Original Article

The Effect of Progressive Breathing Relaxation Training on Preoperative Anxiety and Surgical Stress Response

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Abstract

Bacground: Preoperative anxiety is a common psychological problem that affects many patients undergoing surgery and initiates a surgical stress response. As a result of the response to surgical stress, cortisol reaches its maximum level and vital signs change due to hormonal and neural effects.
Objective: To determine the effect of progressive respiratory relaxation training on surgical stress response, anxiety and vital signs.
Methods: In this study, experimental with a control group research model was used. Participants (N=78) were randomly assigned. The experimental group received progressive breathing relaxation training before surgery. The control group received only the usual preparation. The state anxiety scale (SAI) was used to determine the anxiety level. Surgical stress response was determined by measuring vital signs, blood glucose, and cortisol levels. **Results:** The difference between the vital signs of the two groups was not significant ($p > 0.05$), state anxiety score of the experimental group decreased in the postoperative first day and blood glucose and plasma cortisol levels were low on the 4th postoperative day. The difference between the plasma cortisol levels of the groups on the 4th postoperative day was significant ($p < 0.05$).
Conclusion: The findings of this study provide evidence to support the use of breathing relaxation technique due to a positive effect in reducing the surgical stress response and anxiety.

Key Words: Progressive relaxation, surgical stress response, coronary artery bypass graft surgery, nursing

Introduction

As a stressor, surgical is a known body stress and it is disrupt homeostasis; it causes relatively specific psychophysiological stress responses. Following surgical, trauma or anxiety the nervous system activates the stress response by sending impulses from the injured site to the hypothalamus. The hypothalamus releases hormones which stimulate the production and/or release of pituitary hormones. Pituitary hormones act on their respective target organ causing the release of corticosteroids such as cortisol by the adrenal glands (the hypothalamic–pituitary–adrenal (HPA) axis) (van Bodegom, Homberg, & Henckens, 2017; Herman et al., 2016). HPA axis provides the metabolic support for the stress response by mobilizing stored energy, suppressing the immune response, and potentiating numerous sympathetically mediated effects (Ulrich-Lai & Herman, 2009). Plasma cortisol levels reflect changes in the activation of the HPA axis. Elevations of cortisol, glucagon, catecholamines, and a host of inflammatory cytokines, also exacerbate the stress response to surgery. The neuroendocrine stress response is essential for adequate responding to, coping with, and subsequent recovery from environmental threats that disrupt homeostasis (Sandi & Haller, 2015). However, cortisol is a catabolic glucocorticoid hormone that mobilizes energy stores to prepare the body for the fight or flight response to stressors. It promotes gluconeogenesis in the liver, leading to raised blood glucose levels. Moreover, in the presence of raised cortisol levels in a severe stress response, the rate of protein breakdown exceeds that of protein synthesis, resulting in the net catabolism of muscle proteins to provide substrates for gluconeogenesis (Finnerty, Mabvuure, Ali, Kozar, & Herndon, 2013). The scientific literature on hyperglycemia caused in this way, reduces the rate of wound healing and is associated with an increase in infections and other comorbidities including ischemia, sepsis, and increase mortality (Du, Wang, &Yan, 2018, Finnerty et al., 2013; Nilsson, 2009).

Background

Surgical stress response severity associated with the size of major surgery such as coronary artery bypass graft (CABG) (Nilsson 2009; Dimopoulou et al., 2008) and cortisol, reaches the maximum level (Widmer et al., 2005). It is also known, a related concept is a preoperative anxiety (Dehdari, Heidarnia, Ramezankhani, Sadeghian & Ghofranipour, 2009) and vital signs also change due to these hormonal and nervous effects. Preoperative anxiety is a common psychological issue affecting many patients who are faced with the prospect of undergoing surgery. Thus, health care personnel are responsible for establishing a healing environment for the patient, an environment that reduces anxiety and stress response as a result thereof. Relaxation therapy is a well established psychological therapy for alleviating psychological distress in patients. Therefore breathing relaxation exercises can decrease the stress response. Because breathing relaxation exercises is a special discipline in which muscles, reflexes, and mind are trained, which reduces the activity of the sympathetic nervous system and thereby decrease the stress response. A growing number of empirical studies have revealed that diaphragmatic breathing may trigger body relaxation responses and benefit both physical and mental health (Ma et al., 2017). Studies have revealed breathing practice to be an effective non-pharmacological intervention for emotion enhancement, (Stromberg, Russell, & Carlson, 2015), including a reduction in anxiety (Anju, Anita, Raka, Deepak, & Vedamurthachar, 2015). Also, the recent studies orientated toward the physiological mechanism of breathing intervention effects have indicated a shared physiological basis underlying breathing, emotion, and cognition, involving the autonomic nervous system. A wide variety of rhythmic breathing techniques have been proposed to induce relaxation such as slow breathing, deep breathing, breathing meditation and abdominal breathing. Researchers have found that even a single breathing practice significantly reduces blood pressure, increases heart rate variability (Lehrer & Gevirtz, 2014; Wei et al., 2016). The somatic response to a relaxation technique refers to the effect on physiological parameters including respiration and heart rates.

There are studies in which the method of reducing the anxiety of the patients to be operated is generally preoperative teaching (Kalogianni et al., 2016), music (Ozer, Karaman Ozlu, Arslan, & Gunes, 2013; Nilsson 2009), preoperative nursing visit (Du et al., 2018) and social support (Yılmaz, Sezer, Gurler, & Bekar, 2011). However, there have been no studies using progressive respiratory relaxation training to reduce the anxiety of surgical patients. This study was conducted with the aim of determining the effect of respiratory relaxation training on individuals with CABG surgery on psychological (state anxiety level) and physiological indicators (pulse rate, blood pressure, respiratory rate and blood glucose and plasma cortisol level) of the surgical stress response. This is the first study in Turkey. The hypothesis of the study is as follows:

To exan and determine the effect of progressive respiratory relaxation training on surgical stress response, anxiety and vital signs.

Methods

This is a experimental study and the Null Hypothesis is: H_0: Preoperative progressive breathing relaxation training has not an effect on the surgical stress response, anxiety and vital sings.

Participants : This study was carried out at the cardiovascular surgery clinic in a university hospital. The patients admitted for elective CABG from May 2010 until January 2011 were take part in the study. The sample of the study consisted of a total of 78 patients (intervention group: 39, control group: 39) who underwent CABG surgery. Participants were randomly assigned to the experimental or the control group. The experimental group received usual care and preoperative progressive relaxation training. The control group only received usual prepare for CABG surgery in the unit. The inclusion criteria of the study comprised the following: the patients should (a) have completed a minimum education level of elementary school, (b) be aged 18 or above, (c) hospitalized patients 3 days before the operation, (d) patient could verbally communicate; patient voluntarily participated in this study and signed the informed consent. Exclusion criteria were as follows: (a) patient had cardiac insufficiency, (b) patient had the mental disease, (c) taking drugs for anxiety control, (d) serious chronic diseases and terminal illness because they probably needed specific training, (e) a history of previous cardiac surgery, (f) the patient was not cooperative.

Measurements and instruments : The questionnaire contained 8 questions for determining the sociodemographic characteristics of patients such as age, gender, education level, marital status, employment status, monthly income, surgical experience, hospital experience.

This study measured state anxiety using the the State Anxiety Inventory (S-anxiety-SAI) which is used to assess extensively in research and clinical practice such as in assessing clinical anxiety in surgical. The Spielberger State-Trait Anxiety Inventory developed by Spielberger, Gorsuch and Luschene (1970) was used to determine the state and continuous anxiety levels separately. It comprises separate self-report scales for measuring state anxiety and each item is given a weighted score of 1 to 4. A rating of 4 indicates the presence of a high level of anxiety. The S-Anxiety scale consists of twenty statements that evaluate how respondents feel "right now, at this moment." Scores on the S-Anxiety scale increase in response to physical danger and psychological stress and decrease as a result of relaxation training. The S-Anxiety scale has been found to be a sensitive indicator of changes in transitory anxiety experienced by clients and patients in counseling, psychotherapy, and behavior-modification programs (Spielberger, 1983). The scores obtained from SAI vary between 20 and 80. The average score level determined in practice ranges from 36 to 41. It identifies as 35 points above "anxiety" 35 points below "no anxiety" The Spielberger's State-STAI, which was translated and adapted to the Turkish population by Oner and Le Compte.

As physiological findings of stress, blood pressure, pulse, respiration, serum cortisone, and glucose levels were taken. For physiological values, clinical and laboratory reference intervals of the institution where the study was conducted were taken. Physiological values of the institution: pulse 60-120/min, systolic blood pressure 100-140 mmHg, diastolic blood pressure 45-90 mmHg, respiration rate 18-26/min, blood-glucose level 70-130 mg/dL, blood-cortisol level 7-25 mg/dL.

Data collection and procedure : The data was collected when the patient was admitted to the clinic. The questionnaire form was filled out both experimental and control groups in the patient's room by face-to-face interviewing in the patient's room. The day before the surgery; the vital signs was taken and recorded at 10 a.m. Subsequently, the anxiety level was determined using SAI both group.

Cortisol and blood glucose levels were determined by blood taken to determine routine blood values. In the postoperative period, the 1st and 4th days the vital signs were taken and recorded at 10 am. Blood glucose and cortisol values were determined by blood taken for clinical routines both preoperative and postoperative period, no blood was collected for the study.

These procedures were performed for 2 days in the preoperative period. In the postoperative period, the 1st and 4th days vital signs were taken and recorded, at 10 a.m every morning. Anxiety level was determined with SAI, blood was taken to determine blood cortisol and glucose level (Figure 1).

No interventions were applied to the patients in the control group; in line with the clinical routinesThe experimental group in preoperative period three days twice (morning and afternoon) 30 minutes, was applied progressive breathing relaxation training. This training was performed which in the patients' room and by patient education booklet. Later, the exercises in the booklet were demonstrated by the researcher and the patients were asked to perform them.

Physiological indications of stress response of patients; heart rate, blood pressure, respiration, blood glucose and cortisol values were determined on the 1st day and postoperative 1st and 4th days, and recorded on the form.

Ethical Approval: The study was approved by the university institutional review board. The rights of the participants were protected in this study by obtaining informed consent, as participants were given full information about the study, as to what the requirements, purpose and benefits were. Respect for confidentiality and anonymity was maintained by ensuring that information given by the participants was kept private. Protecting the right to withdraw from the study was enforced by informing the participants that they could refuse to participate at any time during the research process.

Data Analysis: Statistical analysis of the collected data was performed using the software Statistical Package for the Social Sciences, version 14 (SPSS Inc., Chicago, IL), and MEDCALC package programs was used for data analysis. Descriptive statistics, such as number, percentage, mean, and standard deviation, were used to present the descriptive characteristics of the patients in the intervention and control groups. A Shapiro-Wilks test was conducted to ensure that the data were normally distributed. All variables were consistent with normal distribution. Continuous variables were compared using the independent sample t-test and repeated measurements by Friedman test. Statistical significance of the tests was reported at $p<0.05$.

Results

Demographic characteristics of all the participants in each group are summarized in Table 1. A total of 78 participants (39 experimental, 39 control) with a mean age of 63.64 (SD= 8.78) years experimental group, of 64.89 (SD 7.67) years control group. The experimental group 58.9% and control group 64.1% were male. In both groups, the majority of the patients had low education level, were married, lived in the city, had a low level of income, had surgical experience, and were smoking.

Figure 1. Flowchart of the study

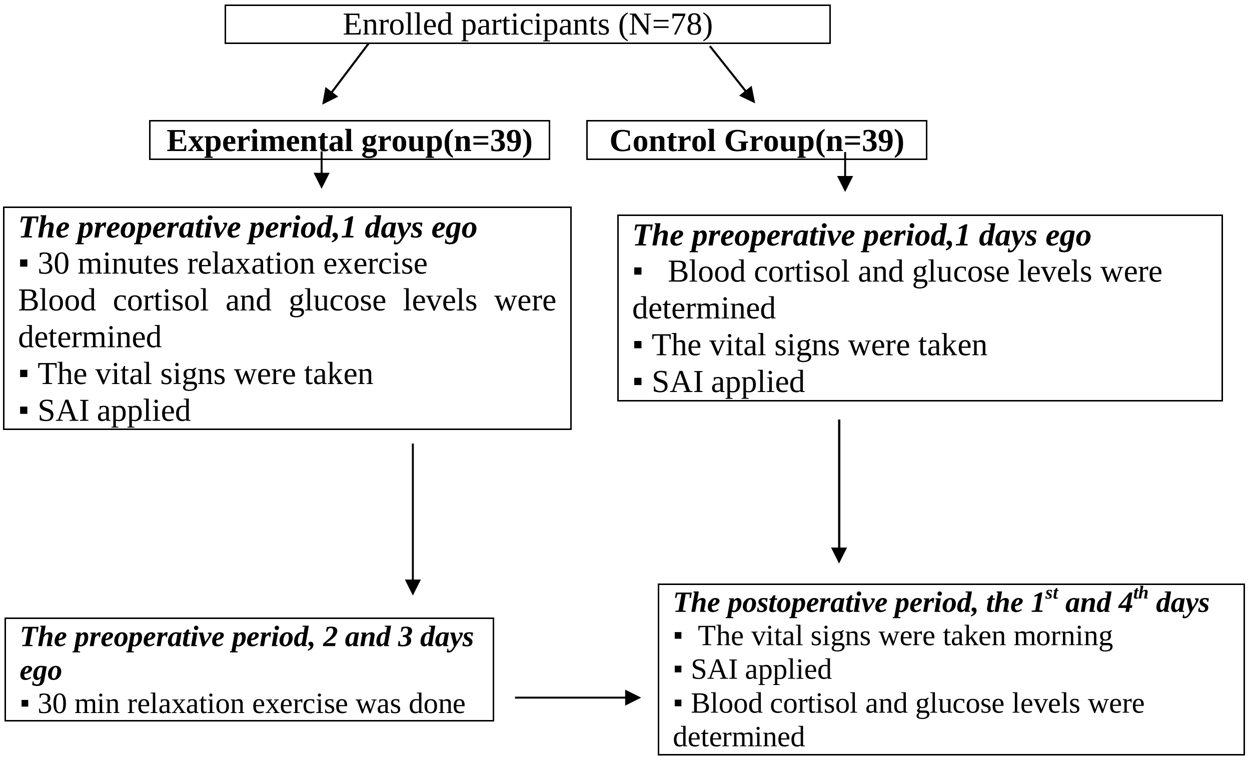

Table 1. Features of Patients (N=78)

		Experimental Group(n=39)	Control Group(n=39)
	The average age	63.64 (SD= 8.78)	64.89 (SD= 7.67)
		n(%)	**n (%)**
Gender	Female	15 (38.2)	14 (35.9)
	Male	24 (61.8)	25 (64.1)
Education	Not literate	5 (12.8)	8 (20.5)
	Primary education	15 (38.4)	21(53.8)
	High school	13 (33.3)	7 (17.9)
	University	6 (15.3)	3 (7.6)
Marital status	Married	27 (69.2)	28 (71.7)
	Single	12 (30.8)	11(28.3)
Employment	Employment	12 (30.8)	10 (25.7)
	Unemployment	27 (69.2)	29 (24.3)
Living place	City	18 (46.2)	20 (51.5)
	Village	9 (23.1)	8 (20.5)
	Town	12 (30.7)	11(28.0)
Income level	Good	6 (15.3)	5 (12.8)
	Middle	17 (43.5)	14 (35.8)
	Poor	16 (41.0)	20 (51.2)
Surgical experience	Yes	23 (58.9)	17 (43.5)
	No	16 (41.1)	22 (66.5)
Smoking	Yes	24 (61.6)	21(63.9)
	No	15 (38.4)	18 (46.1)

Measurement time	State anxiety(SAI)			
	Experimental Group(n=39)	Control Group(n=39)		
	M±SD	**M±SD**	**t-test**	**p-value**
Preoperative	36.08±2.84	37.08±2.91	-1.537	.129
Postop 1. day	31.10±3.44	34.59±3.87	- 4.205	**.000**
Postop 4. day	36.74±3.72	38.15±3.49	-1.727	.088
$^{*}X^2$	30.443	12.014		
$^{**}p$	**.000**	**.002**		

******Friedman test* ******p<0.05

Table 2. Anxiety Level of Patients (N=78)

Table 3. Blood-Glucose Levels and Plasma Cortisol Level of Patients (N=78)

Measurement time	Blood- Glucose levels (mg/dl)		Test		Plasma-Cortisol Level (mg / dl)		Test	
	Experimental group(n=39	Control group (n=39)			Experimental group(n=39	Control group(n=39		
	M±SD	M±SD	*t-tes*	*p*	M±SD	M±SD	t-tes	p-value
Preoperative	120.92± 41.1	126.03±51.86	-.48	.63	13.68±3.26	14.22±3.4	-.70	.486
Postop. 1. day	120.79±26.2	132.36±32.34	-1.73	.08	17.31±2.01	18.07±2.3	-1.53	.130
Postop. 4. day	110.03±19.1	118.56±21.65	-1.84	.06	11.6±1.41	12.43±2.04	-1.95	**.054**
***X^2**	8.667	2.844			47.072	52.311		
****p**	**.013**	.241			**.000**	**.000**		

**Friedman test* **p<0.05

Table 4. Pre-Post Vital Signs of Groups (N=78)

		Measurement times				
		***Preop	****Postop 1. day	Postop 4. day		
	Groups	**M± SD**	**M±SD**	**M± SD**	**X^2**	**p-value**
Pulse dk)	Experimental	80.82±16.1	75.17±11.5	74.33±9.97	4.38	.112
	Control	77.10±11.3	80.71±11.5	79.76±12.51	.803	.669
	t-test	1.13	-2.14	-2.12		
	p	>.05	**<.05**	**<.05**		
*SBP	Experimental	118.17±22.5	110.74±11.21	114.251±1.60	2.39	.302
	Control	120.43±20.9	118.82±15.53	120.05±12.85	.555	.758
	t-test	-2.09	-2.63	-0.25		
	p	>.05	**<.05**	**<.05**		
**DBP	Experimental	63.69±12.59	55.38±6.12	60.56±6.60	28.31	**.000**
	Control	65.64±14.02	62.10±11.17	63.53±8.15	8.44	**.015**
	t-test	-0.6	-3.2	-1.7		
	p	>.05	**<.05**	**<.05**		
Respiratory	Experimental	23.38±4.59	23.30±2.91	22.58±2.85	2.54	.281
	Control	23.10±3.71	24.17±4.47	22.92±3.35	3.88	.144
	t-test	-0.4	-1.01	0.25		
	*******p**	>.05	>.05	>.05		

SBP=Systolic blood pressure ** DBP= Diastolic blood pressure*Preop= Preoperative ****Postop=Postoperative,******p<0.05

In the preoperative period, the mean SAI of the control group was 37.07(SD=2.86) and that of the experimental group was 36.07 (SD=2.86). No statistically significant the difference between the SAI scores of the groups (p>0.05). On the first postoperative day, the SAI scores of the control group was 34.58 (SD=3.87) and the experimental group was 31.10 (SD=3.43). The SAI scores of the groups were statistically significant (p<0.05). On the fourth postoperative day, the SAI mean of the control group was 38.15(SD=3.49) and the SAI average of the experimental group was 36.74 (SD=3.71). No statistically significant the difference between the SAI scores of the groups (p>0.05) (Table 2).

In the preoperative period, the blood cortisol score of the control group was 14.21(SD=3.43) and the experimental group was 13.68 (SD=3.26) and the cortisol values of the groups were not statistically significant (p>0.05). On the first postoperative day, the cortisol score of the control group was 18.07(SD=2.37) and the experimental group was 17.31(SD=2.01). Statistically significant difference was found between cortisol values among the groups (p<0.05). On the fourth postoperative day, the cortisol score of the control group was 12.43 (SD=2.04), and the experimental group was 11.6 (SD=1.41). There was a statistically significant difference between the groups in terms of mean cortisol values (p<0.05). In the preoperative period, the plasma-glucose average of the control group was 126.02(SD=51.86), and the experimental group was 120.92(SD=41.14) The difference between the groups was not statistically significant (p>0.05). On the first postoperative day, the glucose score of the control group was 132.35(SD=32.34) and the experimental group was 120.79 (SD=26.26). However, there was no statistically significant difference between the glucose values of the experimental and control groups (p>0.05). On the fourth day postoperatively, the glucose score of the control group was 118.56 (SD=21.65) and the experimental group was 110.02 (SD=19.15), and the difference between the groups was statistically significant (p<0.05) (Table 3).

Table 4 shows pre-post CABG vital signs of experimental and control group. It was determined that the vital signs of the patients in the experimental group was lower than that of the control group in the postoperative period.

Discussion

The present study was conducted to evaluate the effects of progressive breathing relaxation training on surgical stress response in patients undergoing CABG. In current study notably, SAI scores were almost identical for both experimental and control groups in the preoperative period. However, SAI scores were lower in the experimental group than the control group in the postoperative period. It can be said that this result may have been caused by the progressive breathing relaxation training performed in the experimental group. As known, in surgery, both psychological and physiological anxiety is the primary condition. This anxiety lead to the stimulation of the sympathetic system and thus cause a stress response. Many types of relaxation exercises including breathing techniques, meditation, progressive muscle relaxation, and autogenic training have a positive impact on anxiety. Therefore the use of relaxation techniques can reduce the stress response. It by Benson, Beary and Carol (1974;1978) that raported the relaxation response appears to be an integrated hypothalamic response which result in decreased involuntary sympathetic nervous system activity, and perhaps also increased parasympathetic activity. This response termed the trophotropic response was first described by Walter Hess in the cat (Hess, 1957). Hess was probably the first person to experimentally demostrate an organism's natural response to relaxation. The trophotropic zoneis located in the area of the anterior hypothalamus. Therefore, stimulating the hypothalamus Hess found it could produce what he termed trophotropic activity–a restful and restorative response. Thus, the hypothalamus regarded as an important mechanism governing stress and the fight-flight response was also capable of producing process leading to restorative equlibrium in the organism. It was later raported by Schwartz, Davidson and Goleman (1978) that relaxation techniques have different effects depending on the relative cognitive and somatic components on anxiety. Evidences suggest that relaxation training effectively reduces tension and anxiety as a therapeutic tool and may improve psychological and physiological outcomes in patients. For example, in two studies conducted by Dehdari et al. (2007; 2009), similar to the findings of this study, showed that after progressive muscle relaxation training after CABG surgery, significant reductions in SAI in the experimental group when compared with the controls after the intervention. In a recent study (Parsa Yekta, Sadeghian, Taghavi Larijani, & Mehran, 2017) which emerged from the present findings it was found that the level of patients' anxiety after the surgery, relaxation and the rhythmic breathing techniques implemented the patients were hospitalized for the mastectomy. On the fourth postoperative day, the SAI score of both the experimental and the control groups increased. This increase in anxiety score may be due to the future anxiety of patients.

The current study findings support that both groups were associated with cortisol and glucose levels and anxiety level. During and after surgery the negative feedback mechanisms fail and high levels of both ACTH and cortisol persist in the blood. In the presence of raised cortisol levels in a severe stress response, the rate of protein breakdown exceeds that of protein synthesis, resulting in the net catabolism of muscle proteins to provide substrates for gluconeogenesis (Finnerty et al., 2013). As it is known, the HPA-axis response to stress is the basis for life and cortisol is a critical player in the endocrine response to stress. After activation of the HPA-axis, cortisol secretion may increase about 10-fold by ACTH control to maintain homeostasis from the adrenal gland cortex, for stress adaptation in severe disease, trauma or major surgical procedures. This elevation is the basis for vascular tone, endothelial integrity and distribution of body fluid. In addition to cortisol enhances the action of catacolamines and provides energy to fight the body's stress by causing hyperglycemia via gluconeogenesis, proteolysis and lipolysis (Henzen, Kobza, Schwaller-Protzmann, Stulz, & Briner, 2003). As a result, the blood glucose level also increases. CABG is associated with surgical stress, hypothermia, hyperoxia, enhancement of neuroendocrine outflow, and administration of glucogenic catecholamines that are associated with glucogonolysis and glucogenesis that result in hyperglycemia. As known, hyperglycemia is a normal aspect of surgical response to stress and is occur with most major surgical procedures such as CABG. The cause of hyperglycemia in patients undergoing CABG is a decrease in insulin secretion, the use of peripheral glucose and/or increased insulin antagonist hormones due to hypothermia and pancreatic hypoperfusion (Sucu et al., 2002). Hyperglycemia in nondiabetic patients is related to stress hyperglycemia and is a poor sign (Dungan, Braithwaite, & Preiser, 2009). Because it has been evidence that hyperglycemia is an independent predictor of perioperative morbidity and mortality in both diabetic and nondiabetic patients (Knapik et al., 2009). In other study found that postoperative hyperglycemia is associated with increased in-hospital mortality in nondiabetic patients after CABG. In diabetic patients, hyperglycemia was not associated with mortality (Székely et al., 2011). The literature suggests that patients with persistently elevated glucose levels >200 mg/dL have increased post-operative mortality (Lazar, 2006).

Progressive muscle relaxation is a systematic technique used to achieve a deep state of relaxation (Li et al., 2015). Relaxation exercises can reduce the effect of the sympathetic nervous system stimulated during anxiety. Thus, the physiological manifestations of relaxation; a decrease in pulse, blood pressure and in respiration and oxygen consumption, a slowing of metabolic rate, pupillary narrowing, dilatation of peripheral arteries, increase in peripheral temperature. In the present study, no significant statistically between vital signs the experimental and control groups in perioperative period. However, it was found that the vital signs (pulse, blood pressure and respiration) of the experimental group the scores of the postoperative 1^{st} and 4^{th}-day vital signs were lower than the control group and this difference was statistically significant. This result obtained from this study can be interpreted as the result of progressive breathing relaxation exercise given to the experimental group in the preoperative period. Physiological signs of rest accompanying the relaxation response are often reflected in lower respiration rate, heart rate and blood pressure (Benson et al., 1974). Similarly, in the study conducted by Ibrahimoglu and Kanan (2017) for the effect of progressive muscle relaxation exercises on vital signs and anxiety level in open-heart surgery patients, the lower rates of heartbeat, breathing, arterial blood pressure, and anxiety were shown in the experimental group in open heart surgery patients.

In conclusion, it was determined that the progressive relaxation exercise performed preoperatively in patients with CABG had a positive effect on the hemodynamic values, blood cortisol and glucose values of the patients, and that the values stabilized more rapidly in the postoperative period. Accordingly, " Preoperative progressive breathing relaxation training has not an effect on the surgical stress response" was rejected hypothesis H_0.

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