JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN (E-ISSN 2313-1519)
Original Article DOI: https://doi.org/10.23950/jcmk/13504

The effect of virtual reality glasses on reducing pain during chest tube removal

Zeynep Kızılcık Özkan[1], Ayşe Gökçe Işıklı[2], Fazlı Yanık[3]

[1]*Department of Surgical Nursing, Faculty of Health Sciences, Trakya University, Edirne, Turkey*
[2]*Department of Thoracic Surgery, Trakya University Health Research and Application Center, Edirne, Turkey*
[3]*Department of Thoracic Surgery, Faculty of Medicine, Trakya University, Edirne, Turkey*

Received: 2023-05-15.
Accepted: 2023-07-18

J Clin Med Kaz 2023; 20(4):38-42

Corresponding author:
Zeynep Kızılcık Özkan.
E-mail: zeynepkizilcik26@hotmail.com;
ORCID: 0000-0003-1892-241X

Abstract

Background: The studies that generally investigate the effectiveness of pharmacological and non-pharmacological methods in reducing chest tube removal related pain are remarkable. However, new studies need to expand the use of virtual reality glasses and evaluate its effectiveness.

Aim: This study aims to determine the effect of distraction with virtual reality glasses on pain during chest tube removal in patients undergoing tube thoracostomy.

Material and methods: This quasi-experimental study with a pre-test post-test control group design was performed with the participation of 40 patients. The patients in the intervention group (n=20) watched the video with virtual reality glasses throughout procedure. Pain measurements were evaluated before, during, and after chest tube removal. The patients in the control group (n=20) received standard care.

Results: In the intervention group, it was revealed that the pre-procedure pain score decreased compared to the pain score obtained during the procedure (p=0.002). After the chest tube removal procedure, a statistically significant decrease was observed in pain score in favor of the intervention group. In the intervention group, the pre-procedure pain score was found to decrease statistically significantly in the measurement at the 10th min of the procedure (p=0.000). The pain score of the intervention group 10 min after the chest tube removal procedure was lower than that of the control group (1.80 vs 2.95 and p=0.028).

Conclusion: The virtual reality glasses assisted chest tube removal procedure can help reduce pain. Surgical nurses should benefit from the use of virtual reality glasses for pain control.

Key words: chest tube removal, pain, virtual reality

Introduction

Chest tube (ChT) insertion is a minimally invasive surgical procedure applied for indications such as pleural effusion, pneumothorax, and hemothorax. Its objective is to provide the drainage of the fluid, air, or blood in the pleural space. During follow-ups, a ChT is removed in cases where the chest X-ray is expanded, the air leak stops, and the daily drainage is less than 200 mL [1]. Increased pain and anxiety can usually be observed in patients during chest tube removal (ChTR) [2,3].

In the literature review, studies that generally investigate the effectiveness of pharmacological and non-pharmacological methods in reducing ChTR-related pain are remarkable [4-6]. Distraction techniques (20.6%), relaxation (20.6%) and deep breathing exercises (11.7%) have been reported as the methods most commonly used by patients after thoracic surgery [7]. Distraction methods act on patients by enhancing the effect of analgesic methods and ensuring energy to increase pain tolerance. Healthcare professionals contribute to reducing pain-related fatigue and mood changes using distraction methods [5]. Furthermore, it increases self-confidence and self-control in coping with pain and reduces the fear of recurrent pain. Distraction methods, which are non-pharmacological

interventions, are inexpensive and safe auxiliary methods that can be easily accepted by patients and provide good cooperation between patients and healthcare professionals. Moreover, possible side effects and complications of pharmacological interventions are out of the question for distraction [5].

Virtual reality (VR) glasses are an advanced technology allowing users to create a three-dimensional computer environment for themselves [7]. Owing to VR glasses, attention is directed to the virtual world, and patients' thinking and feeling of pain decrease [8-10]. The distraction provided by VR glasses can inhibit pain particularly effectively, considering its inherently immersive and interactive properties. Using this technology ensures the interaction of patients with the virtual environment at many levels [11]. Patients, who use their multiple senses with VR glasses, leave the environment they live in for a while and transition to the virtual world. Thus, VR technology provides an effective environment for the method of attracting attention in pain control [10]. Some studies have reported that VR glasses, one of the distraction methods, effectively reduces pain [12,13]. VR is estimated to be a promising technological method due to its low cost and the absence of side effects [14]. Furthermore, it has been reported that using VR glasses in hospitalized patients can provide cost savings ($5.39 per patient) for the hospital system [15].

Pain management techniques are required for patients' recovery, and nurses assume many responsibilities in non-pharmacological pain interventions. Hence, nurses must be aware of innovative pain relief tools and be able to provide counseling to patients on new treatment modalities in the future [16]. There is a need for future studies to expand the use of VR glasses, an easy-to-use, inexpensive, and harmless method, by healthcare professionals and investigate its effects in patients who have undergone tube thoracostomy. This study aims to determine the effect of distraction with VR glasses on pain during ChTR in patients undergoing tube thoracostomy.

Materials and methods

A quasi-experimental study involves the comparison of groups that are already naturally exposed to different conditions or interventions. This quasi-experimental study with a pre-test post-test control group design was performed with the participation of 40 patients receiving inpatient treatment in the thoracic surgery ward of a university hospital between March 2020 and May 2023. After including the first case in the study, the study was interrupted when the first case of the new coronavirus disease was detected in March 2021. Cases were started to be included in the study again as of January 2022.

The study sample was calculated to be at least 40 people using an effect size of 0.95, a confidence level of 95%, a margin of error of 5%, and a power of 80%. Patients who agreed to participate in the study, to whom a standard single ChT was applied with the diagnosis of pneumothorax without surgery, had no history of disease that could cause chronic pain, had no neuro/psychiatric problems, did not use any analgesic agents in the last 12 hours before the ChTR procedure, had an American Society of Anesthesiology (ASA) score of <3, and had no biological and cognitive problems that could prevent the use of VR glasses were included in the study.

Patients who received care in an isolated room, had facial trauma, claustrophobia, a history of epileptic seizures, neuro-psychiatric problems, had a ChT inserted for traumatic and operative reasons, had multiple ChTs inserted, to whom a ChT had been inserted before, had a fear of underwater or underwater creatures and who did not agree to participate in the research were excluded from the study.

For data collection “Patient Identification Form” and “Visual Analog Scale” (VAS) were used. Patient Identification Form created by the researchers in line with the literature [5] comprises 7 questions, including the descriptive characteristics of patients (age, sex, education level, smoking status, chronic disease, and day of stay of the ChT) and pre-ChTR anxiety score (numeric 0-10). VAS consists of a 10 cm line (0-10 cm). A line of 0 means “no pain,” while a line of 10 means “unbearable pain.” The patient is requested to mark the place that expresses his/her degree of pain. The patient’s pain degree is determined by the number marked by the patient as the pain level [5]. The patients’ VAS scores were evaluated immediately before ChTR (preprocedural), immediately after ChTR (pain during the procedure-intraprocedural), and 10 min after ChTR (postprocedural).

On the morning of the day when the ChTR procedure would be applied, the researcher received written informed consent from the individuals after the researcher informed the patients about the study. The ‘Patient Information Form’ was applied to the patients in the control and intervention groups. Pain measurements were evaluated before, during, and after ChTR. Pain during the procedure was questioned immediately after the procedure. Post-procedure pain was assessed 10 min after the procedure. The same physician researcher applied the ChTR procedure to all patients. The procedure was performed in the patient's room with the participation of the patient, the physician researcher, and the nurse researcher. The patients in the control group received standard care without any pharmacological or non-pharmacological interventions for pain relief during ChTR. The patients in the intervention group were informed about using VR glasses before the procedure, and the patient tried the use of VR glasses. Prior to the ChTR procedure, the researcher placed VR glasses on the patient's head, and the patient watched the video throughout the procedure. The video contained the undersea view and lasted 10 minute (https://www.youtube.com/watch?v=cC9r0jHF-Fw&feature=youtu.be). Due to the short duration of the procedure, the recording was shortened (first 10 min.) using a video editing program. A longer video was not selected because the time of the procedure was short. During ChTR, patients in both the intervention and control groups were asked to take a deep breath and hold their breath, and the ChT was removed by the physician researcher and nurse researcher at this time. While the physician researcher tied the suture left ready while the ChT was being inserted, the nurse researcher quickly pulled the thoracic drain and closed the dressing. After the ChT was removed, chest radiography was taken, and no iatrogenic pneumothorax was observed in any patient. In this study, deep breathing and holding methods were used in both groups during ChTR.

After use, the inner and outer surfaces of the VR glasses were disinfected with separate gauzes and then left to dry before continuing with the next patient. After the VR glasses dried up, it was kept in a clean, sealed, and disposable bag [17,18].

This study was approved by the Noninvasive Scientific Research Ethics Committee of Trakya University (Date: 02.03.2020, No: 2020/98, Decision: 05/30). Prior to the study, all the participants were informed about the study, and written informed consent was obtained from all participants. The study was conducted in accordance with the principles of the Declaration of Helsinki and the ethical committee.

Statistical analysis

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. was used to evaluate the data from 40 patients. Data are presented as the mean, standard deviation, number, and frequency. The normality of data was checked using the Shapiro−Wilks test. The data analysis used the Independent sample t-test, Mann-Whitney U test, and Kruskal Wallis test. Wilcoxon signed rank test was used to evaluate the difference between measurements within the group. Statistical significance was defined as a p-value .05.

Results

Of the participants (n=40), 90% were male, 37.5% were primary school graduates, and 80% were comprised of patients without chronic diseases. The mean age of the patients was 45.57±18.82 years. The intervention group and the control group were similar in respect of sociodemographic characteristics (p>0.05) (Table 1). The mean day of stay of the drains was 5.00±1.91 days in the intervention group and 5.65±2.75 days in the control group.

Table 1 Patients' sociodemographic characteristics (n = 40)

Characteristics		Intervention Group (n = 20)	Control Group (n = 20)	t-test, U-test or χ2	P - value
Age (year)		46.2 ± 19.7	44.9 ± 18.3	t = -0.224	p = 0.824
Sex (male)		19 (95.0)	17 (85.0)	U = 180.000	p = 0.602
Education level	Primary school	10 (50.0)	5 (25.0)	χ2 = 1.847	p = 0.174
	High school	8 (40.0)	13 (65.0)		
	University	2 (10.0)	2 (10.0)		
Smoking status (yes)		16 (80.0)	13 (65.0)	U = 170.000	p = 0.429
Chronic diseases (yes)		4 (20.0)	4 (20.0)	U = 200.000	p = 1.000

The data are presented as: number (n), percent (%), mean and standard deviation (SD).
t: Independent sample t test, **U:** Mann-Whitney U test, **χ2:** Kruskal Wallis test

In the intervention group, it was revealed that the pre-procedure VAS score decreased compared to the VAS score obtained during the procedure (p=0.002), and the pre-procedure VAS score of the control group increased right after the procedure (p=0.056). After the ChTR procedure, a statistically significant decrease was observed in pain score in favor of the intervention group (p=0.000). Moreover, the decrease in the post-procedure VAS score in favor of the intervention group was found to be statistically significant (p=0.000) (Table 2).

Table 2 Comparisons of patients' preprocedural and intraprocedural pain scores according to groups (n = 40)

Pain score	Intervention Group (n = 20)		Control Group (n = 20)	
	Median	25th-75th percentile	Median	25th-75th percentile
Preprocedure	4.00	4.00 - 5.00	4.00	4.00 - 4.75
Intraprocedure	2.00	1.25 - 3.00	5.00	4.00 - 6.00
Mean difference	-2.00	-3.00 – -2.00	0.00	0.00 – 2.00
Value of statistical	Z = -3.151	p = 0.002	Z = -1.912	p = 0.056

The data are presented as: number (n), percent (%), mean and standard deviation (SD). **Z:** Wilcoxon signed rank test

Table 3 Comparison of patients according to pain scores 10 minutes after the procedure and before the procedure (n = 40)

Pain score	Intervention Group (n = 20)		Control Group (n = 20)	
	Median	25th-75th percentile	Median	25th-75th percentile
Preprocedure	4.00	4.00 - 5.00	4.00	4.00 - 4.75
Postprocedure	2.00	1.00 - 2.00	3.00	1.25 - 4.00
Mean difference	-2.50	-3.00 – -2.00	-1.00	-3.00 – 0.00
Value of statistical	Z = -3.962	p = 0.000	Z = -2.812	p = 0.005

The data are presented as: number (n), median and percentiles.
Z: Wilcoxon signed rank test

In the intervention group, the pre-procedure VAS score was found to decrease statistically significantly in the measurement at the 10th min of the procedure (p=0.000). Likewise, the pre-procedure VAS score was determined to decrease in the control group in the measurement at the 10th min of the procedure (p=0.005).

The higher decrease in the VAS score in favor of the intervention group 10 min after the procedure was found to be statistically significant (-2.75 vs -1.45 and p=0.017) (Table 3).

No significant difference was identified between the groups in terms of anxiety scores before the procedure (p=0.301) (Table 4).

Table 4 Comparison of patients' anxiety scores according to groups (n = 40)

Anxiety	Intervention Group (n = 20)		Control Group (n = 20)		Value of statistical
	Median	25th-75th percentile	Median	25th-75th percentile	
Preprocedure	2.00	1.00 ± 4.75	2.00	0.00 ± 3.00	U = 161.000 p = 0.301

The data are presented as: number (n), median and percentiles.
U: Mann Whitney U test

Discussion

Local anesthesia and moderate sedative agents are mostly used to relieve pain during ChT insertion [19]. This may cause the patient to feel pain at some stages because of the nature of the procedure. The pain felt during ChT insertion increases the feeling in patients that pain may also develop during ChTR. Many methods are employed to reduce pain during the ChTR procedure [4,5,6,20]. It is possible to divide them into two as pharmacological and non-pharmacological methods [20,21]. However, there is no standard method or guide in this matter. In this study, the effects of VR glasses, which were used to decrease the level of pain during the ChTR procedure, were investigated and discussed in line with the literature.

In this study, the pre-procedure baseline pain scores of the intervention and control groups were found to be similar. Similarly, it is reported in the literature that there is no significant difference between the groups in terms of pain score before ChTR [20-27].

In this study, there was a significant decrease in pain score during the procedure compared to the pre-procedure in favor of the intervention group. Yarahmadi et al. [28] reported that cold treatment and combined (cold+musicotherapy) method interventions effectively decreased ChTR-induced pain. In other studies investigating the effectiveness of cold application on pain, it was stated that the intervention group had lower pain score than the control group immediately after ChTR [20,25]. Elmetwalyl and Sayed [22] elucidated that pain score during the procedure was lower in the intervention group undergoing cold application and relaxation exercise compared to the control group (1.23 versus 3.60). Similar results were obtained in other studies in the literature [21,24,26]. In another study, Başak et al. [29] found that procedural pain resulting from peripheral intravenous catheterization was lower in patients who used VR glasses and distracting cards compared to the control group. It is reported that VR glasses are effective in ensuring pain control during different acute interventions [30,31]. According to the study results, it can be said that non-pharmacological methods can be effective in ensuring pain control during the procedure.

It was revealed that the pre-procedure VAS score decreased in the intervention group 10 min after the procedure (p=0.000), and the pre-procedure VAS score of the control group decreased 10 min after the procedure. Ten min after the ChTR procedure, the pain score of the intervention group was found to be lower than that of the control group (1.80 versus 2.95 and p=0.028). The fact that the VAS score decreased more in favor of the intervention group 10 min after the procedure was found to be statistically significant (2.75 versus 1.45 and p=0.017). The study by Soydan and Uğraş [32] reported that the VAS scores before ChTR decreased significantly in the intervention groups concurrently before and after the ChTR procedure. The same study found that the highest pain score of patients in the control group was during the procedure, and the VAS scores 15 min after the procedure were significantly higher in the control group than in the intervention groups. In the study by Ceylan and Rızalar [20], it was observed that pain was at the lowest level during the ChTR procedure in the intervention groups undergoing relaxation and cold application. In the same study, the pain score was the highest during the ChTR procedure in the control group. In their study, Sheykhasadi et al. [5] reported that distraction using the voice of a loved one during ChTR after open-heart surgery was effective in reducing pain. Jahani Shoorab et al. [31] stated that the VR technique reduced pain in patients who underwent episiotomy repair. The study results in the literature show that nursing interventions are effective in reducing pain during ChTR.

While there was no difference in the anxiety scores of the groups before the procedure, Aktaş and Karabulut [33] reported in their study that there was no difference between the pre-procedure anxiety scores of the groups treated with cold therapy, music therapy, and lidocaine spray during the ChTR procedure and the control group. Elmetwalyl and Sayed [22] found that anxiety scores were similar in the intervention cold application and relaxation exercise) and control groups before the ChTR procedure. Similar results were obtained in other studies in the literature [21,27]. In parallel with the literature, no significant difference was identified between the pre-procedure anxiety scores of the groups in this study.

Conclusion

The ChTR procedure, which is frequently used in the daily practice of thoracic surgery, can cause painful processes in patients. To solve this problem, pharmacological and non-pharmacological methods can be used. The VR glasses assisted ChTR procedure appears to be an easy, reliable, and side-effect-free technological intervention that can help reduce pain. Nonetheless, there is a need for future multi-center studies involving larger case series on the subject.

Limitations

The prospective case-controlled nature of the article, and the search for an easy, and safe solution to a clinical problem can be considered the strengths of this study. However, the research has some limitations. First, the low number of samples and the single-center design of the study restrict the generalization of the results. Second, in the study, patients' VAS scores related to the ChTR procedure were evaluated subjectively based on the patients' self-reports. Behavioral and physiological responses to pain were not included in the evaluation. Third, the economic dimension of the use of VR glasses per patient has not been analysed. Studies including calculations of the cost per patient of VR glass use should be planned. Finally, another limitation of the study is that the sample consisted only of patients who were not operated on but underwent ChT insertion due to the diagnosis of pneumothorax.

Disclosures: There is no conflict of interest for all authors.

Acknowledgements: None.

Funding: None.

References

1. Paydar S, Ghahramani Z, Johari HG. Tube thoracostomy (chest tube) removal in traumatic patients:what do we know? what can we do?. *Bulletin of Emergency and Trauma.* 2015; 3(2):37-40.
2. Friesner SA, Curry DM, Moddeman GR. Comparison of two pain-management strategies during chest tube removal: Relaxation exercise with opioids and opioids alone. *Heart & Lung*. 2006; 35(4):269-276. https://doi.org/10.1016/j.hrtlng.2005.10.005
3. Tarhan M, Gökduman S, Ayan A, Nurses' knowledge levels of chest drain management: a descriptive study. *Eurasian Journal of Pulmonology.* 2016; 18:153-9.
4. Demir Y, Khorshid L. The effect of cold application in combination with standard analgesic administration on pain and anxiety during chest tube removal: a single-blinded, randomized, double-controlled study. *Pain Management Nursing.* 2010; 11(3):86-96. https://doi.org/10.1016/j.pmn.2009.09.002
5. Sheykhasadi H, Abbaszadeh A, Bonakdar H, Salmani F, Tavan A, Sedri N. The effect of distraction with a loved one's voice on pain reduction while extracting the chest tube after open heart surgery. *The Open Pain Journal.* 2019; 12(7):6-10. https://doi.org/10.2174/1876386301912010006

6. Watanebe S, Imai K, Kimura T, et al, Effect of lidocaine cream analgesia for chest drain tube removal after video-assisted thoracoscopic surgery for lung cancer: a randomized clinical trial. *Regional Anesthesia & Pain Medicine.* 2019; 1–6. https://doi.org/10.1136/rapm-2019-100760
7. Siu E, Quick JS, Xu X, Correll DJ. Evaluation of the determinants of satisfaction with postoperative pain control after thoracoscopic surgery: a single-center, survey-based study. *Anesthesia & Analgesia*. 2019; 128(3):555-562. https://doi.org/10.1213/ANE.0000000000003756
8. Indovina P, Barone D, Gallo L, Chirico A, De Pietro G, Giordano A. Virtual reality as a distraction intervention to relieve pain and distress during medical procedures. *The Clinical Journal of Pain.* 2018; 34(9):858-877. https://doi.org/10.1097/AJP.0000000000000599
9. Birnie KA, Kulandaivelu Y, Jibb L, Hroch P, Positano K, Robertson S, Campbell F, Abla O, Stinson J. Usability testing of an interactive virtual reality distraction intervention to reduce procedural pain in children and adolescents with cancer. *Journal of Pediatric Oncology Nursing.* 2018; https://doi.org/10.1177/1043454218782138
10. Wiederhold M, Wiederhold B. Virtual reality and interactive simulation for pain distraction. *Pain Medicine.* 2008; 8(3):182-188. https://doi.org/10.1111/j.1526-4637.2007.00381.x
11. Mosso-Vázquez JL, Gao K, Wiederhold BK, Wiederhold MD. Virtual reality for pain management in cardiac surgery. *Cyberpsychology, Behavior, and Social Networking.* 2014; 17(6):371-378. https://doi.org/10.1089/cyber.2014.0198
12. Nilsson S, Enskär K, Hallqvist C, Kokinsky E. Active and passive distraction in children undergoing wound dressings. *Journal of Pediatric Nursing.* 2013; 28(2):158-66. https://doi.org/10.1016/j.pedn.2012.06.003
13. Sharar SR, Miller W, Teeley A, Soltani M, Hoffman HG, Jensen MP, Patterson DR. Applications of virtual reality for pain management in burn-injured patients. *Expert Review of Neurotherapeutics.* 2008; 8(11):1667-1674. https://doi.org/10.1586/14737175.8.11.1667
14. Freitas O, Spadoni V. Is virtual reality useful for pain management in patients who undergo medical procedures? *Einstein*. 2019; 17(2):eMD4837. https://doi.org/10.31744/einstein_journal/2019MD4837
15. Delshad SD, Almario CV, Fuller G, Luong D, Spiegel BM. Economic analysis of implementing virtual reality therapy for pain among hospitalized patients. *NPJ Digital Medicine.* 2018; 1:22. https://doi.org/10.1038/s41746-018-0026-4
16. Matsangidou M, Ang CS, Sakel M. Clinical utility of virtual reality in pain management: a comprehensive research review. *British Journal of Neuroscience Nursing.* 2017; 13(3):133-143. https://doi.org/10.12968/bjnn.2017.13.3.133
17. Pallavicini F, Orena E, Di Santo S, Greci L, Caragnano C, Ranieri P, et al. MIND-VR: Design and evaluation protocol of a virtual reality psychoeducational experience on stress and anxiety for the psychological support of healthcare workers involved in the COVID-19 pandemic. *Frontiers in Virtual Reality.* 2021; 2:620225. https://doi.org/10.3389/frvir.2021.620225
18. Moore N, Dempsey K, Hockey P, Jain S, Poronnik P, Shaban R, et al. Innovation during a pandemic: developing a guideline for infection prevention and control to support education through virtual reality. *Frontiers in Digital Health*. 2021; 3:628452. https://doi.org/10.3389/fdgth.2021.628452
19. Du A, Hannan L, Muruganandan . A narrative review on pain control interventions for non-surgical pleural procedures. *Respiratory Medicine*. 2023; 107119. https://doi.org/10.1016/j.rmed.2023.107119
20. Ceylan E, Rızalar S. Which is more effective: cold application or relaxation exercise on pain during chest tube removal. *International Journal of Caring Sciences.* 2022; 15(3):1879-1885.
21. El Mokadem N, El-Sayed, Ibraheem S. Cold application and breathing exercises to reduce pain and anxiety during chest tube removal. *American Journal of Nursing Science.* 2017; 6(4):285-292. https://doi.org/10.11648/j.ajns.20170604.12
22. Elmetwalyl R, Sayed R.Chest tube removal: efficacy of cold application and breathing exercise on pain and anxiety level. *Evidence Based Nursing.* 2020; 2(4):34-45. https://doi.org/10.47104/ebnrojs3.v2i4.159
23. Gorji H, Nesami B, Ayyasi M, Ghafari R, Yazdan J. Comparison of ice packs application and relaxation therapy in pain reduction during chest tube removal following cardiac surgery. *North American Journal of Medical Sciences.* 2014; 6:19-24. https://doi.org/10.4103/1947-2714.125857
24. Jarrah M, Hweidi I, Al-Dolat S, Alhawatmeh H, Al-Obeisat S, Hweidi L, et al., The effect of slow deep breathing relaxation exercise on pain levels during and post chest tube removal after coronary artery bypass graft surgery. *International Journal of Nursing Science.* 2022; 9(2):155-161. https://doi.org/10.1016/j.ijnss.2022.03.001
25. Mohammadi N, Pooria A, Yarahmadi S, Tarrahi M, Najafizadeh H, Abbasi P. Effects of cold application on chest tube removal pain in heart surgery patients. *Tanaffos*. 2018; 17(1):29-36.
26. Özcan N, Karagözoğlu Ş. Effects of progressive muscle relaxation exercise, cold application and local anesthesia performed before chest tube removal on pain and comfort levels and vital sings of the patient. *Turkiye Klinikleri Journal of Medical Sciences*. 2020; 40(3):285-296. https://doi.org/10.5336/medsci.2019-72505
27. Sajedi-Monfared Z, Rooddehghan Z, Haghani H, Bakshandeh A, Sajedi-Mofared L. Cold therapy and respiratory relaxation exercise on pain and anxiety related to chest tube removal: a clinical trial. *Iranian Journal of Nursing and Midwifery Research*. 2021; 26:54-59. https://doi.org/10.4103/ijnmr.IJNMR_228_19
28. Yarahmadi S, Mohammadi N, Ardalan A, Najafizadeh H, Gholami M. The combined effects of cold therapy and music therapy on pain following chest tube removal among patients with cardiac bypass surgery. *Complementary Therapies in Clinial Practice*. 2018; 31:71-75. https://doi.org/10.1016/j.ctcp.2018.01.006
29. Başak T, Duman S, Demirtaş A. Distraction-based relief of pain associated with peripheral intravenous catheterisation in adults: a randomised controlled trial. *Journal of Clinical Nursing.* 2019; 00:1–8. https://doi.org/10.1111/jocn.15131
30. Guo C, Deng H, Yang J. Effect of virtual reality distraction on pain among patients with hand injury undergoing dressing change. *Journal of Clinical Nursing*. 2015; 24(1-2):115–120. https://doi.org/10.1111/jocn.12626
31. JahaniShoorab N, Ebrahimzadeh Zagami S, Nahvi A, Mazluom SR, Golmakani N, Talebi M, Pabarja F. The effect of virtual reality on pain in primiparity women during episiotomy repair: a randomize clinical trial. *Iranian Journal of Medical Sciences.* 2015; 40(3):219-224.
32. Soydan D, Uğraş G. Effect of different cold application materials on pain during chest tube removal: three-arm randomized controlled clinical trial. *African Health Sciences.* 2021; 21(3):1273-1281. https://doi.org/10.4314/ahs.v21i3.38
33. Aktaş Y, Karabulut N. The use of cold therapy, music therapy and lidocaine spray for reducing pain and anxiety following chest tube removal. Complementary Therapies in Clinical Practice. 2019; 34:179-184. https://doi.org/10.1016/j.ctcp.2018.12.001