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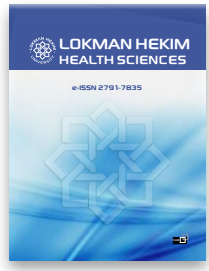

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ORIGINAL ARTICLE

Effects of Breathing Exercises Applied to Coronary Angiography Patients on Anxiety, Pain, and Vital Signs: A Randomized Controlled Trial

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Abstract

Introduction: Coronary angiography patients may experience pain and anxiety due to the invasiveness of the procedure and its involvement with a vital organ such as the heart. This study was conducted to determine the effects of breathing exercises on pain, anxiety, and vital signs in patients who underwent coronary angiography.

Methods: The study was conducted as a single-blind randomized controlled trial between September and November 2024. Patients in the intervention group performed breathing exercises in accordance with the application protocol 30 min before the coronary angiography. Patients in the control group were only given standard treatment and care. Data on anxiety and vital signs were assessed before and after the intervention, and pain levels data were collected after the intervention.

Results: The study was finished with 87 patients (43 in the control group and 44 in the intervention group). After the breathing exercise intervention, the post-test results showed that the pain levels, blood pressure, and anxiety levels of patients in the intervention group were lower than those in the control group ($p<0.05$). The results of the mixed-design analysis of variance test for repeated measures showed that the mean scores for blood pressure, pulse rate, and anxiety levels were significantly affected by the group-time interaction ($p<0.001$).

Discussion and Conclusion: The results of this research show that the breathing exercises applied reduce pain and anxiety in patients and have a positive effect on vital signs. The importance of the routine application of breathing exercises in angiography clinics is also demonstrated.

Keywords: Anxiety; Breathing exercises; Coronary angiography; Nursing; Pain; Vital signs

Coronary artery diseases cause mortality and morbidity among cardiovascular diseases worldwide.[1] Interventions made with advancing technology support diagnosis and assist in treatment planning.[2] Coronary angiography is a frequently preferred and applied intervention for diagnosing and managing diseases among invasive methods.[3] Patients may experience stress before and during the procedure due to the invasiveness of the procedure, possible complication risks, and its relation to a vital organ. The anxiety and stress experienced by patients may affect their vital signs and pain levels.[4,5]

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Patients feel pain due to the invasiveness of the procedure, pressure dressing, and having to lie still for a certain period.[6] The body gives a neurohormonal response to stressful stimuli such as anxiety and pain. This response activates sympathetic systems, increasing heart rate, rate of breathing, and blood pressure.[1,7] Consequently, the need for the heart's pumping power increases, which increases the demand for myocardial oxygen. This poses a risk, especially for cardiovascular patients.[8] Furthermore, it is known that anxiety leads to a higher perception of pain intensity and reduces the pain threshold by affecting pain perception.[7]

Nurses have important roles in managing patients' pain and anxiety. This role is important, especially when considering nurses' intense interactions with patients undergoing interventional procedures.[5] Therefore, nurses must develop comprehensive nursing practices intended to reduce and prevent patients' pain and anxiety.[4] In addition to pharmacological interventions, non-pharmacological methods are frequently preferred during and after interventional procedures. Such methods are indicated to affect patients' complaints of pain and anxiety after invasive procedures.[9]

Breathing exercises represent a relaxation technique with strong positive effects on physical and mental health. Their application before interventional procedures affects the management of patients' physiological symptoms.[10,11] Deep, controlled breathing activates the autonomic nervous system's parasympathetic branch, putting the body into "rest and digest" mode, which lowers stress hormone (e.g., cortisol) levels. When anxiety starts, the average time it takes for the body to relax and focus is 20 min. Therefore, doing breathing exercises 10–15 min before high-stress interventions may be useful in preventing the potential physiological effects of anxiety.[12] Breathing exercises may help balance heart rate and blood pressure, increase tissue oxygenation, and regulate pulmonary artery and aortic pressure.[12,13]

Three-part breathing (full yogic breathing, Dirgha) and square breathing are remarkable breathing exercises. The three-part breathing exercise induces deep breathing and follows the steps of deep breathing to the abdomen, chest, and collarbone, respectively.[14,15] The three-part breathing exercise enables deep and slow breathing that involves different parts of the body compared to standard diaphragmatic breathing and pursed-lip breathing. This helps patients increase their breathing awareness and concentration.[14] Square breathing consists of a cycle of breathing through the nose for 4 s, holding the breath for 4 s, exhaling for 4 seconds, and holding the breath again for 4 s. These simple, cheap, and easily applicable breathing techniques are effective in an individual's relaxation by reducing anxiety and pain.[16]

Despite the positive effects of breathing exercises applied to angiography patients on pain and anxiety levels reported in the literature, these studies are limited. Pain and anxiety are common symptoms experienced during coronary angiography. In light of these findings, the present study was conducted to ascertain the impact of breathing exercises on pain intensity, anxiety levels, and vital signs in patients who underwent coronary angiography.

Materials and Methods

Research Design and Sample Selection

This study was a randomized, controlled, parallel-group, single-blind experimental trial. It was conducted at a cardiology clinic in a state hospital located in the Mediterranean region of Türkiye from September to November 2024.

The Study Hypotheses were Followed

- $H1_1$: There is a significant difference in anxiety levels between patients who underwent breathing exercises and patients in the control group
- $H1_2$: There is a significant difference in pain levels between patients who underwent breathing exercises and patients in the control group
- $H1_3$: There is a significant difference in systolic blood pressure levels between patients who underwent breathing exercises and patients in the control group
- $H1_4$: There is a significant difference in diastolic blood pressure levels between patients who underwent breathing exercises and patients in the control group
- $H1_5$: There is a significant difference in heart rate between patients who underwent breathing exercises and patients in the control group
- $H1_6$: There is a significant difference in saturation values between patients who underwent breathing exercises and patients in the control group.

The study sample consisted of patients who met the inclusion criteria, volunteered to participate, and would undergo coronary angiography. The sample size was computed using the G*Power 3.1.9.7 program. A study evaluating the effects of breathing exercises in coronary

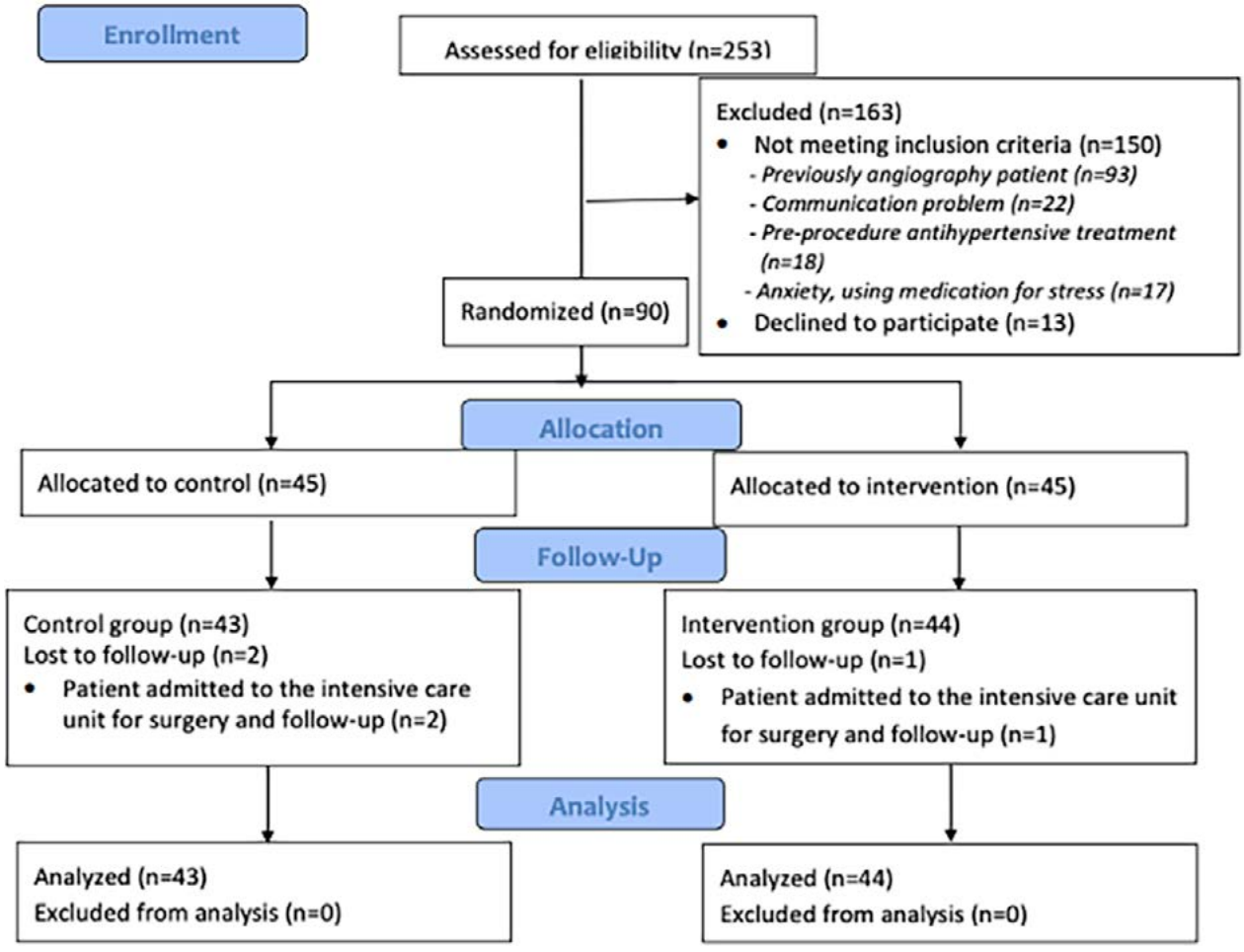

Figure 1. Consolidated Standards of Reporting Trials flow diagram of the study.

angiography patients was found in the literature. Therefore, this study was used as a reference in the sample calculation. The smallest effect size value was used according to the referenced study.[10] Accordingly, the sample size in each group was 41, with an effect size of 0.96, power of 99%, error of 5%, and confidence interval of 95% (Means: Difference between two independent means, two-tailed). Considering data losses and ensuring the application of parametric tests, it was concluded that the sample size would be 45 individuals for the intervention group and 45 individuals for the control group. The study was conducted with a total of 87 patients (Fig. 1).

Randomization and Blinding

The study used a simple randomization method to ensure a random and equal allocation of patients to both groups. The researchers performed randomization using a website (https://www.randomizer.org/). As a result of randomization, two groups of number lists, ranging from 1 to 90, were determined. The numbers drawn by an independent person formed the intervention group. Based on the inclusion criteria, patients were assigned to either group according to the order in which they applied to the clinic. The researcher collected the pre-test data for the study. A nurse who worked the day shift in the clinic and was independent of the study collected post-test data. The nurse was not informed of which patients were included in which group. Thus, blinding was performed when collecting the post-test data. The Consolidated Standards of Reporting Trials 2010 checklist was followed in reporting the study.[17]

Inclusion and Exclusion Criteria

Patients over the age of 18 years who underwent coronary angiography for the 1st time, had no respiratory distress, no communication problems, and were willing to participate in the study were included. Patients who were using any medication that suppressed anxiety symptoms and pain, underwent emergency coronary angiography, and/or complained of chest pain, were treated with

anti-hypertensive therapy before the procedure due to hypertension, or were diagnosed with a psychiatric illness by a specialist physician, were not included in the study. Patients who underwent emergency intervention during coronary angiography and were transferred to the intensive care unit for surgical procedures and follow-up were excluded from the study (Fig. 1).

Data Collection Forms

Patient Descriptive Form

This form was prepared by researchers based on studies in the literature.[4,5] It included 17 questions to determine the participants' sociodemographic and disease-related characteristics.

Vital Signs Record Form

The researchers prepared the form to record patients' blood pressure, saturation, and pulse values.

Visual Analog Scale (VAS)

This scale represents a 10 cm ruler that can be used to determine the minimum and maximum levels of pain. "0" indicates no pain, and "10" refers to unbearable pain. Research indicates that this tool is valid and reliable for assessing acute pain.[18]

State-Trait Anxiety Inventory (STAI)

The inventory developed by Spielberger et al.[19] consists of two subscales: STAI-Trait (STAI-T) and STAI-State (STAI-S). Each subscale consists of 20 items on a four-point Likert scale. STAI-S determines how an individual feels at a specific moment under specific conditions. STAI-T, on the other hand, expresses how an individual generally feels, regardless of their current situation.[19] The scale was adapted into Turkish by Öner and Le Compte, and its validity and reliability were assessed.[20] In this study, the STAI-S was used. The scores obtained from each scale range from 20 to 80. The 10 items in the STAI-S are reverse-scored. A high score indicates a high level of anxiety.[19,20] The reliability of the scale in Turkish was assessed using the test-retest method. The correlation coefficient for the STAI-S was found to be between 0.26 and 0.68. In the Turkish validity and reliability study, the internal consistency coefficient for the STAI-S was found to be between 0.83 and 0.87.[20] This study calculated Cronbach's alpha coefficient as 0.79 in the pre-test and 0.96 in the post-test. Accordingly, in this study, Cronbach's alpha value was found to be acceptable in the pre-test and excellent in the post-test.

Breathing Exercises Applied

The first researcher had an internationally recognized and university-approved breathing technique application certificate. In this study, three-part and square-breathing techniques were applied to patients. Expert opinions were received from a breathing techniques trainer, a faculty member with a breathing technique application certificate, and a cardiologist on the applicability of the breathing exercise protocol. The breathing technique application protocol was finalized based on expert opinions. The application steps of the breathing techniques are presented in the breathing technique application protocol (Supplemental file).

A pilot study was conducted with three patients who met the inclusion criteria before the study's initiation to evaluate the applicability of the breathing exercise protocol and data collection forms. Patients who underwent a pilot study were not included. There have been no changes to the data collection form or application protocol.

Application and Data Collection

Patients in the intervention group were informed of the study's purpose, and their consent to participate was obtained both verbally and in writing. Vital signs were recorded on the form created by the researcher by measuring blood pressure, saturation values, and pulse. Measurements were performed with the calibrated devices used in the hospital. Pre-test data were collected from patients face-to-face using the patient descriptive form and STAI-S measurement tool by the data collection forms. It took approximately 10 min to collect the pre-test data. The application was performed in a separate room in the clinic so that the patient could concentrate and not be affected by other patients. Patients were asked to sit halfway up and lie down in a comfortable position during the procedure. Before the application, the researchers showed the breathing exercise techniques to the patients using a demonstration method to ensure the correct application of the breathing exercises. Half an hour before the coronary angiography, breathing exercises were performed with patients following the breathing exercise protocol. The application took 15–20 min in line with the protocol. Post-test data (VAS, STAI-S, and vital signs) were collected within 15 min after the patient was taken to bed after the coronary angiography procedure. The data from the post-test were collected by a nurse working the day shift in the clinic and independent of the study. The nurse was not informed about which patients were included in which group, so blinding was ensured when collecting post-test data.

Patients in the control group were informed of the study's purpose, and their consent to participate was obtained both verbally and in writing. Thirty minutes before the coronary angiography, vital signs, blood pressure saturation values, and pulse were measured and recorded on the form prepared by the researcher. The pre-test data were collected in person from the patients using the patient descriptive form and STAI-S in line with the data collection forms. The patients in the control group continued to receive routine hospital care and treatment. The researchers performed no intervention. After the procedure, the post-test data (vital signs, VAS, and STAI-S) were collected face-to-face by a nurse independent of the study within 15 min after the patient was taken to bed. Breathing exercises were administered to patients in the control group after the study if there were no contraindications.

Statistical Analysis

The IBM Statistical Package for the Social Sciences (SPSS) 25 software package (The SPSS, IBM Corp., Armonk, NY, USA) was utilized for data analysis. Individuals' descriptive characteristics were presented as numbers, percentages, means, and standard deviations. The exact method of Fisher's Chi-square test was used in 2×2 and rxc tables to compare the study groups with categorical variables.[21] The normality of the data was assessed using the Shapiro–Wilk test, histograms, Q-Q plots, and skewness and kurtosis values. The data were observed to follow a normal distribution. An independent samples t-test was used for between-group comparisons at each time point, and a paired samples t-test was used for within-group pre-posttest comparisons. Effect sizes were computed as Cohen's d with 95% confidence intervals. According to the value of Cohen's d, a value of 0.2 was considered a small effect, 0.5 a medium effect, and 0.8 or higher a strong effect.[22] Repeated measurements were evaluated using a mixed-design analysis of variance (ANOVA) test to determine changes according to time and groups. Partial eta squared (η^2) was employed as the effect size in the evaluation of the mixed-design ANOVA (small effect: 0.01, medium effect: 0.06, and large effect: 0.14).[22] In statistical analyses, the level of significance was considered as $p<0.05$.

Ethical Considerations of the Study

Approval was obtained from the Non-Invasive Research Ethics Committee of Kahramanmaraş İstiklal University before the study (Decision No. 2024/10-02, dated June 28, 2024). Approval was obtained in writing from the institution where the study took place. Scale usage permissions were obtained. The patients were informed about the study's protocol, and written and verbal consent was obtained from the volunteers who were willing to participate. This study was conducted in accordance with the principles of the Helsinki Declaration and the rules of publication ethics. No adverse events occurred in any patient concerning this research.

Results

The study was completed with a total of 87 patients (study group 44 and control group 43). The mean age of patients in the control group was 61.21±7.83 years, and the mean age of patients in the intervention group was 60.39±7.43 years. There were no significant differences in the descriptive characteristics of the patients between the groups (Table 1).

In the initial measurements before intervention, there were no differences between the groups in terms of vital signs or STAI-S mean scores $p>0.05$ (Table 2). The patients did not experience pain because they had not undergone coronary angiography before the intervention. Thus, patients' pain was not assessed in the pre-test.

In the post-test, the mean systolic blood pressure and diastolic blood pressure of the patients in the control group were found to be significantly higher than in the pre-test, while their mean STAI-S scores were lower ($p<0.05$). The pulse rate and saturation values of patients in the control group were found to be similar in the initial and final tests $p>0.05$ (Table 2).

The mean post-test pulse rate and STAI-S score of patients in the intervention group were found to be lower than those in the pre-test ($p<0.05$). In the intragroup comparison, no significant difference was observed between the baseline saturation values, systolic and diastolic blood pressure values, and values after intervention in the intervention group ($p>0.05$). When comparing the post-test scores between groups, it was observed that the heart rate, systolic blood pressure, diastolic blood pressure, STAI-S, and VAS mean scores of patients in the breathing exercise group were lower than those in the control group that did not undergo breathing exercises ($p<0.05$). It was also determined that this significant difference had a medium effect size for blood pressure values. There was a large effect size for pulse rate, STAI-S, and VAS scores. Saturation values were similar in both groups post-test $p=0.129$ (Table 2).

According to the mixed-design ANOVA results obtained from repeated tests, the effects of systolic and diastolic blood pressure, STAI-S, and pulse rate are significant in terms of group and time interaction mean scores ($p<0.001$, Table 3). The intervention group showed higher reductions in systolic

Table 1. Comparison of descriptive characteristics of patients (n=87)

Variables	**Control group (n=43) Mean±SD**	**Intervention group (n=44) Mean±SD**	**t**	**p**
Age (min-max)	61.21±7.83 (40–73)	60.39±7.43 (46-72)	0.503	0.616
BMI (min-max)	30.36±4.41 (21.50–42.74)	29.90±4.41 (22.19–42.81)	0.445	0.657
Variables	**n (%)**	**n (%)**	**p†**	
Gender			0.825	
Female	15 (34.9)	17 (38.6)		
Male	28 (65.1)	27 (61.4)		
Marital status			0.484	
Married	38 (88.4)	41 (93.2)		
Single	5 (11.6)	3 (6.8)		
Education			0.853	
Non-literate	6 (14.0)	9 (20.5)		
Literate	5 (11.6)	5 (11.4)		
Primary education	27 (62.8)	24 (54.5)		
High school and above	5 (11.6)	6 (13.6)		
Family type			0.542	
Nuclear family	36 (83.7)	39 (88.6)		
Extended family	6 (14.0)	3 (6.8)		
Living alone	1 (2.3)	2 (4.5)		
Occupation			0.630	
Not working/homemaker	5 (11.6)	7 (15.9)		
Working	13 (30.2)	16 (36.4)		
Retired	25 (58.1)	21 (47.7)		
Socio-economic status			0.772	
Income less than expenditure	36 (83.7)	38 (86.4)		
Income equal to expenditure	7 (16.3)	6 (13.6)		
Has health insurance			1.000	
Yes	38 (88.4)	38 (86.4)		
No	5 (11.6)	6 (13.6)		
Smoking status			0.828	
Current smoker	10 (23.3)	13 (29.5)		
Quitted smoking	16 (37.2)	15 (34.1)		
Never smoked	17 (39.5)	16 (36.4)		
Alcohol use			0.594	
Drinking alcohol	2 (4.7)	0 (0)		
Quitting	2 (4.7)	3 (6.8)		
Never alcohol	39 (90.7)	41 (93.2)		
Previous surgery status			0.663	
Yes	18 (41.9)	16 (26.4)		
No	25 (58.1)	28 (63.6)		
Knowledge about coronary angiography			0.493	
Yes	12 (27.9)	16 (36.4)		
No	31 (72.1)	28 (63.6)		
Chronic disease			0.314	
Yes	37 (86.0)	41 (93.2)		
No	6 (14.0)	3 (6.8)		
Artery used in the procedure			0.783	
Radial artery	7 (16.3)	9 (20.5)		
Femoral artery	36 (83.7)	35 (79.5)		
Procedure status in chronic angiography (drug-eluting stent, PTCA balloon)			0.811	
Yes	11 (25.6)	13 (29.5)		
No	32 (74.4)	31 (70.5)		

†: Ki kare Fisher's exact test or Fisher-Freeman-Halton exact test, t: Independent sample t test. SD: Standard deviation.

Table 2. Comparison of vital signs, STAI-S, and VAS scores intragroup and intergroup (n=87)

	Control (n=43)		Intervention (n=44)		Intergroup		Effect size
	Mean±SD	p[a]	Mean±SD	p[a]	t	p[b]	Cohen's d (95% CI)
Systolic blood pressure							
Pre-test	119.77±12.44	**<0.001**	121.59±12.00	0.075	-0.696	0.488	-0.15 (-0.57 to 0.27)
Post-test	125.58±13.15		118.18±8.96		3.073	**0.003**	0.66 (0.23 to 1.09)
Mean difference (pre-post test)	-5.81±9.32		3.41±12.38		-3.920	**<0.001**	-0.84 (-1.28 to -0.40)
Diastolic Blood Pressure							
Pre-test	71.63±7.21	**<0.001**	72.73±7.88	0.198	-0.678	0.500	-0.14 (-0.57 to 0.28)
Post-test	76.60±8.19		70.91±6.76		3.540	**<0.001**	0.76 (0.32 to 1.19)
Mean difference (pre-post test)	-4.98±8.06		1.81±9.21		-3.656	**<0.001**	-0.78 (-1.21 to -0.34)
Pulse rate							
Pre-test	77.86±8.85	0.090	81.55±10.68	**<0.001**	-1.750	0.084	-0.37 (-0.80 to 0.05)
Post-test	79.86±8.15		73.52±6.73		3.957	**<0.001**	0.85 (0.41 to 1.29)
Mean difference (pre-post test)	-2.00±7.55		8.02±9.98		-5.275	**<0.001**	-1.13 (-1.59 to -0.67)
Saturation							
Pre-test	95.44±2.20	0.165	94.98±1.99	0.684	1.033	0.304	0.22 (-0.20 to 0.64)
Post-test	95.00±1.90		94.84±1.76		0.405	0.687	0.09 (-0.33 to 0.50)
Mean difference (pre-post test)	0.44±2.05		0.14±2.21		0.669	0.505	0.14 (-0.27 to 0.56)
STAI-S							
Pre-test	60.98±3.94	**<0.001**	62.55±5.46	**<0.001**	-1.533	0.129	-0.33 (-0.75 to 0.09)
Post-test	55.19±6.90		34.68±5.13		15.752	**<0.001**	3.38 (2.72 to 4.03)
Mean difference (pre-post test)	5.79±7.24		27.86±7.56		-13.905	**<0.001**	-2.98 (-3.60–-2.37)
VAS							
Post-test	2.77±2.01	–	0.66±0.99	–	6.232	**<0.001**	1.34 (0.87–1.80)

p<0.05 are in bold. a: Paired samples t-test; Comparison within groups; b: Independent Sample t-test, Comparison between groups. SD: Standard deviation; STAI-S: The State-trait anxiety inventory-state; VAS: Visual analogue scale

blood pressure (F(1,85)=15.363, p<0.001), diastolic blood pressure (F(1,85)=13.366, p<0.001), STAI-S (F(1,85)=193.37, p<0.001), and pulse rate (F(1,85)=27.827, p<0.001), over time compared to the control group. It was also determined that this significant difference had a medium effect size for diastolic blood pressure values. There was a large effect size for systolic blood pressure, pulse rate, and STAI-S (Table 3).

Discussion

This study is a randomized controlled trial examining the effects of breathing exercises administered to angiography patients before the procedure on stress, pain, and vital signs. The present study has demonstrated that breathing exercises performed before angiography have a significant effect in reducing anxiety levels, blood pressure, pulse rate, and pain levels in individuals after angiography.

Breathing exercises are frequently preferred practice in stress management. Effective and systematic breathing leads to a higher parasympathetic response to high sympathetic activity that causes stress and anxiety. This leads to a positive effect on the autonomic nervous system and the brain, reducing individuals' anxiety levels.[23,24] According to the findings of the study, the anxiety levels of participants in both groups were high before the intervention, and this was thought to be related to factors such as the invasive procedure process, complications, and fear of surgical intervention. Both groups showed a decrease in anxiety levels after the intervention. However, the anxiety levels of patients who performed breathing exercises were significantly lower than those who did not. It was determined that this statistically significant difference had a very high effect size. Although studies on breathing exercises have been conducted in the literature, the number of studies on patients with angiography is limited. Similar studies have also shown that breathing exercises reduce anxiety in patients and have a high effect size.[4,10] It is possible to say that the completion of the angiography procedure reduces anxiety in patients. It is thought that the elimination of stress

Table 3. Comparison of the change in vital signs and STAI-S mean scores of intervention and control groups over time (n=87)

Variables	F	p	Partial η^2
Systolic blood pressure			
Group	F(1,85)=1.572	0.213	0.018
Time	F(1,85)=1.044	0.310	0.012
Group*Time	F(1,85)=15.363	**<0.001**	0.153
Diastolic blood pressure			
Group	F(1,85)=3.027	0.086	0.034
Time	F(1,85)=2.888	0.093	0.033
Group*Time	F(1,85)=13.366	**<0.001**	0.136
Pulse rate			
Group	F(1,85)=0.677	0.413	0.008
Time	F(1,85)=10.048	**0.002**	0.106
Group*Time	F(1,85)=27.827	**<0.001**	0.247
Saturation			
Group	F(1,85)=0.771	0.383	0.009
Time	F(1,85)=1.602	0.209	0.018
Group*Time	F(1,85)=0.447	0.505	0.005
STAI-S			
Group	F(1,85)=121.00	**<0.001**	0.587
Time	F(1,85)=499.44	**<0.001**	0.841
Group*Time	F(1,85)=193.37	**<0.001**	0.695

p<0.05 are in bold. F: Mixed-ANOVA test; η^2: Eta squared; ANOVA: Analysis of variance; STAI-S: State-trait anxiety inventory-state.

factors in patients on completion of the procedure makes the results of our breathing exercise program more effective and is associated with our high effect size results.

Patients may experience pain after angiography due to the procedure, vascular sensitivity, and staying in a fixed position for a long time. The pain felt after coronary angiography is related not only to the procedure but also to stress. The anxiety level of patients before the intervention may trigger and increase the perception of pain.[25] In this regard, breathing exercises may reduce anxiety and indirectly affect the perception of pain. Some studies have reported that breathing exercises reduce pain.[26,27] However, it can be said that breathing exercises are effective non-pharmacological methods in relieving pain after minimally invasive procedures, such as angiography. The current study has demonstrated that breathing exercises performed before angiography have a significant effect on reducing post-procedure pain. These results indicate that breathing exercises are one of the non-pharmacological methods that nurses can use in the clinical setting to reduce pain.

Pain and stress cause an increase in heart rate, blood pressure, and oxygen saturation levels through activation of the sympathetic system and release of stress hormones.[25] It is believed that breathing exercises, which are considered the first step of relaxation, indirectly stimulate the release of endorphins. Thus, relief may occur in the patient's pain level. Reduced pain and anxiety indirectly impact vital signs.[10] The literature indicates a strong relationship between pain, anxiety, and vital signs.[28] The results of a study conducted with breathing exercises indicated that the exercises reduced the person's stress level and, accordingly, provided balance in the pulse rate.[29] In the study by Naik et al.,[30] a group of participants performed breathing exercises for 30 min a day, 5 times a week. At the end of 12 weeks, it was stated that the perceived stress, blood pressure, and pulse rate of the intervention group decreased. In this study, it was observed that the heart rate and blood pressure values of the group that performed breathing exercises were at a better level. Despite this, no significant difference was observed in oxygen saturation levels between the groups. In this respect, it can be stated that breathing exercises can effectively reduce physiological changes, but they alone may not provide a sufficient solution.

According to the results of the study, breathing exercises administered to patients before coronary angiography have positive effects on anxiety, pain, and vital signs.

Limitations

The fact that the study was conducted at only one center reduces the applicability of the results to other regions. Pain and anxiety were assessed with subjective information obtained from patients. Factors such as the patient's environment, cultural structure, and individual factors may be confounding factors in these results. In addition, the inability to blind the patients participating in the study, with only the nurse collecting data in the final test being blinded, is among the limitations of the study.

Conclusion

Patients scheduled for coronary angiography often experience significant pre-procedure anxiety. Patients also experience pain after the procedure because it is invasive. The present study found that breathing exercises effectively reduced physiological symptoms of pain and anxiety in patients after angiography. Considering these results, we conclude that it is of great importance to apply breathing exercises in angiography clinics. We recommend that these exercises, which are easy to apply and cost-free for nurses, be included as a part of nursing care. Further research on this topic is recommended in the future, using different sample groups and clinics, to evaluate its effectiveness.

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Informed Consent: Written informed consent was obtained.

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