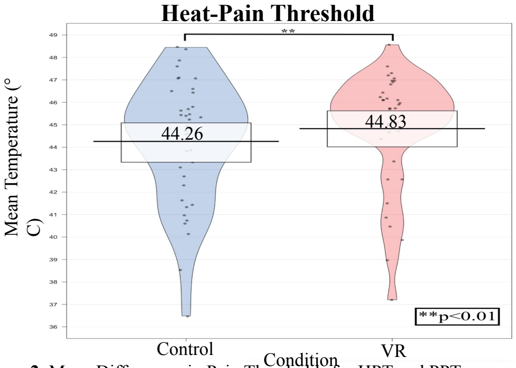

Figure 2. Mean Differences in Pain Thresholds for HPT and PPT. The VR condition resulted in increases in HPT** compared to the control condition.

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