ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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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

Göğüs Tüpü Çıkarılmadan Önce Yapılan Progresif Kas Gevşeme Egzersizi, Soğuk Uygulama ve Lokal Anestezinin Hastanın Ağrı ve Konfor Düzeyleri ile Hayati Bulguları Üzerine Etkileri

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This article was presented as an oral presentation at the 1st International Health Science and Life Congress (2-5 May 2018, Burdur).

ABSTRACT Objective: This study was conducted to examine the effect of progressive muscle relaxation exercise, cold application and local anaesthesia before chest tube removal on pain, comfort level and life findings of the patient. **Material and Methods:** In the sample of the controlled experimental study, 160 patients in whom a chest tube was placed in the chest surgery service of a university hospital for any reason and who met the inclusion criteria were included. In the study, three intervention groups (progressive muscle relaxation exercise, cold application and local anaesthesia) and a control group were constituted and 40 individuals were assigned to each group. Pain intensity and comfort level were measured in 5 minutes before chest tube removal, immediately after tube removal and 15 minutes after tube removal in all groups and hemodynamic indicators were recorded as well. Patient Information Form, Visual Analogue Scale (VAS), Comfort Scale and Vital Signs Monitoring Form were used to collect the data. **Results:** Immediately after removing the chest tube, it was found that the pain in the relaxation exercise and control group increased compared to before, the comfort decreased; the pain in the cold application and local anaesthesia group significantly decreased ($p<0.001$, $p<0.001$), the comfort in the same group increased and this situation continued after 15 minutes. **Conclusion:** In our study, it was observed that cold application and local anaesthesia significantly reduced pain and comfort level compared to other methods during chest tube removal. In this context, it has been proposed to use cold application and local anesthesia as a primary method in chest tube removal.

Keywords: Chest tube; pain; comfort; cold application; progressive relaxation exercise

ÖZET Amaç: Bu çalışma göğüs tüpü çıkarılması işlemi öncesinde uygulanan progresif kas gevşeme egzersizi, soğuk uygulama, lokal anestezinin hastanın ağrı, konfor düzeyi ve yaşam bulguları üzerine etkisini incelenmek amacıyla yapılmıştır. **Gereç ve Yöntemler:** Kontrollü deneysel nitelikteki çalışmanın örneklemine bir üniversite hastanesinin göğüs cerrahi servisinde herhangi bir nedenle göğüs tüpü yerleştirilmiş, çalışma kriterlerine uyan 160 hasta alınmıştır. Çalışmada üç müdahale (progresif kas gevşeme egzersizi grubu, soğuk uygulama grubu, lokal anestezi grubu) ve bir kontrol grubu oluşturulmuş, her bir gruba 40 birey atanmıştır. Tüm gruplarda göğüs tüpü çıkarılma işlemi başlamadan 5 dakika önce, tüp çıkarıldıktan hemen sonra ve 15 dakika sonrasında ağrı şiddeti, konfor düzeyi ölçülmüş ve hemodinamik göstergeler kaydedilmiştir. Verilerin toplanmasında Hasta Tanıtım Formu, Visüel Analog Skala (VAS), Konfor Skalası ve Yaşam Bulguları İzlem Formu kullanılmıştır. **Bulgular:** Göğüs tüpü çıkartıldıktan hemen sonra gevşeme egzersizi ve kontrol grubunda öncesine göre ağrının artış gösterdiği, konforun azaldığı, soğuk uygulama ve lokal anestezi grubunda ise ağrının önemli düzeyde ($p<0,001$, $p<0,001$) düştüğü ve konforun arttığı, 15 dakika sonrasında da bu durumun devam ettiği saptanmıştır. **Sonuç:** Çalışmamızda göğüs tüpü çıkarılması sürecinde soğuk uygulama ve lokal anestezinin ağrı ve konfor düzeyini diğer yöntemlere göre önemli derecede azalttığı görülmüştür. Bu bağlamda, göğüs tüpü çıkarılması işleminde soğuk uygulama ve lokal anestezi yönteminin öncelikli kullanılması önerilmiştir.

Anahtar Kelimeler: Göğüs tüpü; ağrı; konfor; soğuk uygulama; progresif gevşeme egzersizi

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Chest tube placement is the process of draining the air or fluid in the pleural cavity by placing a tube in sterile conditions.[1,2] Though chest tubes are mostly placed in heart-lung operations while the patient is under general anesthesia, they can also be applied in emergency departments, interventional radiology units and clinics in cases such as hemothorax, pneumothorax, empyema and pleural effusion.[3] Chest tubes adhere to the endothelium after they are placed in the pleural cavity and retained in place. Therefore, the force applied to remove a chest tube can break these adhesions and causes intense, regional and transient acute pain.[4-6] Pain occurring during chest tube removal is an iatrogenic pain caused by an invasive intervention.[4,5] Hence, chest tube removal is a frightening experience causing pain and anxiety for the patient.[4,5,7-9]

Effective management of pain in treatment and care services is important and has priority.[10,11] Effective pain management reduces hospitalization time and the cost of care by ensuring early mobilization and improving the patient's comfort and satisfaction.[4,11,12] In addition to pain control, attempts to increase the patient's comfort are one of the important parameters in the provision of health service.[13]

In the literature, several approaches are reported to relieve pain occuring during chest tube removal. These approaches are generally either pharmacological or non-pharmacological. While local anesthetics, nonsteroidal anti-inflammatory drugs and opioid analgesics are among the commonly used pharmacological agents, cold application and relaxation exercises are among the non-pharmacological approaches.[3,4,14] Non-pharmacological methods strengthen the patient's coping abilities by reducing the intensity of pain and giving the patient a feeling of control over pain, also reduce pain sensation by minimizing pain related discomfort.[15]

In the literature, there are several research results, especially on pharmacological approaches used to control pain experienced during chest tube removal.[3,8,9,16-18] On the other hand, a limited number of studies indicate that using non-pharmacological methods alone or together with pharmacological methods is effective in relieving pain or reducing its intensity.[4,11] The literature review revealed that while a large number of studies were conducted on the effects of pharmacological approaches before chest tube removal, a small number of studies were performed on the effect of non-pharmacological approaches.[3-5,8,9,16-22] Moreover, in these studies, mostly the approaches were examined separately and there are very few studies compared with each other.

Another noteworthy point the review demonstrated was that while there were many studies aimed at reducing pain during chest tube removal, there were no studies on the comfort of the patient. This study was conducted to examine the effect of progressive muscle relaxation exercise, cold application and local anaesthesia before chest tube removal on pain, comfort level and life findings of the patient.

MATERIAL AND METHODS

TYPE OF THE STUDY

The study was a randomized controlled experimental study designed to investigate the effects of local anesthesia, a pharmacological pain control method, and cold application and progressive muscle relaxation exercise, non-pharmacological pain control methods, on the pain and comfort of adult patients who underwent chest tube removal.

SITE AND CHARACTERISTICS OF THE STUDY

The study was performed at the Thoracic Surgery Department. In the hospital where the study was performed, there is no routine application before chest tube removal. Analgesia is not applied to patients before chest tubes are removed, but patients who report pain after tube removal are administered analgesics. Standard chest tubes with number 28 F made of silicone are usually used depending on the condition of the patient. Prilocaine is routinely administered to relieve pain during chest tube removal as a local anaesthetic. The decision to remove the chest tube is made by a specialist physician. The chest tube is removed in the room where dressing is performed by a physician and a nurse in cooperation. In order to prevent atmospheric air from entering the pleural space during the removal of the chest tube, the patient is asked to breathe deeply and hold his/her breath. During the removal of the tube by the physician, sutures sewed on

the skin beforehand are rapidly tied by the nurse and the intervention is completed.

THE POPULATION AND SAMPLE OF THE STUDY

All patients who had a chest tube placement for any reason in the Thoracic Surgery Department after September 01, 2016 comprised the study population. The study was completed on the date of January 25th 2017. Of them, 160 who had a chest tube inserted after the onset of the study and met the undermentioned inclusion criteria were included in the sample of the study. In the study, three intervention groups (progressive muscle relaxation exercise, cold application and local anaesthesia) and a control group were constituted and 40 individuals were assigned to each group. At the beginning of the study, the groups were named as follows;

Cold application group: A

Progressive relaxation exercise group: B

Local anesthetic group: C

Control group: D

When the study started, a participant with the same pain score was taken to other groups for each patient included in the first group. Patients were asked to choose any of the cards labelled A, B, C, D for group selection. The patient was placed in the group written on the selected card. When there was a group in which a patient who previously gave the same score was located, the card of that group was removed before the selection process, so the groups were tried to be balanced in terms of pain score averages by enabling them to choose any of the other groups. This cycle was maintained until all groups were completed (Figure 1). The sample size was determined based on a previous study conducted by Demir and Khorshid (2010).[4] Data analysis was performed using G-Power program. Given α=0.05 ß=0.20 (1-ß)=0.80, the power of the study was found to be for 40 individuals in each group.

INCLUSION CRITERIA

1. Those who were able to speak and understand Turkish,

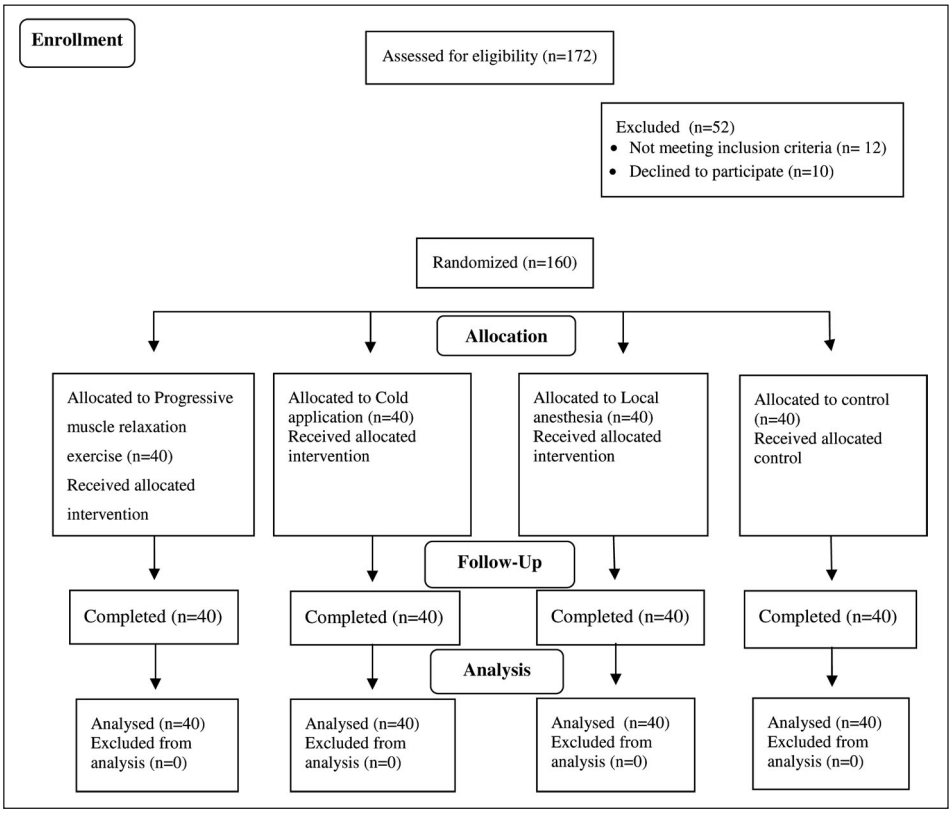

FIGURE 1: Participant flow chart.

2. 18 to 74 years old,

3. Those who had no vision and hearing problems,

4. Those who did not receive analgesic drugs before the intervention

EXCLUSION CRITERIA

Those who

1. had a diagnosis of diabetes,

2. used transdermal tape due to chronic pain,

3. had body mass index > 30,

4. had disorientation problem,

5. were under mechanical ventilation support,

6. had psychiatric disorders

7. were in the group in which prilocaine was to be used had a condition (i.e. allergy to any substance in the contents of prilocaine, anemia problem, a disease due to the high amount of methemoglobin in the blood) preventing the use of prilocaine were not included in the study.

DATA COLLECTION TOOLS

The study data were collected using the Patient Information Form, and Pain, Comfort and Vital Signs Follow-up Form.

PATIENT INFORMATION FORM

The form developed by the researcher includes 15 items. While 9 of the items question the sociodemographic characteristics of the participants, the remaining 6 items question their medical history, pain coping methods and knowledge of the features, signs and symptoms of pain.

PAIN, COMFORT AND VITAL SIGNS FOLLOW-UP FORM

The form consists of 3 parts.

Part I includes the Visual Analogue Scale-VAS. VAS, one of the several measurement tools used to assess the intensity of pain, is considered as a safe, valid and easily applicable measurement tool for repeated measurements. The VAS is a horizontal or vertical line, 10 cm in length with one end corresponding to "no pain" and the other end corresponding to "worst possible pain" (most severe pain/irresistible pain/unbearable pain)".[3,4] In the present study, the VAS with a horizontal line was used to evaluate the intensity of pain.

Part II includes the comfort scale: The comfort scale developed by the researchers is a 10-cm horizontal line. While one end of the line corresponds to the "most comfortable situation", the other end corresponds to the "most uncomfortable situation".

Part III includes the pain, comfort and hemodynamic indicators follow-up chart. The scale includes measurements of pain intensity, comfort level, hemodynamic indicators (blood pressure, pulse, fever, and respiration) obtained before, immediately after and 15 minutes after the intervention.

IMPLEMENTATION OF THE STUDY AND DATA COLLECTION

The study data were collected separately for each of the four following groups: progressive muscle relaxation exercise group, cold application group, local anesthesia group and control group. The review of the studies relevant to the issue indicated that measurements were performed immediately before, immediately after and 15 minutes after the chest tube removal. In the present study, it was decided to carry out the measurements as in the literature. The pain intensity levels, comfort levels and hemodynamic indicators of the participants in all the 4 groups who were decided to undergo the chest tube removal intervention by the physician were recorded before the intervention was started (1st measurement). Measures in progressive muscle relaxation exercise, cold application and all other groups were conducted by the same researcher. Following the first measurement, intervention steps carried out in each of the 3 intervention groups are listed below.

PROGRESSIVE MUSCLE RELAXATION EXERCISE GROUP

Progressive muscle relaxation exercise is the sequential voluntarily tensing and passive relaxing of major muscle groups, leading to a decrease in the activity of the sympathetic nervous system and an increase in the activity of the parasympathetic nervous system. The intervention is started by taking a few slow and deep breaths. The body muscles starting at the head and moving down the body to the feet are tensed by counting up to 5 and then are relaxed.

While slowly breathing, the person starts from the muscles of the neck, shoulders and continues downwards in 18 steps.[23] Following the first measurement, the patients in this group were asked to perform the progressive muscle relaxation exercise after they were shown how to perform the exercise just before the removal of the chest tube. Then, the chest tube was removed in about 1-2 minutes by the physician and nurse in cooperation. Immediately after the removal of the chest tube, pain intensity and comfort levels felt by the patient during the removal of the tube and his/her hemodynamic parameters were recorded (2nd measurement). Finally, the patient's pain intensity, comfort level and hemodynamic parameters were re-measured and re-recorded 15 minutes after the chest tube was removed (3rd measurement).

COLD APPLICATION GROUP

A cold gel pack was used for cold application. Cold gel packs are available in different sizes and shapes. Because they do not lose their softness when cooled, it conforms well to the body's natural contours. Due to its low conductivity, gel can be applied for a relatively long time without losing its coldness. Before a gel pack is applied, a piece of thin gauze is placed between the skin and the gel pack in order to obtain a homogeneous cooling, to ensure hygiene and to tolerate extreme coldness felt (prevent frostbite) in the first contact of the gel pack. Then, it is kept in place for about 15-30 minutes until the anesthesia is felt. Provided that they are not overly sensitive, stimulation of cold-sensitive fibres has an analgesic effect with the door control mechanism at the segmental level and the release of endorphins at the supra segmental level. The analgesic effect of cold application is also explained by the reduction of the transmission rate of small myelin-free nerve fibers that carry painful stimuli from centre to centre. As the temperature decreases by 1 ° C, conduction velocity of nerve impulse decreases by 2-2.4 meters/second. If cooling continues, the conduction velocity of nerve decreases and conduction obstruction occurs gradually.[24] Cold gel packs, 13x13cm in size, are cut in the middle and placed around the tube. After the first measurement, the cold gel pack wrapped with gauze was directly placed on a 5-cm^2 skin to cover the chest tube for 20 minutes. After the 20 minutes, the cold gel pack was removed and then the chest tube was removed in approximately 1-2 minutes by the physician and nurse in cooperation. Immediately after the removal of the chest tube, pain intensity and comfort levels felt by the patient during the removal of the tube and his/her hemodynamic indicators were recorded (2nd measurement). Finally, the patient's pain intensity, comfort level and hemodynamic parameters were re-recorded 15 minutes after the chest tube was removed (3rd measurement).

LOCAL ANESTHESIA GROUP

Prilocaine HCI 20 mg/ml was used for local anesthesia. Prilocaine HCI is used in surgical operations to create an anesthetic effect in a certain part of the body and to ensure that the pain is not felt.[20] Prilocaine hydrochloride was not used in patients who were allergic to prilocaine hydrochloride or any substance in the contents of prilocaine, had an anemia (reduction in red blood cells) problem and/or had a disease due to the high amount of methemoglobin in the blood.[25] Prilocaine is administered in the clinic. Prilocaine hydrochloride was ordered by the doctor.

After the first measurement, 1 ml of prilocaine HCI (20 mgr) was injected to the region where the chest tube was placed with an insulin injector by the physician just before the intervention was started. After waiting for 1-2 minutes for the drug to take effect, the chest tube was removed by the physician and nurse in cooperation. Immediately after the removal of the chest tube, pain intensity and comfort levels felt by the patient during the removal of the tube and his/her hemodynamic parameters were recorded (2nd measurement). Finally, the patient's pain intensity, comfort level and hemodynamic parameters were re-measured and re-recorded 15 minutes after the chest tube was removed (3rd measurement).

CONTROL GROUP

The patients in this group underwent no intervention. The pain intensity, comfort level and hemodynamic parameters of the patient were measured and recorded before, immediately after and 15 minutes after the intervention.

ANALYSIS OF THE STUDY DATA

The study data obtained were analyzed using the SPSS (version 22.0). Whether the continuous data confirmed with the normal distribution was evaluated with the Kolmogorov-Smirnov test. When the parametric test assumptions were not fulfilled, the Mann-Whitney U test was used to compare two independent groups for a variable obtained by measurement, and the Kruskal-Wallis test to compare three or more independent groups for a variable. When obtained by measurement, Friedman test was used for repeated measurement and Pearson Chi-square test was used to compare the differences between the groups in terms of a variable obtained by counting. When the variables obtained by counting were below the expected frequency, Fisher Freeman Halton test was applied. Spearman correlation was used to evaluate the relationship between pain and comfort scores according to measurement times. $\alpha<0.05$ were considered statistically significant. For this study, the significance was determined as 0.05/6=0.0083 with Bonferroni correction because the number of paired comparison groups in the variable of pain and comfort level was six. Therefore, after the Kruskal-Wallis H analysis, the significance level for the MannWhitney U test used to test the difference between the pain and comfort scores between the groups was taken as p=0.0083.

ETHICAL ISSUES

Before the study was conducted, the ethics committee approval (dated May 17, 2016, numbered 2016-05/07) was obtained from the Cumhuriyet University Clinical Practices Ethics Committee. Written permission to conduct the study was obtained from the hospital where the study was to be conducted. After all the patients to be included in the study were informed about the applications, their informed consent was obtained. This study was carried out according to the rules of the Helsinki Declaration.

RESULTS

This experimental study included 160 patients (36 female, 124 male). The patients were assigned to three intervention groups and one control group. Each group consisted of 40 patients. Table 1 shows the distribution of the participants in terms of their sociodemographic characteristics and medical history. There was a difference between the groups in terms of the number of days with chest tube inserted (p=0.001). The duration of the chest tube is longer in the cold application and local anesthesia group. There was no statistically significant difference between the groups in terms of their sociodemographic characteristics and medical history (age, p=0.493; gender, p=0.571; education, p=0.909; diagnoses, p=0.756; presence of a chronic disease, p=0.491; alcohol consumption, p=0.964).

The analysis of the participants' pain coping methods revealed that the majority of them took painkillers to cope with pain, and that the most intensive pain type experienced by the patients with the chest tube inserted was the stinging pain. There were no statistically significant differences between the groups in terms of the methods used to cope with pain and the features (intensity) of pain (p=0.373, p=0.231).

The comparison of the mean pain scores according to the different methods applied to the patients during chest tube removal demonstrated that the mean pain scores were close to each other before the intervention and there were no statistically significant differences between the groups (p=0.806) (Table 2). However, the difference between the mean pain scores obtained immediately after and 15 minutes after the intervention was statistically significant ($p<0.001$, $p<0.001$). The intra-group comparisons of the mean pain scores showed that the difference was statistically significant in all the groups ($p<0.001$). The pain score increased in the progressive muscle relaxation exercise and control group immediately after the tube was removed. However, 15 minutes after the chest tube was removed, it decreased in all intervention groups, but the decrease was less in the progressive muscle relaxation exercise group than in the cold application and local anesthesia groups. In the control group, there was no change (Table 2).

The comparison of the pre-intervention comfort levels of the participants revealed that the mean comfort scores were close to each other in all groups and

TABLE 1: Distribution of the participants in terms of their sociodemographic characteristics and medical history.

	Cold application group		Relaxation exercise group		Local anesthesia group		Control group		Total		
	Number (n=40)	%	Number (n=40)	%	Number (n=40)	%	Number (n=40)	%	Number (n=160)	%	p value
Age (years)											
<30	10	24	8	20	8	20	5	13	31	19	0.493****
31-60	15	38	21	52	17	42	24	60	77	48	
≥61	15	38	11	28	15	38	11	27	52	32	
Gender											
Female	6	15	9	23	10	25	11	28	36	23	0.571****
Male	34	85	31	77	30	75	29	72	124	77	
Education											
Illiterate	5	12	7	18	6	15	5	13	23	15	0.909*****
Primary school	20	50	18	45	24	60	19	47	81	50	
High school	12	30	13	32	8	20	14	35	47	29	
Higher education	3	8	2	5	2	5	2	5	9	6	
Diagnoses											
Spontaneous pneumothorax	10	25	8	20	8	20	10	25	36	22	0.756*****
Chest Trauma*	7	18	6	15	9	22	6	15	28	18	
Pleural Effusion	4	10	11	27	5	13	9	22	29	18	
Mass in the Lung	15	37	10	25	6	15	5	13	48	30	
Other Chest Diseases **	4	10	5	13	4	10	10	25	19	12	
The number of the days the chest tube remained in place	5 (1-11)		3.5 (1-16)		6 (3-20)		3 (1-16)		4 (1-20)		0.001******
Presence of a chronic disease***											
Yes	16	40	13	33	18	45	20	50	67	42	0.491****
No	24	60	27	67	22	55	20	50	93	58	
Alcohol consumption											
Yes	2	5	3	8	2	5	1	3	8	5	0.964*****
No	38	95	37	92	38	95	39	97	152	95	

*: Pneumothorax, hemothorax, hemopneumothorax; **: Empyema, bronchiectasis, hyperhidrosis, hydatid cyst, diaphragmatic rupture; ***: Hypertension, coronary artery disease, chronic obstructive pulmonary disease, asthma, bronchiectasis; ****: Pearson Chi-Square Test; *****: Fisher Freeman Halton test; ******: Kruskal Wallis Test.

there was no statistically significant difference between them (Table 3) (p=0.114). However, the difference between the mean comfort scores immediately after and 15 minutes after the intervention was statistically significant (p<0.001, p<0.001). The intra-group comparison of the mean comfort scores showed that the difference was statistically significant in all groups (p<0.001). The comfort level decreased in the progressive muscle relaxation exercise and control groups immediately after the tube was removed. It increased statistically significantly in the cold application and local anesthesia groups (p<0.001) and a little in the progressive muscle relaxation exercise group 15 minutes after the chest tube was removed. In the control group, pre- and post-intervention comfort levels were almost the same.

In this study, the respiratory rates, heart rate, systolic blood pressure and diastolic blood pressure values of patients in all groups during and after the chest tube removal process generally continued within physiological limits and stably (Figure 2). No significant hemodynamic changes were observed in patients included in the study. According to the different methods applied to the patients during the chest tube removal process, it was determined that in hemodynamic indicators, the medians of the values before and after the 15th minute of the procedure were close to each other and there was no statistically significant difference between them (p=0.604, p=0.672, p=0.513, p=0.350). Immediately after the procedure, a significant difference was detected between the groups in the comparison of respiration, pulse, sys-

TABLE 2: Distribution of the Mean Pain Scores in terms of Different Methods Applied to the Participants during the Chest Tube Removal Process.

Pain Level (VAS)*	Cold application group[a] Median (min-max)	Relaxation Exercise Group[b] Median (min-max)	Local anesthesia group[c] Median (min-max)	Control group[d] Median (min-max)	Kruskal-Wallis H Test (p)	Man Whitney U Test (p)
Before the intervention	5(1-9)	5(2-7)	5(0-8)	4(1-8)	0.806	0.984^{a-b}
						0.506^{a-c}
						0.520^{a-d}
						0.475^{b-c}
						0.460^{b-d}
						0.968^{c-d}
Immediately after the intervention	3(0-10)	5(0-10)	3(0-10)	8(3-10)	<0.001	$<0.001^{a-b}$
						0.554^{a-c}
						$<0.001^{a-d}$
						$<0.001^{b-c}$
						$<0.001^{b-d}$
						$<0.001^{c-d}$
15 minutes after the intervention	1(0-8)	3(0-7)	1(0-5)	5(0-10)	<0.001	$<0.001^{a-b}$
						0.867^{a-c}
						$<0.001^{a-d}$
						$<0.001^{b-c}$
						0.002^{b-d}
						$<0.001^{c-d}$
Friedman F Test (p)	<0.001	<0.001	<0.001	<0.001		

[a-b]Compared with the Cold Application Group-Relaxation Exercise Group; [a-c]Compared with the Cold Application-Local Anesthesia Group; [a-d]Compared with the Cold Application-Group Control Group; [b-c]Compared with the Relaxation Exercise Group- Local Anesthesia Group; [b-d]Compared with the Relaxation Exercise Group- Control Group; [c-d]Compared with the Local Anesthesia Group-Control Group; *Visüel Analog Scala.

tolic and diastolic blood pressure values ($p<0.001$, $p=0.039$, $p=0.019$, $p=0.008$). On the other hand, respiratory, pulse, systolic and diastolic blood pressure values increased slightly in intra-group comparisons after the procedure and decreased after 15 minutes in all groups so the difference between the values was found statistically significant. This difference was mainly ensued from values immediately after the procedure and 15 minutes after the procedure ($p<0.001$).

As for the demographic characteristics, there were statistically significant differences between the mean pain and comfort scores obtained during the chest tube removal intervention except for gender variable ($p<0.001$). Immediately after and 15 minutes after the intervention, the pain level was statistically significantly higher in the female participants than in the male participants ($p=0.034$, $p=0.013$). Whereas the comfort level was lower in the female participants than in the male participants and the difference between the mean scores was statistically significant ($p=0.022$). The analysis of the relationship between the mean pain and comfort scores obtained before, immediately after and 15 minutes after the chest tube removal intervention revealed that there was a strong and statistically significant relationship between them ($p <0.001$) (Table 4).

DISCUSSION

The results of the present study suggest that pain related to the chest tube removal intervention was most intense during the removal of the tube. The results of several studies conducted on the issue are consistent

TABLE 3: Distribution of the Mean Comfort Scores in terms of Different Methods Applied to the Participants during the Chest Tube Removal Process.

Pain Level (VAS)*	Cold application group[a] Median (min-max)	Relaxation Exercise Group[b] Median (min-max)	Local anesthesia group[c] Median (min-max)	Control group[d] Median (min-max)	Kruskal-Wallis H Test (p)	Man Whitney U Test (p)
Before the intervention	3(0-8)	3.5(0-7)	3(0-6)	4(0-8)	0.114	0.633[a-b]
						0.220[a-c]
						0.390[a-d]
						0.087[b-c]
						0.791[b-d]
						0.040[c-d]
Immediately after the intervention	2(0-10)	5(0-10)[b]	2(0-9)	8(0-10)	<0.001	<0.001[a-b]
						0.698[a-c]
						<0.001[a-d]
						<0.001[b-c]
						<0.001[b-d]
						<0.001[c-d]
15 minutes after the intervention	0(0-8)[a]	2(0-5)[b]	0(0-5)[c]	4.5(0-8)[d]	<0.001	0.002[a-b]
						0.598[a-c]
						<0.001[a-d]
						0.001[b-c]
						0.008[b-d]
						<0.001[c-d]
Friedman F Test (p)	<0.001	<0.001	<0.001	<0.001		

[a-b]Compared with the Cold Application Group-Relaxation Exercise Group; [a-c]Compared with the Cold Application-Local Anesthesia Group; [a-d]Compared with the Cold Application-Group Control Group; [b-c]Compared with the Relaxation Exercise Group- Local Anesthesia Group; [b-d]Compared with the Relaxation Exercise Group- Control Group; [c-d]Compared with the Local Anesthesia Group-Control Group.

with those of the present study.[3-7,21,22,26,27]

The comparison of the mean pain scores obtained before and immediately after the chest tube was removed in terms of the different methods applied to the patients during chest tube removal demonstrated that the mean pain scores increased significantly in the progressive muscle relaxation exercise and control groups but decreased significantly in the cold application and local anesthesia groups. Fifteen minutes after the removal of the chest tube, the mean pain score continued to decrease significantly in the cold application and local anesthesia groups and slightly in the progressive muscle relaxation exercise group. However, in the control group it was almost the same as that obtained before the intervention (Table 2).

Our review of the literature indicated that no study was conducted to compare the effects of cold application, progressive muscle relaxation exercise and local anesthesia during the chest tube removal intervention in the same way as the present study was conducted. In the present study, cold application and local anesthesia had similar effects on the patients in the process of chest tube removal and decreased the pain level significantly. In contrast to our study, in their study conducted to compare the relaxation exercise with the cold application performed by reducing the skin temperature to 13ºC, Gorji et al. found that the effects of the two methods were close to each other. In her study, Ertuğ and Ülker compared the effect of cold application similar to the way Gorji et al. used in their study and found that cold application was effective. In line with the results of the present study and other studies, cold ap-

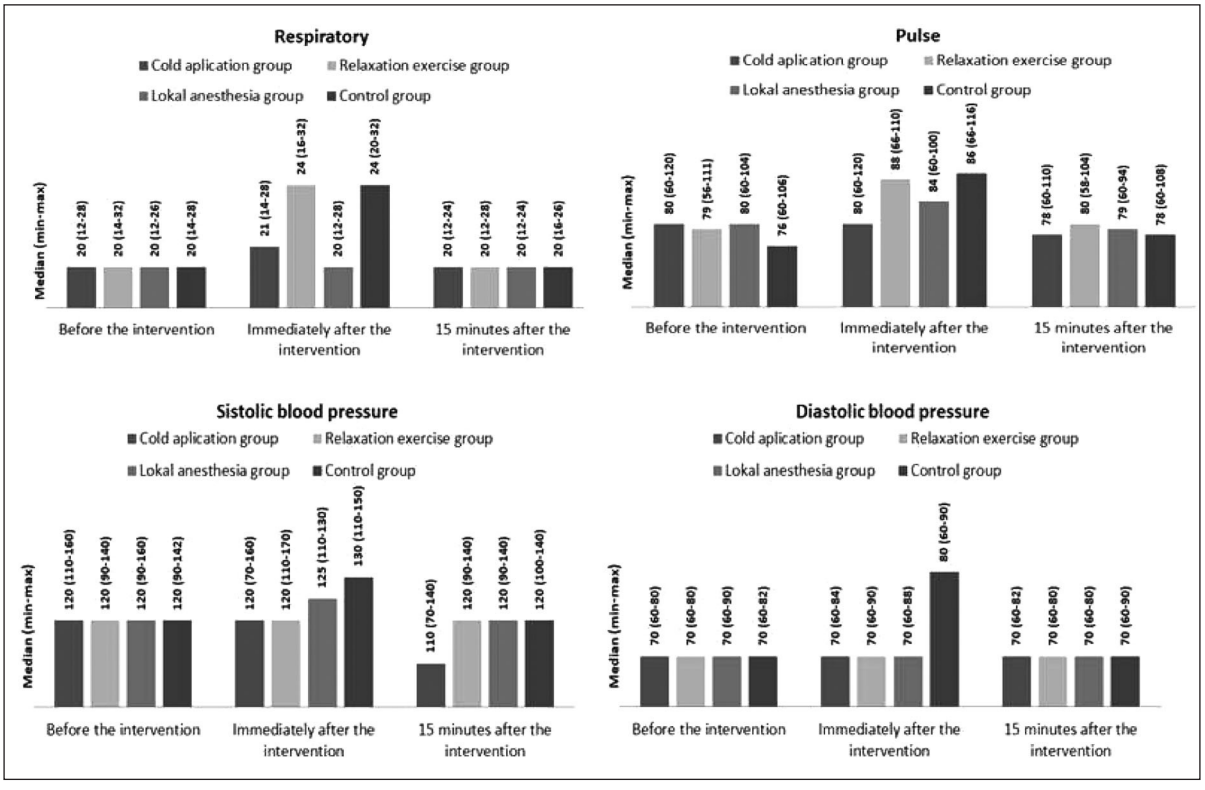

FIGURE 2: Hemodynamic indicator median values of groups in breast tube removal process.

TABLE 4: Correlation analysis between pain and comfort levels.

			Comfort Levels		
Variable	**When**	**Statistics**	**Before the intervention**	**Immediately after the intervention**	**15 minutes after the intervention**
Pain levels	Before the intervention	r	-0.782		
		p	p<0.001		
	Immediately after the intervention	r		-0.890	
		p		p<0.001	
	15 minutes after the intervention	r			-0.879
		p			p<0.001

plication can be said to be an effective method in controlling the pain felt during the chest tube removal process.[3,4,6,14,21,27]

In the present study, local anesthesia applied to the patients prior to the intervention significantly reduced the pain they experienced during the removal of the tube. The literature review demonstrated that although there were no studies conducted in the way the present study was conducted, there are studies comparing pharmacological agents with each other.[19,20] These studies showed that local anesthesia was effective in pain control even the agents used were different.

In the current study, the progressive muscle relaxation exercise applied to the patients before the intervention reduced the pain during the chest tube removal process, although not as much as did other methods. In her study, Arıoğlu found that progressive muscle relaxation exercises reduced pain, which was consistent with the result of the present study.

In their studies, Friesner et al. and Gorji et al. eported that deep breathing, one of the relaxation exercises, applied to control pain during the chest tube removal process reduced the pain.

The comfort level decreased in the progressive muscle relaxation exercise and control groups immediately after the removal of the tube. Fifteen minutes after the tube was removed, the comfort level increased significantly in the cold application and local anesthesia groups but was almost the same as the pre-intervention score in the control group. In the progressive muscle relaxation exercise group, it increased but not as much as it did in the cold application and local anesthesia groups (Table 3). Pain and comfort are closely related concepts. In the present study, a statistically significant correlation was determined between the pain and comfort levels (Table 4). Patients' comfort level increases as their pain level decreases. Therefore, the effective handling of pain during chest tube removal will enable them to undergo the process more comfortably.

In the present study, changes in the hemodynamic parameters of the patients in the chest tube removal process were at a minimal level in all the groups. Findings of other studies are consistent with those of the present study.[4,19]

In the present study, the analysis of the mean pain and comfort scores obtained by the participants by gender demonstrated that the pain level was higher in the female participants than was that in the male participants immediately after and 15 minutes after the intervention. Similarly, the comfort level immediately after the intervention was lower in the female participants. Demir and Khorshid's study found that women are more sensitive to painful interventions. In the literature, it is stated that generally, women have a lower pain threshold and less tolerance to pain than men have, thus they experience pain more intensely after a surgical intervention.[4,28]

CONCLUSION

In this study, different methods for reducing pain in chest tube removal were compared. In the present study, cold application and local anesthesia reduced pain and comfort level in the chest tube removal process significantly more than did the other methods. According to measurements performed in the chest tube removal process, there was a statistically significant relationship between pain and comfort levels ($p<0.05$) and it was concluded that the comfort level increased as the pain level decreased. In this context, it is aimed to increase the awareness of health professionals for the effectiveness of different methods.

STUDY LIMITATIONS AND RECOMMENDATIONS

The results of this study are limited to the sample of patients included in this study. The fact that patient diagnoses are not distributed fully homogenously to the groups because may affect the initial pain level and therefore the pain level in other measurements, so it is among the limitations of the study. More studies are needed using objective pain measurement methods to find the most effective method to reduce the pain experienced during process of chest tube removal. These results can help nurses. It can be used as a reference in nursing practices to reduce pain in chest tube removal.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Nurdan Özcan;* ***Design:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Control/Supervision:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Data Collection and/or Processing:*** *Nurdan Özcan;* ***Analysis and/or Interpretation:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Literature Review:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Writing the Article:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Critical Review:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***References and Fundings:*** *Nurdan Özcan, Şerife Karagözoğlu;* ***Materials:*** *Nurdan Özcan.*

REFERENCES

1. Porcel JM. Chest tube drainage of the pleural space: a concise review for pulmonologists. Tuberc Respir Dis (Seoul). 2018;81(2):106-15. [Crossref] [PubMed] [PMC]
2. Ring LM, Watson A. Thoracostomy tube removal: Implementation of a Multidisciplinary Procedural Pain Management Guideline. J Pediatr Health Care. 2017;31(6):671-83 [Crossref] [PubMed]
3. Ertuğ N, Ulker S. The effect of cold application on pain due to chest tube removal. J Clin Nurs. 2012;21(5-6):784-90. [Crossref] [PubMed]
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 Manag Nurs. 2010;11(3):186-96. [Crossref] [PubMed]
5. Friesner SA, Curry DM, Moddeman GR. Comparison of two pain-management strategies during chest tube removal; relaxation exercises with opioids and opioids alone. Heart Lung. 2006;35(4):269-76. [Crossref] [PubMed]
6. Mohammadi N, Pooria A, Yarahmadi S, Tarrahi MJ, Najafizadeh H, Abbasi P, et al. Effects of cold application on chest tube removal pain in heart surgery patients. Tanaffos. 2018;17(1):29-36. [PubMed]
7. Aktaş YY, Karabulut N. The use of cold therapy, music therapy and lidocaine spray for reducing pain and anxiety following chest tube removal. Complement Ther Clin Pract. 2019;34:179-84. [Crossref] [PubMed]
8. Joshi VS, Chauhan S, Kiran U, Bisoi AK, Kapoor PM. Comparison of analgesic efficacy of fentanyl and sufentanil for chest tube removal after cardiac surgery. Ann Card Anaesth. 2007;10(1):42-5. [Crossref] [PubMed]
9. Singh M, Gopinath R. Topical analgesia for chest tube removal in cardiac patients. J Cardiothorac Vasc Anesth. 2005;19(6):719-22. [Crossref] [PubMed]
10. Glowacki D. Effective pain management and improvements in patients' outcomes and satisfaction. Crit Care Nurse. 2015;35(3):33-43; quiz 43. [Crossref] [PubMed]
11. Özveren H. [Non-pharmacological methods at pain management]. Hacettepe University Faculty of Health Sciences Nursing Journal. 2011;18(1):83-92.
12. Demir Dikmen Y, Yıldırım Usta Y, İnce Y, Türken Gel K, Akı Kaya M. [Determining of nurses' knowledge, behavior and clinical decision making regarding pain management]. Journal of Contemporary Medicine. 2012;2(3):162-72.
13. Karabacak Ü, Acaroğlu R. Konfor kuramı. Maltepe Üniversitesi Hemşirelik Bilim ve Sanatı Dergisi. 2011;4(1):198-201.
14. Hsieh LY, Chen YR, Lu MC. Efficacy of cold application on pain during chest tube removal: a randomized controlled trial: a CONSORT-compliant article. Medicine (Baltimore). 2017;96(46):e8642. [Crossref] [PubMed] [PMC]
15. Mwanza E, Gwisai RD, Munemo C. Knowledge on nonpharmacological methods of pain management among nurses at Bindura Hospital, Zimbabwe. Pain Res Treat. 2019;2019:2703579. [Crossref] [PubMed] [PMC]
16. Houstons S, Jesurum J. The quick relaxation techhnique: effect of pain associated with chest tube removal. Appl Nurs Res. 1999;12(4):196-205. [Crossref] [PubMed]
17. Mimnaugh L, Winegar M, Mabrey Y, Davis JE. Sensations experienced during removal of tubes in acute postoperative patients. Appl Nurs Res. 1999;12(2):78-85. [Crossref] [PubMed]
18. Puntillo K, Ley SJ. Appropriately timed analgesics control pain due to chest tube removal. Am J Crit Care. 2004;13(4):292-301. [Crossref] [PubMed]
19. Akrofi M, Miller S, Colfar S, Corry PR, Fabri BM, Pullan MD, et al. A randomised comparison of three methods of anagesia for chest drain removal in postcardiac surgical patient. Anesth Analg. 2005;100(1):205-9. [Crossref] [PubMed]
20. Valenzuela RC, Rosen DA. Topical lidocaine-prilocaine cream (EMLA) for thoracostomy tube removal. Anesth Analg. 1999;88(5):1107-8. [Crossref] [PubMed]
21. Al-Otaibi RA, Mokabel FM, AL-Ghuneimy Y. The effect of cold application on pain and anxiety during chest tube removal. J Am Sci. 2013;9(7):13-23.
22. Payami MB, Daryei N, Mousavinasab N, Nourizade E. Effect of cold application in combination with Indomethacin suppository on chest tube removal pain in patients undergoing open heart surgery. Iran J Nurs Midwifery Res. 2014;19(1):77-81. [PubMed]
23. Topcu SY, Findik UY. Effect of relaxation exercises on controlling postoperative pain. Pain Manag Nurs. 2012;13(1):11-7. [Crossref] [PubMed]
24. Erek Kazan E. [Cold applications and nursing care]. Hacettepe University Faculty of Health Sciences Nursing Journal. 2011;18(1):73-82.
25. Ommaty R. Vademecum+ATC Index. 33. Baskı. İstanbul: Medical Tribune Yayıncılık Ltd. Şti.; 2011. p.1165.
26. Gorji HM, Nesami BM, Ayyasi M, Ghafari R, Yazdani J. Comparison of ice packs application and relaxation therapy in pain reduction during chest tube removal following cardiac surgery. N Am J Med Sci. 2014;6(1):19-24. [Crossref] [PubMed] [PMC]
27. 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. Complement Ther Clin Pract. 2018;31:71-5. [Crossref] [PubMed]
28. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley 3rd JL. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain. 2009;10(5): 447-85. [Crossref] [PubMed] [PMC]