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Review

Impact of Virtual Operating Room Tours on Relieving Perioperative Anxiety in Adult Patients: A Systematic Review

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A B S T R A C T

Purpose: To evaluate the effects of virtual operating room tours on perioperative anxiety in adult patients.
Design: This study was a systematic review of randomized controlled trials (RCTs).
Methods: PubMed, Cochrane Library, Embase, Web of Science, Proquest, Scopus, SinoMed, CNKI, and Wan-Fang were systematically searched for English and Chinese RCTs published up to November 18, 2021, for studies on the effectiveness of virtual operating room tours in reducing perioperative anxiety in adult patients (>18 years of age). Primary and secondary outcomes were perioperative anxiety levels and understanding level of perioperative information and patient satisfaction, respectively. The data were synthesized using a qualitative method.
Findings: Five studies were found eligible for inclusion; 3 studies showed a significant decrease in perioperative anxiety levels in patients of the virtual operating room tours group. Furthermore, the overall satisfaction, understanding of perioperative information, and preoperative preparedness were significantly enhanced respectively in 3 studies.
Conclusions: This study showed the effectiveness of virtual operating room tour on alleviating perioperative anxiety on adult patients. Furthermore, the satisfaction and understanding of perioperative information in intervention group improved owing to these tours. Future quantitative studies are needed to support these findings.

Perioperative anxiety causes stress, as most patients undergo frightening experiences on entering the operating room.[1] Furthermore, preoperative experiences and unconsciousness during anesthesia are highly anxiety-provoking factors.[2] An estimated 25% and 80% of patients admitted to hospitals for surgery experience preoperative anxiety. Anxiety levels reach the peak when patients leave the ward for the operating room.[3]

Although some degree of anxiety leads to a positive response in a stressful situation,[4] preoperative anxiety has been associated with the need for higher dosage of intravenous anesthesia before and during surgery.[5] A significant relationship has also been reported between preoperative anxiety and severity of acute postoperative pain,[6] thus negatively influencing a patient's recovery.[7,8] Therefore, clinicians must have a high level of suspicion for surgical patients' perioperative anxiety.

In a systematic review, Ruiz Hernández et al[9] confirmed that many studies supported the provision of operation-related information to patients before surgery as effective in lessening anxiety. Zhou et al[10] performed a qualitative study to understand the information-related requirements for patients with scheduled surgery during the preoperative period. They showed that most patients were perceptive on operating room information and believed that it could help reduce the anxiety.[10] The strict management of the operating room makes it difficult for people to visit. The education forms of operating room, equipment in the operating room or the surgical procedure are often provided by verbal or written leaflet with a brief description. Moreover, fear of the unknown is the one of the causes of preoperative anxiety. Therefore, to find a realistic method by which we could offer patients the opportunity of experiencing situations and procedures in the perioperative period will be helpful in diminishing preoperative anxiety.

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Virtual reality (VR) is a state-of-the-art, technologically advanced system that allows users to be transported to a "virtual world." This true to life interaction between users and the simulated environment allows complete immersion.[11] Recently, the application of VR technology has expanded from the entertainment industry to clinical medicine, such as in pain management, surgical training, and physical rehabilitation.[11–13]

The virtual operating room tour (VORT) is one of such method that allows simulation of pre- and postoperative settings. Here, patients watch a video recorded by the medical team to experience a 360° virtual tour of the operating room. The video usually comprises an introduction to surgical procedures and perioperative nursing. Morgan et al[14] allowed 64 adults a VORT before elective cardiac catheterization, which resulted in lower perioperative anxiety, better procedural understanding, and higher overall satisfaction. At present, data on clinical utility of VORT are very limited and inconsistent. Whether such an immersion is efficient in reducing preoperative anxiety is unclear.

This systematic review aimed to explore the effectiveness of the nursing staff's use of VORT during the preoperative period to alleviate perioperative anxiety.

Methods

Protocol and Registration

This review was conducted according to the Cochrane Handbook for Systematic Review,[15] and the results were reported following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) checklist. Although we did not publish a protocol for this review, the study was registered in the PROSPERO register (number: CRD42021292862).

Search Strategy

Two authors independently searched the MEDLINE (through PubMed), Cochrane Controlled Register of Trials (CENTRAL), Embase, SCOPUS, Proquest, Web of Science, China National Knowledge Infrastructure, WanFang, and SinoMed databases from November 2021 to December 2021 using combinations of Medical Subject Headings and free text terms. Additional studies were manually acquired from the references of retrieved articles. The key search terms included "perioperative," "preoperative," "postoperative," "virtual reality," "VR," "anxiety". At the same time, We used Boolean search terms "not" and wildcard characters "*" to exclude child* and pediatric. The search strategy is presented in Appendix 1.

Eligibility Criteria

We established the study problems and screened articles using the PICOS frame (type of participants, intervention, comparison, primary and secondary outcomes, and study design).The studies were selected according to the inclusion and exclusion criteria of PICOS elements. The inclusion criteria were as follows:

- Population: age greater than or equal to 18 years and underwent elective surgery
- Intervention: VORT or a 3D virtual operating room environment facility provided in the preoperative period
- Comparison: perioperative care
- Outcomes: preoperative anxiety measured using anxiety assessment scales as the primary outcome, with secondary outcomes as patient understanding of perioperative information and overall satisfaction determined using any kind of questionnaires
- Study design: randomized controlled trials (RCTs)

The exclusion criteria were as follows:

- Surgeries performed outside the operating room (eg, dental surgery)
- Receiving anxiolytic premedication or diagnosed with certain cognitive impairments (eg, psychiatric and autism spectrum disorder)
- Unable to tolerate VR interventions and experienced dizziness or felt sick when using the VR
- VR used in rehabilitation exercise for patients or VR intervention implemented by the surgeon

Specifically, the inclusion and exclusion criteria for selecting articles were as follows:

- Articles in either English or Chinese language were included.
- Gray literature (such as unpublished internal materials like symposium papers and conference minutes), reviews, comments, case reports, and meta-analyses were excluded.
- Studies with incomplete data even after attempting to contact the authors, duplicates of the included trials, and unavailability of full text were excluded.

Study Selection

Articles were downloaded to a reference management program (Zotero). Two authors independently reviewed articles considering the inclusion and exclusion criteria. Full text of the articles was downloaded and color-tagged in Zotero if they were for inclusion. if they were excluded, each author tagged the reasons. Disagreements on article inclusion matters were resolved with input from a third author.

Data Extraction

Two researchers independently extracted the data and recorded them on a standard data extraction form from the Cochrane Effective Practice and Organization of Care. If insufficient information was available, the authors of eligible articles were contacted via email. The information recorded included that on author(s), publication year, publication journal, study design, objectives and outcomes, settings, participants, assessment and intervention tools, and main findings.

Risk of Bias

Risk of bias was assessed by 2 independent researchers using version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2).[16] The tool covers 5 domains of bias arising from the following: (1) randomization process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported result. Before the assessment, the authors indicated the specific results extracted from the assessed trails. Considering that the nursing system would recommend VORT as a perioperative education tool, we included intention-to-treat effects. If there were disagreements regarding assessment outcomes between the 2 authors, a discrepancy check was conducted, and these differences were resolved through discussion with a third author.

Synthesis of Results

Sample size, anxiety scores, and type of surgery were different in each included study, hence, the heterogeneity among included studies was high. A qualitative method was used to synthesize the literature.

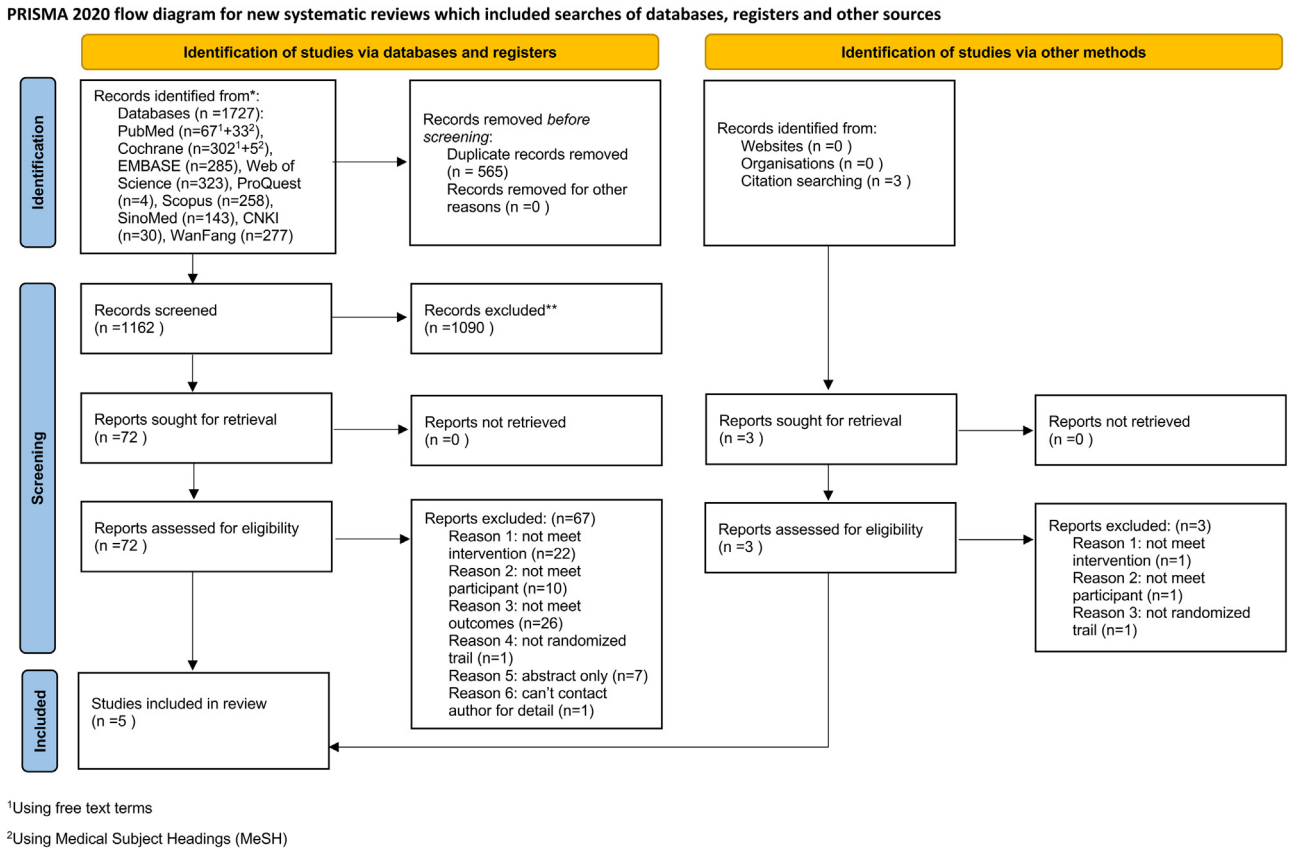

Figure 1. PRISMA 2020 flow diagram.

Results

Study Selection

A total of 1,727 articles were identified through the database search, while 3 were identified manually: 565 were duplicates and 1,090 were excluded considering their titles and abstracts. Full text of the remaining 75 were examined, and 70 were excluded owing to (1) unavailability of full-length articles (n = 7);(2) intervention (n = 23), outcomes (n = 26), and patient criteria (n = 11); (3) inability to contact corresponding authors for details (n = 1); and (4) study designs aside from RCTs (n = 2). Ultimately, 5 studies were included. in this systematic review.[14,17–20] Figure 1 shows the flow diagram of the selection process implemented in this study.

Study Characteristics

Table 1 shows the detailed information of each study included in this review; all were conducted between 2016 and 2021 from Germany,[17] Spain,[18] the Netherlands,[19] the United Kingdom,[14] and the United States.[20] All studies were single-center RCTs and included 2 groups.

Participants in the control group were supplied standard information via traditional means. In contrast, those in the VORT group watched an immersive video that described the surgical set-up they will be facing, including preoperative preparation, a view of the operating room, and postoperative anesthesia resuscitation using VR glasses/headsets.

Included studies used different tools to measure anxiety. These included the State-Trait Operation Anxiety Inventory, Hospital Anxiety and Depression Scale, Visual Analog Scale for Anxiety (VAS-A), a 6-item short form of the State Trait Anxiety Inventory (6-item STAI), and the Amsterdam Preoperative Anxiety and Information Scale. A high score corresponded to a high level of anxiety in 4 studies,[14,17–19] while another study showed that scoring high in these tools was associated with a low anxiety level.[20]

A total of 498 participants were included in this study. The surgeries they underwent ranged from colorectal surgery, cesarean delivery, and cardiac catheterization to cranial and spinal surgery.

Risk of Bias Assessment

Figure 2 shows the risk of bias results. The overall bias for one study was low,[20] while the other 3 showed concerns due to unclear concealed allocation sequences (study 2) and unclear random sequence generation (study 1 and study 4).[14,17,18] Study 3 was considered at high risk of bias owing to the randomization process and deviation from the intended intervention.[19] Details of the bias of each study are presented in Appendix 2.

Perioperative Anxiety

All 5 studies used different tools to measure perioperative anxiety (Table 2). Studies 1, 3, and 4 showed no significant difference in preoperative anxiety scores between the VORT and control groups.[14,17,19] Meanwhile, studies 2 and 5 suggested a significant decrease in preoperative anxiety scores in the VORT group versus control group.[18,20] Study 5 showed a greater anxiety alleviation in the VORT group than in the no VORT group.[20] In study 2, the authors did not measure the preoperative anxiety score in the control group,

Table 1
Characteristics and Main Results of the Included Studies (N = 5)

Author (s) (Year)	Study Design	Objective and Outcomes	Setting, Country and Study Period	Participants			The Timing of Applying VR	Experimental Group Intervention (Number of Patients)	Control Group Intervention (Number of Patients)	Instruments and Time Points of Outcomes Assessment	Main Results
				n	Age (Mean ± SD)/ Median (Range)	Type of Surgery					
Vogt et al 2021[17]	RCT	**Aim:** To investigate whether a virtual operating room tour (VORT) before surgery can be used to ameliorate perioperative anxiety. **Primary outcomes:** Anxiety **Secondary outcomes:** Evaluation of VORT	The Clinic for Anesthesiology, RWTH Aachen University Hospital, Germany September 2020 to January 2021	84	T:54.19±15.94	elective surgery with general anesthesia (except for thoracic surgery, neurosurgery, and tumor surgery)	Before the surgery	Watching a 6 minutes 28 seconds virtual tour of the operation room	No virtual tour of the operation room	**Anxiety:** the State-Trait Operation Anxiety Inventory (STOA) in which Trait anxiety (STOA-T) was measured at T2 (before operation) and State anxiety (STOA-S) was measured at T1 and T3(within 48 hours after operation) **Evaluation of VORT:** an in-house designed questionnaire	For the anxiety level, there were no significant differences at T2 and T3 between 2 groups
Turrado et al 2021[18]	RCT	**Aim:** To evaluate the effectiveness of exposure to the entire perioperative environment through virtual reality in decreasing the preoperative anxiety **Primary outcomes:** Anxiety	Third-level Academic Center in Barcelona, Spain April 2018 to February 2020	126	E: 68 C: 64	Elective colorectal surgery	After patients were recruited and before the surgery	Exposure to a realistic perioperative period environment	No virtual reality exposure	**Anxiety:** the State-Trait Anxiety Inventory Scale State (STAI-S) and the Hospital Anxiety and Depression Scale (HADS) were measured at T1 (after randomization and before intervention) and T2 (before surgery, only for intervention group)	For both the HADS and STAI-S the observed values were significantly decreased in intervention group for the change of T1 to T2 (HAD-A: difference, -1.00; $P < .001$, STAI-S: difference, -6.00; $P < .01$)
Morgan et al 2021[14]	RCT	**Aim**: to evaluate the use of an immersive VR experience on periprocedural anxiety, compared with using generic video-based material before an elective cardiac catheterization. **Primary outcomes:** periprocedural anxiety level **Secondary outcomes:** patients knowledge of their procedure and overall satisfaction.	The tertiary center of University Hospital of Wales, Cardiff, United Kingdom August 2019 to February 2020	64	T:68.7±9.8	Cardiac Catheterization	After patients were recruited and before the surgery	Watching a 10-minute VR immersive video on a dedicated VR headset which describes the procedural experience except for receiving an information booklets and verbal explanation ($n = 33$)	Receiving the standard preprocedural care (BHF information booklets, verbal explanation of the procedure and watch the BEIF cardiac catheterization video) ($n = 31$)	**Anxiety:** the 6-item short form of the State Trait Anxiety Inventory (STAI) at T1 (after informed consent), T2 (Preprocedure) and T3 (Postprocedure) **Patients knowledge of their procedure**: a patient-reported knowledge score at T1, T2 and T3 **Overall satisfaction**: a patient-reported statements	For the anxiety level, a significant lower than control group at T3(8.5 vs 9.7, respectively; $P = .48$), and the change from T1 to T3 (-5.1 vs -4.0, respectively; $P = .03$) The VR group had a better procedural understanding (3.88 vs 3.23, respectively; $P < .01$) and higher overall satisfaction than the control group (9.35 vs 8.97, respectively; $P = .04$)

(*continued on next page*)

Table 1 (*Continued*)

Author (s) (Year)	Study Design	Objective and Outcomes	Setting, Country and Study Period	Participants			The Timing of Applying VR	Experimental Group Intervention (Number of Patients)	Control Group Intervention (Number of Patients)	Instruments and Time Points of Outcomes Assessment	Main Results
				n	Age (Mean ± SD)/ Median (Range)	Type of Surgery					
Noben et al 2019[19]	RCT	**Aim:** to determine whether a VR video in addition to standard preoperative information decreases anxiety levels before a planned cesarean delivery (CD) . **Primary outcomes:** a change on the Visual Analogue Scale for Anxiety (ΔVAS-A) measured at admission for CD **secondary outcomes:** the symptoms of motion sickness when experienced CR video (both for CD and partner), distress and the postoperative quality of care((for all participants)	Máxima Medical Center in Veldhoven, the Netherlands November 2016 to January 2018	97	E: 32.6±3.9 C: 33.12±4.3	Cesarean Delivery	After patients were recruited and before the surgery	Watching an 285 seconds 360° VR video which shows a procedure of cesarean delivery through Infor-Med app and VR glasses except for receiving the standard information (n = 49)	Receiving the standard information from their doctor through information leaflets and oral counseling (n = 48)	**Anxiety:** the Visual Analogue Scale for Anxiety (VAS-A) at T1 (after informed consent) and T2 (admission to the ward) **Motion sickness:** The Simulation Sickness Questionnaire (SSQ) at T1 (for VR group) **Distress:** The Tilburg Pregnancy Distress Scale(TPDS) at T1, T2 and T3 (1-2 weeks after CD) and The Childbirth Perception Scale (CPS) at T3 **Quality of care:** the Pregnancy and Childbirth Questionnaire (PCQ) at T3	For the anxiety level, there is no significant difference at T1 and T2 between 2 groups (n = 48; ΔVAS-A = 1.0; P = .08; 95% CI −0.1 to 2.0). No discomfort or motion sickness during VR experience. No significant difference in TPDS. For the PCQ questionnaire, a significantly higher score for the VR group without a history of emergency CD (10.2±3.8 vs 12.9±3.5; P = .02)
Bekelis et al 2016[20]	RCT	**Aim:** To investigate the effect of exposure to a VR environment preoperatively on patient-reported outcomes for surgical operations. **Primary outcomes:** experience and satisfaction, preoperative anxiety **Secondary outcomes:** pain, stress and preparedness	Dartmouth-Hitchcock Medical Center, Lebanon, NH, America November 2015 to April 2016	127	T:55.3	Cranial and spinal procedures	Before the surgery	Watching a 5-minute VR video describing the preoperative and postoperative experience for the day of the surgery (n = 64)	Receiving the routine audiovisual descriptions of the preoperative experience (n = 63)	**Anxiety:** the Amsterdam Preoperative Anxiety and Information score (APAIS) at T2 (preoperatively on the day of the surgery) **Satisfaction:** the Evaluation du Vecu de l'Anesthesie Generale (EVAN-G) score at T3 (postprocedure) and visual analog scales of satisfaction at T2 and T3 **Pain:** visual analog scales of pain at T2, T3 and 30-days postoperatively were only obtained for spine patients **Stress:** Visual analog scales of stress at T2 **Preparedness:** Visual analog scales of preparedness at T2	For the anxiety level, a significant lower than control group at T2 (difference, 29.9; 95% CI, 24.5-35.2; P < .01) VR led to lower preoperative VAS stress score (difference, -41.7; 95% CI, -33.1 to -50.2; P < .01), and higher preoperative VAS preparedness (difference, 32.4; 95% CI, 24.9-39.8; P < .01), and VAS satisfaction (difference, 33.2; 95% CI, 25.4-41.0; P < .01) scores. No association was identified with VAS pain score at T2, T3 and 30-days postoperatively

Figure 2. Study results bias.

whose study showed a significant decrease on anxiety score only by using a self-control within the intervention group.[18] Two studies (study 1 and 4) also measured the postoperative anxiety scores.[14,17] Study 4 showed a significant alleviation of anxiety in the VORT group.[14]

As elderly patients may exhibit possible individual differences in adapting to new technology, study 2 analyzed preoperative anxiety according to age (≤65 years vs >65 years) and found no significant differences in perceived anxiety levels in patients who either received a virtual tour.[18] Additionally, study 3 found that for women with a history of cesarean delivery, VR was more effective in easing anxiety, although this was not significant ($P = .06$).[19]

Secondary Outcomes

Study 4 reported that the VORT group better understood the surgical procedure than the control group (perioperative knowledge scores 3.88 vs 3.23, respectively; $P < .01$).[14] For this reason, in study 1, participants perceived VORT as a useful tool for preparation for surgery (median rating 4 in a 1- to 5-grade questionnaire).[17] Furthermore, in study 5, VORT experience led to greater preoperative preparedness (difference, 32.4; 95% confidence interval, 24.9 to 39.8).[20] Finally, studies 4 and 5 reported in the VORT group had a higher satisfaction rate than the control group.[14,20]

Discussion

This systematic review evaluated the effectiveness of VORTs in reducing perioperative anxiety in adult patients. Although included studies showed a lack of homogeneity in terms of the patients, sex, surgery types, and tools used to measure anxiety, VORT application showed a propensity to allay perioperative anxiety. VORT offers participants a chance to learn more about the surgical department's appearance and perioperative details. VORT was a significant factor in increasing patient satisfaction and improving their understanding of perioperative information.

Participants showed a positive response to VORT. Only a singular adverse effect was reported: one patient experienced transient dizziness within seconds of starting the viewing but was still able to complete the tour.[18] Most participants found the VORT experience pleasant and were willing to recommend it. This supports the possible clinical application of VORT in a surgical setting.

Preoperative visits have been shown to reduce anxiety.[9] Other studies have also suggested that multimedia resources, such as videos containing preoperative information, have the same effect.[21,22] Patients can access VORT repeatedly using VR glasses and applications on their mobile phones. Thus, VORT can be considered a convenient way to provide perioperative information to reduce anxiety levels concerning surgery.

Better understanding of perioperative information is linked to better preoperative preparedness, which lessens cancellations and delay of elective surgeries.[23] Such efficient education format is especially fit for high-speed operation setting such as day surgery. Further studies should explore VORT's effectiveness in day surgery or outpatient surgery, where patient education is seriously restricted by time owing to the rapid patient turnover.

Notably, perioperative anxiety scores did not differ significantly between the 2 groups in studies 1, 3, and 4.[14,17,19] This may be, in part, because all these 3 studies included participants who have history of surgery in eligibility criteria. According to previous studies, patients with no prior surgeries may be at greater risk of preoperative anxiety.[24] This may have led to biases in the included studies, contributing to unnoticeable changes between the VORT group and control groups.

The RCTs analyzed included women undergoing cesarean delivery. Many women experience moderate or severe anxiety, depression, and fear as baseline emotions during pregnancy.[25,26] More studies are required to explore preoperative information requirements of pregnant women who are going to undergo cesarean delivery.

When providing information, need-based patient education should be followed. According to this concept, patients' desire to be educated regarding their elective surgery should be assessed before providing information. According to a previous study,[27] patients with an avoidant coping style who desire only minimal amount on their surgery may become more anxious owing to VORT. In short, patient education via VORT should be tailored accordingly.

Limitations

This review has some limitations. First, we could not perform a quantitative synthesis because each study's reported anxiety scores and surgical populations were different. Second, the included studies in the systematic review are outdated. Owing to the limited number of studies, the effectiveness of VORT was demonstrated only in 3 studies. Finally, only studies published in English and Chinese language were included.

Conclusion

This systematic review showed VORT as a promising tool in alleviating perioperative anxiety in adult patients. The intervention

Table 2
Time Points and Tools for Measuring Anxiety in 5 Studies

		Vogt et al 2021	Turrado et al 2021	Morgan et al 2021	Noben et al 2019	Bekelis et al 2016
Time (T) points of anxiety assessment	Before intervention (T1)	-	HADS and STAI-S	6-item short form of STAI	VAS-A	-
	Before surgery (T2)	STOA-S	HADS and STAI-S*	6-item short form of STAI	VAS-A	APAIS*
	After surgery (T3)	STOA-S and STOA-T	-	6-item short form of STAI*	-	-

APAIS, Amsterdam Preoperative Anxiety and Information Scale; HADS, hospital anxiety and depression scale; STAI, state trait anxiety scale; STOA-S, state-trait operation anxiety inventory, VAS-A, visual analog scale for anxiety.
* A significant difference is observed.

groups reported greater satisfaction, better understanding of perioperative information, and better preoperative preparation. The results are consistent with findings that multiple modes of education delivery help reduce perioperative anxiety.[28,29] While, the educational content and details are not completely consistent for different patients, further quantitative studies that can personalize VORT experiences may be needed to support the conclusions of this study.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jopan.2022.11.013.

References

1. Welsh J. Reducing patient stress in theatre. Alison Bell Memorial Award. *Br J Perioper Nurs*. 2000;10:321–324, 326–327. https://doi.org/10.1177/175045890001000605.
2. Mitchell M. General anaesthesia and day-case patient anxiety. *J Advan Nurs*. 2010;66:1059–1071. https://doi.org/10.1111/j.1365-2648.2010.05266.x.
3. Carr E, Brockbank K, Allen S, Strike P. Patterns and frequency of anxiety in women undergoing gynaecological surgery. *J Clin Nurs*. 2006;15:341–352. https://doi.org/10.1111/j.1365-2702.2006.01285.x.
4. Salmon P. The reduction of anxiety in surgical patients: an important nursing task or the medicalization of preparatory worry? *Int J Nurs Stud*. 1993;30:323–330. https://doi.org/10.1016/0020-7489(93)90104-3.
5. Nagase K, Ando-Nagase K. Preoperative anxiety and intraoperative anesthetic requirements. *Anesth Analg*. 2000;91:250. https://doi.org/10.1097/00000539-200007000-00062.
6. Sobol-Kwapinska M, Bąbel P, Plotek W, Stelcer B. Psychological correlates of acute postsurgical pain: a systematic review and meta-analysis. *Eur J Pain*. 2016;20:1573–1586. https://doi.org/10.1002/ejp.886.
7. Chevillon C, Hellyar M, Madani C, Kerr K, Kim SC. Preoperative education on postoperative delirium, anxiety, and knowledge in pulmonary thromboendarterectomy patients. *Am J Crit Care*. 2015;24:164–171. https://doi.org/10.4037/ajcc2015658.
8. Rhodes L, Nash C, Moisan A, et al. Does preoperative orientation and education alleviate anxiety in posterior spinal fusion patients? A prospective, randomized study. *J Pediatr Orthop*. 2015;35:276–279. https://doi.org/10.1097/BPO.0000000000000260.
9. Ruiz Hernández C, Gómez-Urquiza JL, Pradas-Hernández L, et al. Effectiveness of nursing interventions for preoperative anxiety in adults: a systematic review with meta-analysis. *J Adv Nurs*. 2021;77:3274–3285. https://doi.org/10.1111/jan.14827.
10. Zhang Y, Zhou L. Qualitative study on informational needs during preoperative visits among inpatients with scheduled surgery. *J Nurs Sci*. 2010;25:45–47. Accessed May 2, 2022; https://er.szlib.org.cn/rwt/331/https/NNYHGLUDN3WXTLUPMW4A/kcms/detail/detail.aspx?dbcode=CJFD&dbname=CJFD2010&filename=HLXZ201018027&uniplatform=NZKPT&v=c5FgZf0Yevs033hDghu5RaJ5TjOl7DD2CTrkae4zTgWszJVkaB8vNkjc00om5op0.
11. Li A, Montaño Z, Chen VJ, Gold JI. Virtual reality and pain management: current trends and future directions. *Pain Manag*. 2011;1:147–157. https://doi.org/10.2217/pmt.10.15.
12. Lei C, Sunzi K, Dai F, et al. Effects of virtual reality rehabilitation training on gait and balance in patients with Parkinson's disease: a systematic review. *PLoS One*. 2019;14: e0224819. https://doi.org/10.1371/journal.pone.0224819.
13. Chen Z, Mo S, Fan X, You Y, Ye G, Zhou N. A meta-analysis and systematic review comparing the effectiveness of traditional and virtual surgical planning for orthognathic surgery: based on randomized clinical trials. *J Oral Maxillofac Surg*. 2021;79:471.e1–471.e19. https://doi.org/10.1016/j.joms.2020.09.005.
14. Morgan H, Gallagher SM. The effect of a virtual reality immersive experience upon anxiety levels in patients undergoing cardiac catheterisation: the virtual cath trial. 2021. *J Invasive Cardiol*. 2021;33:E681–E686.
15. Higgins J, Thomas J, Chandler J, et al. Cochrane Handbook for Systematic Reviews of Interventions Version 6.3 (Updated February 2022). Cochrane; 2022. Accessed March 15, 2022. www.training.cochrane.org/handbook.
16. Higgins J, Savović J, Page M, Elbers R, Sterne J. Chapter 8: Assessing risk of bias in a randomized trial. In: Higgins JPT, Thomas J, Chandler J, eds, et al.. Cochrane Handbook for Systematic Reviews of Interventions Version 6.3 (Updated February 2022). Cochrane; 2022. Accessed January 1, 2022. www.training.cochrane.org/handbook.
17. Vogt L, Klasen M, Rossaint R, Goeretz U, Ebus P, Sopka S. Virtual reality tour to reduce perioperative anxiety in an operating setting before anesthesia: randomized clinical trial. *J Med Internet Res*. 2021;23:e28018. https://doi.org/10.2196/28018.
18. Turrado V, Guzmán Y, Jiménez-Lillo J, et al. Exposure to virtual reality as a tool to reduce peri-operative anxiety in patients undergoing colorectal cancer surgery: a single-center prospective randomized clinical trial. *Surg Endosc*. 2021;35:4042–4047. https://doi.org/10.1007/s00464-021-08407-z.
19. Noben L, Goossens SMTA, Truijens SEM, et al. A virtual reality video to improve information provision and reduce anxiety before cesarean delivery: randomized controlled trial. *JMIR Ment Health*. 2019;6:e15872. https://doi.org/10.2196/15872.
20. Bekelis K, Calnan D, Simmons N, MacKenzie TA, Kakoulides G. Effect of an immersive preoperative virtual reality experience on patient reported outcomes: a randomized controlled trial. *Ann Surg*. 2016;265:1068–1073. https://doi.org/10.1097/SLA.0000000000002094. no pagination.
21. Che YJ, Gao YL, Jing J, Kuang Y, Zhang M. Effects of an informational video about anesthesia on pre- and post-elective cesarean section anxiety and recovery: a randomized controlled trial. *Med Sci Monit*. 2020;26: e920428. https://doi.org/10.12659/MSM.920428.
22. Zarei B, Valiee S, Nouri B, Khosravi F, Fathi M. The effect of multimedia-based nursing visit on preoperative anxiety and vital signs in patients undergoing lumbar disc herniation surgery: a randomised clinical trial. *J Perioper Pract*. 2018;28:7–15. https://doi.org/10.1177/1750458917742045.
23. Xie H, Cai Z, Fei H, et al. Reason and inner experience of the patient's cancellation of day surgery: a qualitative study. *Chin J Mod Nurs*. 2021;27:1706–1710. Accessed May 2, 2022; https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDZHYX&filename=HLJH202113005&v=.
24. Nigussie S, Belachew T, Wolancho W. Predictors of preoperative anxiety among surgical patients in Jimma University Specialized Teaching Hospital, South Western Ethiopia. *BMC Surg*. 2014;14:67. https://doi.org/10.1186/1471-2482-14-67.
25. Nilsson C, Hessman E, Sjöblom H, et al. Definitions, measurements and prevalence of fear of childbirth: a systematic review. *BMC Pregnancy Childbirth*. 2018;18:28. https://doi.org/10.1186/s12884-018-1659-7.
26. Nath S, Lewis LN, Bick D, Demilew J, Howard LM. Mental health problems and fear of childbirth: a cohort study of women in an inner-city maternity service. *Birth*. 2021;48:230–241. https://doi.org/10.1111/birt.12532.
27. Wongkietkachorn A, Wongkietkachorn N, Rhunsiri P. Preoperative needs-based education to reduce anxiety, increase satisfaction, and decrease time spent in day surgery: a randomized controlled trial. *World J Surg*. 2018;42:666–674. https://doi.org/10.1007/s00268-017-42.
28. Petrescu MD, Popa F, Purcarea VL. How could perioperative anxiety be addressed via surgical team communication approaches? Findings from a scoping review. *Hosp Pract (Minneap)*. 2022;50:159–169. https://doi.org/10.1080/21548331.2022.2059979.
29. Wang R, Huang X, Wang Y, Akbari M. Non-pharmacologic approaches in preoperative anxiety, a comprehensive review. *Front Public Health*. 2022;10: 854673. https://doi.org/10.3389/fpubh.2022.854673.

Appendix 1
Search Strategy

Search strategy Data base	Search strategy	Number
PubMed (Mesh)	((virtual reality[MeSH Terms])) AND ((((((nursing, operating room[MeSH Terms])) OR ((period, perioperative[MeSH Terms]))) OR ((period, preoperative[MeSH Terms]))) OR ((care, postoperative[MeSH Terms]))))	33
PubMed (Freedom)	((((((((perioperative[Title/Abstract]) OR (preoperative[Title/Abstract])) OR (postoperative[Title/Abstract])) OR (operati*[Title/Abstract]))) AND (((virtual reality*[Title/Abstract]) OR (VR[Title/Abstract])))))) NOT (((child*[Title/Abstract]) OR (Pediatric[Title/Abstract])))))) AND (((RCT[Title/Abstract]) OR (randomized controlled trial[Title/Abstract])OR (randomized clinical trial[Title/Abstract])))	67
Cochrane (Mesh)	#1 MeSH descriptor: [Perioperative Period] explode all trees #2 MeSH descriptor: [Preoperative Period] explode all trees #3 MeSH descriptor: [Postoperative Period] explode all trees #4 MeSH descriptor: [Virtual Reality] explode all trees #5 MeSH descriptor: [Randomized Controlled Trial] explode all trees #6 MeSH descriptor: [Child] explode all trees #7 #1 OR #2 OR #3 #8 #7 AND #4 #9 #8 NOT #6	5
Cochrane (Freedom)	#1 (perioperative):ti,ab,kw #2 (preoperative):ti,ab,kw #3 (postoperative):ti,ab,kw #4 (operati*):ti,ab,kw #5 (virtual reality*):ti,ab,kw #6 (VR):ti,ab,kw #7 #1 OR #2 OR #3 OR #4 #8 #5 OR #6 #9 #7 AND #8 #10 (child*):ti,ab,kw #11 (pediatric):ti,ab,kw #12 #10 OR #11 #13 #9 NOT #12 #14 (randomized controlled trial OR randomized clinical trial OR RCT):ti,ab,kw #15 #14 AND #13	302
Embase	#15. #14 AND #13 #14. 'randomized controlled trial':ti,ab,kw OR 'randomized clinical trial':ti,ab,kw OR rct:ti,ab,kw #13. #9 NOT #12 #12. #10OR #11 #11. pediatric:ab,kw,ti #10. child*:ab,kw,ti #9. #4 AND #8 #8. #6 OR #7 #7. vr*:ab,kw,ti #6. virtual AND reality*:ab,kw,ti #5. #1 OR #2 OR #23 OR #4 #4. operati*:kw,ab,ti #3. postoperative:kw,ab,ti #2. preoperative:kw,ab,ti #1. perioperative:kw,ab,ti	285
Web of Science	#1 (((TS=(preoperative)) OR TS=(perioperative)) OR TS=(postoperative)) OR TS=(operati*) #2 (TS=(virtual reality*)) OR TS=(VR) #3 (#1) AND #2 #4 (TS=(child*)) OR TS=(pediatric) #5 (#3) NOT #4 #6 (TS=(RCT)) OR TS=(randomized controlled trial) OR TS=(randomized clinical trial) #7 (#5) AND #6	323
Proquest	((su(Randomized controlled trial) OR su(Randomized clinical trial) OR su(RCT)) AND (su(Virtual Reality*) OR su(VR)) AND (su(Perioperative) OR su(Preoperative) OR su(Postoperative) OR su(operati*))) NOT (su(child) OR su(pediatric))	4
Scopus	((TITLE-ABS-KEY (perioperative*) OR TITLE-ABS-KEY (preoperative) OR TITLE-ABS-KEY (postoperative) OR TITLE-ABS-KEY (operati*))) AND (TITLE-ABS-KEY (virtual AND reality) OR TITLE-ABS-KEY (vr)) AND (TITLE-ABS-KEY (randomized AND controlled AND trial) OR TITLE-ABS-KEY (randomized AND clinical AND trial) OR TITLE-ABS-KEY (rct)) AND NOT (ALL (child*) OR ALL (pediatric))	258
Sinomed	(((((((围术期 OR 术前 OR 术中 OR 术后)) AND ((虚拟现实 OR 虚拟现实技术 OR 增强现实 OR 增强现实技术)))) AND (护理))) NOT ((儿童 OR 患儿 OR 小儿)))	143
CNKI	(((((((围术期 OR 术前 OR 术中 OR 术后)) AND ((虚拟现实 OR 虚拟现实技术 OR 增强现实 OR 增强现实技术)))) AND (护理)))	30
Wanfang	((主题:(围术期) or 主题:(术前) or 主题:(术中) or 主题:(术后)) AND (主题:(虚拟现实) or 主题:(虚拟现实技术) or 主题:(增强现实) or 主题:(增强现实技术) or 主题:(VR)) AND 主题:(护理)) NOT (全部:(患儿) or 全部:(儿童) or 全部:(早产儿))	277

Appendix 2
Bias Details of Each Study

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
Ref or Label		Aim	assignment to intervention (the 'intention-to-treat' effect)		
Experimental	VORT	Comparator	standard operation preparation procedure	Source	
Outcome	Preoperative anxiety	Results		Weight	1
Bias arising from the randomization process	1.1 Was the allocation sequence random?			Y	Participants were randomly assigned to one of the study arms (VORT vs STOPP) by a person not involved in data acquisition using the following procedure: for all patients (N = 80), we created opaque assignment envelopes containing a folded paper with a study arm assignment (VORT or STOPP), with a total of 40 participants in each arm. The order of the envelopes was randomized before the beginning of the study.
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?			Y	
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?			PY	Data from the remaining 72 patients (mean age 54.19, SD 15.94, with a range of 20 to 81 years), with 35 female and 37 male subjects, was analyzed (VORT: n = 35 vs STOPP: n = 37). Due to no characteristics of baseline shown, the level of anxiety may various due to a significant difference in population of different type of surgery.
	Risk of bias judgment			Some concerns	
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?			Y	Patients were informed about the study background, the study arms, and the content of the video.
	2.2.Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?			Y	
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?			PN	
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?			NA	
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?			NA	
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?			PY	
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?			NA	
	Risk of bias judgment			Low	
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?			N	In total, 84 patients were included in the study. Dropouts (n = 12; 14.3%) were in the expected range; however, since all dropouts occurred during the enrolment of the first 62 patients, we decided at this time point to create and randomize 20 additional assignment envelopes. The primary reason for dropouts was the early discharge of the patient. Other reasons included postponed or additional surgeries and postoperative complications. VORT-associated concerns or worries were not reported; therefore, VORT did not contribute to participation dropouts.
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?			Y	
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?			NA	
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?			NA	
	Risk of bias judgment			Low	
Bias in measurement of the outcome	4.1 Was the method of measuring the outcome inappropriate?			N	both trail registration and trail only used one method (STOA) to measure outcomes
	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?			N	The interview consisted of a detailed explanation by the educating physician (anesthetist). A standardized information sheet was further used to explain the procedure and the anesthesia used, corresponding to the hospital's standard operating procedure, and it was identical for all patients in both study arms (VORT and STOPP).
	4.3 Were outcome assessors aware of the intervention received by study participants?			Y	it's a participant-reported outcomes
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?			PN	Patients in anxiety will express their true anxiety level, although they may be know which intervention they have received.
	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?			NA	
	Risk of bias judgment			Low	

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Appendix 2 (*Continued*)

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
Bias in selection of the reported result	5.1 Were the data that produced this result analyzed in accordance with a prespecified analysis plan that was finalized before unblinded outcome data were available for analysis?			Y	through examination of a trail protocol, the way to measure outcome is same
	5.2 ... multiple eligible outcome measurements (eg, scales, definitions, time points) within the outcome domain?			N	through examination of a trail protocol, only STOA used to measure outcome
	5.3 ... multiple eligible analyses of the data?			N	outcomes report contain 1 tool and 2 time point as the same as the trail protocol
	Risk of bias judgment			Low	
Overall bias	Risk of bias judgment			Some concerns	due to the nature of the intervention
Unique ID	Turrado 2021	Study ID	NCT04058600	Assessor	yu
Ref or Label		Aim	assignment to intervention (the 'intention-to-treat' effect)		
Experimental	VR video	Comparator	no VR	Source	
Outcome	STAI anxiety level	Results		Weight	1
Bias arising from the randomization process	1.1 Was the allocation sequence random?			Y	Patients were randomized using en bloc randomization with random block sizes.
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?			NI	
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?			N	There were no differences in terms of age or sex distribution between both groups, or in the surgeries performed in both groups. Median hospital stay was 3.1 days (95% CI 2.3–4.8 days), with no differences between groups: 3.2 days (95% CI 2.2–4.7 days) in the no-VR group and 3.1 (95% CI 2.4–4.9 days) in the VR group.
	Risk of bias judgment			Some concerns	
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?			Y	If interested, an interview was scheduled in which they signed the informed consent and were randomized into the control group (no Virtual Reality exposure) or the intervention group (Virtual Reality exposure). Patients were randomized using en bloc randomization with random block sizes.
	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?			Y	
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?			PN	No adverse effects were noted and no subjective assessments of the experience by patients were reported. Only one of the patients exposed to the virtual reality simulation experienced a transient dizzy sensation within seconds of starting the viewing, but was able to complete it successfully.
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?			NA	
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?			NA	
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?			Y	No adverse effects were noted and no subjective assessments of the experience by patients were reported. Only one of the patients exposed to the virtual reality simulation experienced a transient dizzy sensation within seconds of starting the viewing, but was able to complete it successfully.
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?			NA	
	Risk of bias judgment			Low	
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?			Y	No adverse effects were noted and no subjective assessments of the experience by patients were reported. Only one of the patients exposed to the virtual reality simulation experienced a transient dizzy sensation within seconds of starting the viewing, but was able to complete it successfully.
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?			NA	
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?			NA	
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?			NA	
	Risk of bias judgment			Low	
Bias in measurement of the outcome	4.1 Was the method of measuring the outcome inappropriate?			Y	Patients in control group only completed baseline questionnaires, this limitation is also mentioned in the last of the article.

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Appendix 2 (*Continued*)

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?			PN	
	4.3 Were outcome assessors aware of the intervention received by study participants?			NA	
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?			NA	
	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?			NA	
	Risk of bias judgment			Low	
Bias in selection of the reported result	5.1 Were the data that produced this result analyzed in accordance with a prespecified analysis plan that was finalized before unblinded outcome data were available for analysis?			Y	through examination of a trail protocol, the way to measure outcome is same
	5.2 ... multiple eligible outcome measurements (eg, scales, definitions, time points) within the outcome domain?			N	through examination of a trail protocol, the way to measure outcome is same
	5.3 ... multiple eligible analyses of the data?			N	outcomes report contain 1 tool and 2 time point as the same as the trail protocol
	Risk of bias judgment			Low	
Overall bias	Risk of bias judgment			Some concerns	
Unique ID	Morgan 2021	Study ID	NCT03957538	Assessor	yu
Ref or Label		Aim	assignment to intervention (the 'intention-to-treat' effect)		
Experimental	VR experiences	Comparator	standard procedural care	Source	
Outcome	anxiety (6-item STAI)	Results		Weight	1
Bias arising from the randomization process	1.1 Was the allocation sequence random?			NI	patients were then randomized to standard preprocedural care or preprocedural care with immersive VR experience(but there were no detail about sequence generation process and allocation sequence concealed)
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?			NI	
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?			N	
	Risk of bias judgment			Some concerns	
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?			PY	due to the nature of this intervention
	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?			Y	
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?			PN	
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?			NA	
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?			NA	
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?			PY	due to the COVID-19 the trail terminated prematurely
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?			NA	
	Risk of bias judgment			Low	
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?			N	There were 87 patients recruited into the trial between August 2019 and February 2020. The trial was terminated prematurely due to service changes related to the COVID-19 pandemic. In total, 64 patients completed the trail protocol and were included in the analysis. Of these, 33 were randomized to the VR arm, and 31 to the control arm.
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?			N	
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?			PN	due to the pandemic
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?			NA	
	Risk of bias judgment			Low	
Bias in measurement of the outcome	4.1 Was the method of measuring the outcome inappropriate?			N	The primary outcome measure was periprocedural anxiety level. Data collection was via questionnaire based on the validated 6-item short form of the State Trait Anxiety Inventory (STAI), a well-established and validated measure of anxiety.
	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?			N	Preprocedural (Appendix 1B) and postprocedural anxiety questionnaires (Appendix IC), as well as a satisfaction questionnaire (Appendix ID) were then completed when the patient attended their procedure.
	4.3 Were outcome assessors aware of the intervention received by study participants?			Y	it's a participant-reported outcomes

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Appendix 2 (*Continued*)

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?			PN	Patients in anxiety will express their true anxiety level, although they may be know which intervention they have received.
	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?			NA	
				Risk of bias judgment	
Low					
Bias in selection of the reported result	5.1 Were the data that produced this result analyzed in accordance with a prespecified analysis plan that was finalized before unblinded outcome data were available for analysis?			Y	through examination of a trail protocol, the way to measure outcome is same
	5.2 ... multiple eligible outcome measurements (eg, scales, definitions, time points) within the outcome domain?			N	through examination of a trail protocol, the way to measure outcome is same
	5.3 ... multiple eligible analyses of the data?			N	outcomes report contain1 tool and 3 time point as the same as the trail protocol
	Risk of bias judgment			Low	
Overall bias	Risk of bias judgment			Some concerns	
Unique ID	Noben 2019	Study ID	ISRCTN74794447	Assessor	yu
Ref or Label		Aim	assignment to intervention (the 'intention-to-treat' effect)		
Experimental	VR video	Comparator	standard preoperative information	Source	
Outcome	anxiety (VAS-A)	Results		Weight	1
Bias arising from the randomization process	1.1 Was the allocation sequence random?			Y	Randomization was performed by the researcher (LN) using a Web-based computer randomizer generating a randomization list. Couples were randomized into 2 groups by means of stratified block randomization
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?			NI	
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?			N	There were no differences between the groups with respect to age, gestational age at delivery, parity, and the incidence noticed a significant difference in the level of education, with a higher proportion of participants with a high level of education level in the control group (P = .03). while a linear regression analysis was used to test the influence of VR
	Risk of bias judgment			Some concerns	
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?			PN	They were not explicitly informed that the study involved a VR video but were told that the intervention group received a novel method of information provision in addition to the standard information. Masking of the researcher and participants was not possible because of the nature of the intervention.
	2.2.Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?			Y	
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?			NI	
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?			NA	
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?			NA	
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?			PN	high number of missing data, we decided continuing included participants until we reached 80 completed questionnaire, while there is no detail why missing date was happen
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?			NI	
	Risk of bias judgment			High	
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?			PN	Owing to the high number of missing questionnaires at the start of the study, we decided to continue including patients until we reached 80 completed questionnaires at time point 2, which included our primary outcome measure.
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?			PN	the author did not suggest the reason of missing data
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?			PN	
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?			NA	
	Risk of bias judgment			Low	
	4.1 Was the method of measuring the outcome inappropriate?			N	The VAS-A was used in the first and second questionnaires to measure preoperative anxiety

(*continued on next page*)

Appendix 2 (*Continued*)

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
Bias in measurement of the outcome	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?			N	both intervention group and control group used a VAS_A to measure outcomes
	4.3 Were outcome assessors aware of the intervention received by study participants?			Y	it's a participant-reported outcomes
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?			PN	Patients in anxiety will express their true anxiety
	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?			NA	level, although they may be know which intervention they have received.
	Risk of bias judgment			Low	
Bias in selection of the reported result	5.1 Were the data that produced this result analyzed in accordance with a prespecified analysis plan that was finalized before unblinded outcome data were available for analysis?			Y	through examination of a trail protocol, the way to measure outcome is same
	5.2 ... multiple eligible outcome measurements (eg, scales, definitions, time points) within the outcome domain?			N	through examination of a trail protocol, the way to measure outcome is same
	5.3 ... multiple eligible analyzes of the data?			N	outcomes report contain1 tool and 2 time point as the same as the trail protocol
	Risk of bias judgment			Low	
Overall bias	Risk of bias judgment			High	
Unique ID	Bekelis 2016	Study ID	NCT02619708	Assessor	yu
Ref or Label		Aim	assignment to intervention (the 'intention-to-treat' effect)		
Experimental	VR experience	Comparator	standard preoperative experience	Source	
Outcome	anxiety by APAIS	Results		Weight	1
Bias arising from the randomization process	1.1 Was the allocation sequence random?			Y	A block-randomization design was used with
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?			Y	randomly permuted block sizes of 4 on the basis of a computerized random-number generator with sequentially numbered opaque, sealed envelopes for each stratum.
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?			PN	A total of 127 patients (mean age 55.3 years, 41.9% females) were randomized into this study from November 2015 to April 2016 (Figure 1). Table 1 demonstrates the distribution of patient characteristics between patients exposed to a preoperative immersive VR experience, and those undergoing a standard preoperative experience.
	Risk of bias judgment			Low	
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?			Y	Because of the nature of the interventions, patients
	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?			Y	and treating physicians were aware of the study-group assignments
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?			PN	
	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?			NA	
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?			NA	
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?			Y	All analyses were based on the intention-to-treat principle,
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?			NA	
	Risk of bias judgment			Low	
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?			PY	each group have 11/12 patients dropout due to same reason
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?			NA	
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?			NA	
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?			NA	
	Risk of bias judgment			Low	
Bias in measurement of the outcome	4.1 Was the method of measuring the outcome inappropriate?			N	The primary outcomes (Supplementary Methods, http://links. lww.com/SLA/B150) were the Evaluation du Vecu de l'Anesthesie Generale (EVAN-G) score and the Amsterdam Preoperative Anxiety and Information (APAIS) score.2

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Appendix 2 (*Continued*)

Unique ID	Vogt 2021	Study ID	NCT04579354	Assessor	yu
	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?			N	The APAIS score [range 4 (worst) to 20 (best)] is a standardized self-reported questionnaire to evaluated preoperative patient anxiety (Supplementary Methods, http://links.lww.com/SLA/ B150).24 It consists of 6 items, which cover 3 separate anxiety domains, and was obtained preoperatively on the day of the surgery.24
	4.3 Were outcome assessors aware of the intervention received by study participants?			Y	it's a participant-reported outcomes
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?			PN	Patients in anxiety will express their true anxiety level, although they may be know which intervention they have received.
	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?			NA	
	Risk of bias judgment			Low	
Bias in selection of the reported result	5.1 Were the data that produced this result analyzed in accordance with a prespecified analysis plan that was finalized before unblinded outcome data were available for analysis?			Y	through examination of a trail protocol, the way to measure outcome is same
	5.2 ... multiple eligible outcome measurements (eg, scales, definitions, time points) within the outcome domain?			N	through examination of a trail protocol, the way to measure outcome is same
	5.3 ... multiple eligible analyses of the data?			N	outcomes report contain 1 tool and 2 time point as the same as the trail protocol
	Risk of bias judgment			Low	
Overall bias	Risk of bias judgment			Low	

VR, virtual reality; VORT, virtual operating room tour; STOPP, standard operation preparation procedure; STOA, the State-Trait Operation Anxiety Inventory; STAI, the State-Trait Anxiety Inventory Scale; HADS, the Hospital Anxiety and Depression Scale; VAS-A, the Visual Analogue Scale for Anxiety; APAIS, the Amsterdam Preoperative Anxiety and Information Scores; Y/PY/NI, Yes/Probably Yes/ No information; N/PN/NI, No/Probably No/ No information.