

A Hospital Based Prospective Randomized Control Study Evaluating the Effect of Virtual Reality on Pain during Intravenous Cannulation and Preoperative Separation Anxiety in Pediatric Patient

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Abstract

Aim: The aim of the proposed study was to evaluate virtual reality (VR) as a non-pharmacological intervention tool to reduce pain and separation anxiety in patients of paediatric age group undergoing intravenous cannulation and surgery.

Methods: A prospective randomized control study was conducted in Department of Anaesthesiology at ESICMCH, Bihta, Patna after clearance by ethical committee. Patients with ASA physical status I, II posted for elective surgeries were included in the study which was conducted during 1 year period. Sixty patients were randomized into two groups.

Results: statistical analysis of the heart rate and oxygen saturation of Children with moderate anxiety and severe anxiety and anxiety with regard to parental separation and about the unfamiliar people and environment done using paired t test. Patients using VR exhibited lower pain and anxiety score during intravenous cannulation and parental separation.

Conclusion: This current study found that application of immersive VR had better pain alleviation and parent separation anxiety score when compared with non-VR group patient.

Keywords: Intravenous Cannulation, Preoperative Separation Anxiety.

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Introduction

Preoperative anxiety is a natural and compatible response to surgery stress which may happen at any time before surgery. [1] This stress is intensified when a patient is informed about the need for surgery, during hospitalization and at the initiation of surgery. [2,3] Some signs of stress include anxiety, distraction, irritation, fear, and increase in heart rate. [4] Preoperative anxiety is a potential threat for a patient due to the changes in psychologic responses, including elevation of blood pressure and heart rate, and may endanger patient's health. [5] On the day of surgery, 50 to 70% of children experience anxiety that usually peaks during induction of anaesthesia. [6] Preoperative anxiety is associated with problematic induction of anaesthesia, [7] risk of emergence delirium, [7,8] increased pain and poorer recovery. [9,10]

Anxious children undergoing surgery, and their parents, are also at risk of post-traumatic stress symptoms. [11,12] These adverse outcomes underscore the urgent need for effective interventions to reduce pre-operative anxiety.

Patient anxiety may increase complications of surgery and anesthesia. Preoperative anxiety can reduce the quality of anesthesia and increase demand for analgesics, which can inadvertently prolong the duration of anesthesia. The patient wakes up from anesthesia later, which leads to increase anesthesia and surgery complications. Preoperative anxiety not only causes pain and discomfort for many children with surgery experience, but also has a negative impact on post-surgical duration of improvement and recovery. [13] Postoperative anxiety behaviors are negative behaviors during surgery experience, including impatience, crying, unintentional urination, and need to physical limiting tools during anesthesia, [14] and are accompanied by some other postoperative inconsistent behaviors, including distress addition in recovery level, return behavioral disorders after the surgery (nightmare), separation anxiety, eating disorder, and sleep and enuresis disorders. [15]

Preoperative anxiety can also cause emergence delirium and studies have shown significant psychological changes in two weeks after the surgery and the post trauma stress symptoms persisting upto 6 months in the age group of 6-18 year old. [16,17] Pharmacological interventions to treat preoperative anxiety in children has its own side effects. Hence, Non-pharmacological interventions could help avoid these complications. [18] A promising innovative intervention is virtual reality. Virtual reality is especially engaging for children, as they often become truly captivated by imaginative play. [19] Virtual reality exposure (VRE) has already been proven effective in treating anxiety disorders, such as specific phobias (fear of spiders), [20.21] but very limited research has been conducted on the effect of VRE as preparation for medical procedures.

The objective was to determine the role and feasibility of using VRE to reduce pain during IV cannulation and anxiety during parent separation

Material & Methods

A prospective randomized control study was conducted in the Department of Anaesthesiology, ESIC MCH, Bihta, Patna, Bihar. Patients with ASA physical status I, II posted for elective surgeries were selected for study. The study was conducted during 1 year period. Sixty patients were randomized into two groups and patients were randomly allocated to either of the group based on the computer generated tables:

Group A- VR group

Group B- EMLA patch

Inclusion criteria:

- Age of 7-11 years of either sex undergoing elective surgery and ASA physical status I and 2

Exclusion Criteria:

- Cognitive Impairment, History of Epilepsy, IV Cannula In Place Or Previous Attempt Of IV

Cannulation Done. History of previous surgery, Allergic to EMLA cream, ASA physical status>II.

Methodology:

Group A- On the previous day of the surgery to get the patient acquainted to the VR gadget. A standardized trial video was played and the child is sensitized to the gadget. VR effectively immerses a child in a virtual environment where the child can swim with dolphins or play cricket game etc On the day of surgery, before shifting the patient to the preoperative room, the children were made to wear the gadget with the headgear powered by smartphone playing the videos and were allowed to watch the videos and transferred to the reoperative room and operation theatre from the ward.

Group B – EMLA cream is applied 1hour prior at the site of iv cannulation.

And in both the groups, an observer who is blinded to either group is asked to assess the pain during IV cannulation using faces pain scale and parent separation anxiety. Heart rate and oxygen saturation were measured using pulseoximeter ten minutes preprocedure ,during and ten minutes post procedure.

Statistical Analysis

All data were analysed with IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp. Armonk, NY). A P value less than 0.05 was considered statistically significant. . The Shapiro–Wilk test was used to test the assumption of normal distribution. Nonnormally distributed continuous variables were compared between conditions using the Mann–Whitney U test. Categorical variables were analysed with the x2 test. Continuous nonnormally distributed data were reported as median [interquartile range]. Categorical nonnormally distributed data were presented as frequency (percentage).

Results

Table 1: Descriptive Statistics

Groups		Age	Weight kg	Parental separation anxiety scale	Faces pain scale
Group A	Mean	8.212	28.558	2.512	5.314
	SD	.9625	5.1735	.9764	1.3135
Group B	Mean	8.260	28.032	3.537	6.544
	SD	1.4335	3.7140	.5032	1.1632
Total	Mean	8.242	29.300	3.016	5.934
	SD	1.2048	4.4735	.9200	1.3828

Table 2: Paired Samples Statistics of Group A

	Group A	Mean	SD	P Value
Pair 1	At10 mins pre-HR	86.00	7.53	.082
	During procedure HR	84.76	6.74	
Pair 2	At10 mins pre-HR	86.00	7.53	.452
	At10 mins post procedure HR	83.87	6.54	
Pair 3	At10 mins post procedure HR	84.86	6.59	.456
	During procedure HR	84.74	6.72	
Pair 4	At10 mins pre procedure SPO2	99.40	0.81	.480
	During procedure SPO2	99.60	0.70	
Pair 5	At10 mins pre procedure SPO2	99.45	0.84	.062
	At10 mins post procedure SPO2	99.63	0.46	
Pair 6	During procedure SPO2	99.57	0.68	.116
	At 10 mins post procedure SPO2	99.77	0.43	

Table 3: Paired Samples Statistics of Group B

	Group B	Mean	SD	P Value
Pair 1	At10 mins pre-HR	88.36	8.3030	<0.0001
	During procedure HR	82.232	7.2932	
Pair 2	At10 mins pre-HR	88.333	8.3030	<0.0001
	At10 mins post procedure HR	76.700	7.3864	
Pair 3	At10 mins post procedure HR	84.270	7.2970	<0.0001
	During procedure HR	82.22	7.3866	
Pair 4	At10 mins pre procedure SPO2	99.932	0.1830	<0.05
	During procedure SPO2	99.632	0.6610	
Pair 5	At10 mins pre procedure SPO2	99.970	0.1830	<0.05
	At10 mins post procedure SPO2	99.736	0.5204	
Pair 6	During procedure SPO2	99.670	0.6605	0.560
	At 10 mins post procedure SPO2	99.733	0.5204	

Statistical analysis of Children with moderate anxiety and severe anxiety and children had anxiety with regard to separation and about the unfamiliar people and environment done using paired t test. Patients using VR exhibited lower pain and anxiety score during intravenous cannulation and parental separation.

Discussion

With advent of VR, its application in medical field is growing immensely, its inherent distraction from the outer world has allowed doctors to evaluate its potential applications. One such application is distracting a child to help to reduce the separation anxiety and pain. Virtual reality is a technology that allows individuals to experience a virtual world. VR allows the patients to be immersed in an interactive world stimulating sights, sounds and it's been hypothesized that more immersion is related to more pain reduction ultimately reducing the anxiety. [11,22] Considering the paediatric case load and the existent practices in hospital and also the non-invasive nonpharmacological nature of VR, it was proposed to study the role and feasibility of using VR during IV cannulation.

Statistical analysis of heart rate and oxygen saturation of Children with moderate anxiety and severe anxiety and children with anxiety with regard to separation and about the unfamiliar

people and environment done using paired t test. Patients using VR exhibited lower pain and anxiety score during intravenous cannulation and parental separation. Virtual reality has previously been investigated as a means of improving health outcomes and previous studies have found that virtual reality reduced the anxiety in children undergoing different medical procedures.[23-25] Most of these studies showed virtual reality being successfully used as a method of distraction. Because these studies were small, often not blinded and lacked standardised assessments, chance findings and a degree of bias could not be ruled out. Previously studied medical procedures that included oncological and burn wound care were more complex and painful. [23]

Preoperative anxiety strongly differs with age. Older children may have fear of undergoing surgery and associated pain. younger children may suffer from fear of strangers and separation anxiety. [26] Anna marialannicelli et al. concluded that VR seems to be effective tool for pain reduction in paediatric patients similar to our study. [27] Biffi et al. in their study on 12 children with acquired brain injury used interactive VR system called GRAIL(gait real time analysis interactive lab)found improvement in walking abilities leading way to use VR in rehabilitation.28 Malloy KM, Milling Ls in their study found VR to be an innovative

intervention to improve induction of anaesthesia in children is providing a virtual reality tour of the operative room environment and anaesthesia procedures prior to surgery. [28] Sato et al. used VR for treating complex regional pain syndrome in patients and found 50% reduction in the pain intensity which is in sync with present study. [29] Moerman et al. in their study noted that the HR and BP are the dependent variables to assess anxiety levels in behavioural studies similar to our study. [30]

Conclusion

This current study found that application of immersive VR had better pain alleviation and parent separation anxiety score when compared with non-VR group patient.

References

1. Bahrami N, Soleymani M, Arjinee Z, Sharifnia S, Masodi R, Shahrokhi A. Impact anxious patient care based upon the nursing process for elective surgery for women. *J Nurs Iran*. 2012; 25(77):9-30.
2. Matthias AT, Samarasekera DN. Preoperative anxiety in surgical patients-experience of a single unit. *Acta Anaesthesiologica Taiwanica*. 2012 Mar 1;50(1):3-6.
3. Nourian M, Jalaledinee A, Saatchi K, Kavossi Doulanfar A. Effects of stroke massage using sesame oil on hospitalization anxiety in school-age girls. *Mod Care J*. 2014;10(3):210-8.
4. Perry JN, Hooper VD, Masiongale J. Reduction of preoperative anxiety in pediatric surgery patients using age-appropriate teaching interventions. *J Peri Anesth Nurs*. 2012; 27(2):69-81.
5. Namazi M, Akbari SA, Mojab F, Talebi A, Majd HA, Jannesari S. Aromatherapy with citrus aurantium oil and anxiety during the first stage of labor. *Iranian Red Crescent Medical Journal*. 2014 Jun;16(6).
6. Kain ZN, Mayes LC, Caldwell-Andrews AA, Saadat H, McClain B, Wang SM. Predicting which children benefit most from parental presence during induction of anesthesia. *Pediatric Anesthesia*. 2006 Jun; 16(6):627-34.
7. Kain ZN, Mayes LC, Caldwell-Andrews AA, et al. Preoperative anxiety, postoperative pain, and behavioral recovery in young children undergoing surgery. *Pediatrics* 2006; 118:651-658.
8. Kain ZN, Caldwell-Andrews AA, Maranets I, McClain B, Gaal D, Mayes LC, Feng R, Zhang H. Preoperative anxiety and emergence delirium and postoperative maladaptive behaviors. *Anesthesia & Analgesia*. 2004 Dec 1;99(6):1648-54.
9. Chorney JM, Kain ZN. Behavioral analysis of children's response to induction of anesthesia. *Anesthesia & Analgesia*. 2009 Nov 1;109(5): 1434-40.
10. Kain ZN, Caldwell-Andrews AA, Mayes LC, Weinberg ME, Wang SM, MacLaren JE, Blount RL. Family-centered preparation for surgery improves perioperative outcomes in children: a randomized controlled trial. *The Journal of the American Society of Anesthesiologists*. 2007 Jan 1;106(1):65-74.
11. Ben-Amitay G, Kosov I, Reiss A, Toren P, Yoran-Hegesh R, Kotler M, Mozes T. Is elective surgery traumatic for children and their parents? *Journal of paediatrics and child health*. 2006 Oct;42(10):618-24.
12. Meentken MG, Van Beynum IM, Legerstee JS, Helbing WA, Utens EM. Medically related post-traumatic stress in children and adolescents with congenital heart defects. *Frontiers in Pediatrics*. 2017 Feb 13;5:20.
13. Ahmed MI, Farrell MA, Parrish K, Karla A. Preoperative anxiety in children risk factors and non-pharmacological management. *Middle East J Anaesthesiol*. 2011 Jun 1;21(2):153-64.
14. Wright KD, Stewart SH, Finley GA, Buffett-Jerrott SE. Prevention and intervention strategies to alleviate preoperative anxiety in children: a critical review. *Behavior modification*. 2007 Jan;31(1):52-79.
15. Babashahi, Fayazi, S, Aghel, N, Haghhighizadeh. Effect of aromatherapy on anxiety level among preoperative patients. *Scientific Medical Journal*. 2010 Nov 3;9(5).
16. Robin Eijlers, Lonneke M Staals, Jeroen Legerstee *Journal of Clinical Psychology in Medical Settings* (2021)28:313-322
17. Ben Amitay, G Kosov, I Reiss A Toren Kotler M et al. (2006). *Journal of paediatrics and child health*,42(10)618-624
18. Faruki, Thynguyen, Samantha Proeschel, Nadav Levy, Jessica YU *Trials*. 2019; 20:782.
19. Lillard AS. Pretend play skills and the child's theory of mind. *Child Dev* 1993; 64:348-371.
20. Powers MB, Emmelkamp PMG. Virtual reality exposure therapy for anxiety disorders: a meta-analysis. *J Anxiety Disord* 2008; 22:561-569.
21. Carl E, Stein AT, Levihn-Coon A, et al. Virtual reality exposure therapy for anxiety and related disorders: a meta-analysis of randomized controlled trials. *J Anxiety Disord* 2019; 61:27-36.
22. Hoffman HG, HG Sharer Sr et al. *Pain* 2004;111:162-168.
23. Eijlers R, Utens EM, Staals LM, de Nijs PF, Berghmans JM, Wijnen RM, Hillegers MH, Dierckx B, Legerstee JS. Meta-analysis: systematic review and meta-analysis of virtual reality in pediatrics: effects on pain and

- anxiety. *Anesthesia and analgesia*. 2019 Nov; 129(5):1344.
24. Ryu JH, Park SJ, Park JW, Kim JW, Yoo HJ, Kim TW, Hong JS, Han SH. Randomized clinical trial of immersive virtual reality tour of the operating theatre in children before anaesthesia. *Journal of British Surgery*. 2017 Nov;104(12):1628-33.
 25. Ryu JH, Park JW, Nahm FS, Jeon YT, Oh AY, Lee HJ, Kim JH, Han SH. The effect of gamification through a virtual reality on preoperative anxiety in pediatric patients undergoing general anesthesia: a prospective, randomized, and controlled trial. *Journal of Clinical Medicine*. 2018 Sep 17;7(9):284.
 26. Berghmans JM, Poley M, Weber F Van De Velde M, Adriaenssens P, Klein J, Himpe D, Utens E. Does the Child Behavior Checklist predict levels of preoperative anxiety at anesthetic induction and postoperative emergence delirium? A prospective cohort study. *Minerva Anesthesiol*. 2015 Feb;81(2): 145-56.
 27. Anna Maria Lannicelli Daniele Vitoitalian *Journal of Paediatrics*. 2019;45:171.
 28. Biffi E, Bereetta E, Cesareo A Maghini C *Methods Inf Med* 2017;56,119-126.
 29. Malloy, KM, milling IS, *Clini Psychol Rev*. 2010;30:1011- 1018.
 30. Sato K, Fukumori S, M atsusaki T. *Pain Med*. 2010;11:622- 9.