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Original Article

The effect of progressive muscle relaxation on sleep quality and postoperative pain in patients undergoing heart valve replacement surgery

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Abstract

Background and aims: To investigate the effect of progressive muscle relaxation on sleep quality and postoperative pain in patients undergoing heart valve replacement surgery.

Methods: In this quasi-experimental study, 60 patients undergoing surgery that enter were randomly divided into the muscle relaxation (n=30) or control group (n=30). Data were collected by Pittsburgh Sleep Quality Index and McGill Pain Questionnaire before and after the intervention. Patients in the control group received routine care, but patients in the muscle relaxation group performed a progressive relaxation technique twice a week for one month.

Results: Most of the male participants in both groups had diplomas. There is no significant difference between the two groups of relaxation and control regarding age, gender, occupation, and education levels. The mean sleep quality score in the control group was not significantly reduced after the intervention. However, the mean sleep quality in the relaxation group before 13.90±2.23 and after the intervention was 8.03±2.01 significantly decreased ($P<0.001$). Also, the pain score was significantly reduced after the progressive relaxation group in the intervention group ($P<0.001$). Although the two groups were the same in all the dimensions of sleep quality before the intervention, significant differences were observed between groups after the intervention in all the dimensions.

Conclusion: Progressive muscle relaxation has an influential role in the pain decrease and sleep quality of patients undergoing heart valve replacement surgery and can be used as a safe and cost-free method for patients.

Keywords: Pain, Sleep quality, Progressive muscle relaxation, Valve replacement

Introduction

Cardiovascular diseases are among the most common chronic diseases and the leading cause of death worldwide (1,2). They are the cause of 50% and 25% of deaths in developed and developing countries, respectively (3), and In Iran, it is the first cause of death with a frequency of 30%-35% (3,4). Generally, according to studies in Iran and the world, heart diseases lead to the death of 17 million people every year. It is predicted that it will reach 23 million people per year by 2030 (4,5) that 70% of health care costs are allocated to heart diseases, and among heart diseases, 30% are related to valve disorders (6,7). Valve diseases that are increasing day by day; They occur due to various causes, including congenital disabilities, rheumatic fever, bacterial infection, and aging (8), and these disorders are more common in the aortic and mitral valves, In moderate to severe cases, it causes symptoms such as shortness of breath and angina pectoris, fatigue and intolerance to activity and syncope and consequently reduces the quality of life and requires patient treatment with medication or surgery (replacement or repair) (9,10). Valve replacement surgery, the last line of treatment to improve valve function, accounts for 23.8% of open-heart surgeries in Iran (8,6). Despite significant improvement in symptoms, it causes great anxiety for patients before and after surgery, as its rate has been reported to be 24.7% after surgery (1). Anxiety stimulates the autonomic nervous system and increases the need for oxygen, and increases the risk of ischemia of the heart tissue, the occurrence of arrhythmia and heart failure, a decrease in the strength of the immune system, and a negative effect on the healing process and increase in pain (1,9,10).

According to formal reports, 33% to 75% of patients complain of moderate to severe pain after heart surgery, which musculoskeletal pain, surgery, wounds, the insertion of chest tubes and tissue manipulation, and

anxiety can cause. Pain stimulates the sympathetic system and organ hypoxia and disorders of the respiratory system (ineffective breathing and atelectasis), heart, and kidneys, decreased sleep quality, delayed delay in getting out of bed, followed by pulmonary embolism and increased hospitalization time and treatment costs (11,12).

On the other hand, people spend a third of their life in sleep, which increases with age and the occurrence of diseases; Also, patients hospitalized in the wards suffer from sleep problems due to frequent visits, ward noises such as the sound of monitors, pain, and anxiety. According to studies, more than 50% of patients experience sleep disorders after heart surgery; therefore, lack of importance to the patient's sleep problems causes the patient to enter the cycle. It becomes defective, and the occurrence of diseases or the aggravation of their diseases (13-15).

Sleep quality disorders occur in two forms: insomnia and bad sleeping; Insomnia includes difficulties in falling asleep, intermittent awakening, waking up too early in the morning, and poor sleep include excessive or insufficient sleep, low-quality sleep, difficulties in falling asleep, frequent awakenings and respiratory problems and low sleep quality increases stress and cardiovascular diseases (16,17).

Pharmacological and non-pharmacological methods can improve pain and sleep quality disorders in patients. Analgesics and narcotics are the most popular drugs to decrease pain. For sleep problems, benzodiazepines are most applicable. However, these drugs cause side effects such as gastrointestinal problems (constipation and nausea), kidney problems, decreased platelet function, respiratory depression, patient dependence, and increased treatment costs. On the other hand, non-pharmacological methods such as complementary medicine, acupuncture, aromatherapy, massage therapy, and progressive muscle relaxation can be performed by nurses; and used without cost and complications for the patient. In addition, educating the patient can be implemented by the individual and causes a sense of self-efficacy and involvement in self-care, reducing depression, improving and promoting the nurse-patient relationship, and reducing referrals to medical centers (18,19).

Progressive muscle relaxation was introduced by Jacobson in 1938 and is one of the complementary medicine therapies that can be performed by nurses and can also be performed after training by itself. In this method, active contraction and expansion of the specific muscles lead to patient relaxation. By regulating the nervous system's activity, this method promotes concentration and pleasant feelings and restrains negative thoughts. According to studies, it has been introduced as an effective way to reduce stress, and depression, improve sleep quality and reduce fatigue and blood pressure without complications (20,21). The progressive muscle relaxation technique reduces muscle cramps and consists of the contraction and expansion of 18 muscle groups in the body. It balances the anterior and posterior hypothalamus, reduces sympathetic activity, and releases catecholamines. Moreover, it reduces heart activity, muscle spasms, angina, arrhythmia, ischemia, and anxiety (22,23). Therefore, considering the effects of this method on anxiety and cardiac output and creating calm in the patient, it is expected that valve replacement is also effective in improving pain and sleep quality in patients (24).

Considering the complications of surgery and drugs and the greater sensitivity of patients undergoing heart valve replacement surgery, it was necessary to introduce an uncomplicated and easy method to improve the process of recovery and discharge faster and reduce complications. Therefore, this study aimed to investigate the effect of progressive muscle relaxation on sleep quality and postoperative pain in patients undergoing heart valve replacement surgery.

Methods

This study was quasi-experimental, with pre-test and post-test designs in two groups. This study was performed in Shahid Chamran Hospital of Isfahan in 1399-1400 with the code IR.SKUMS.REC.1400.128 from Shahrekord University of Medical Sciences. The study population comprised 60 patients undergoing replacement surgery hospitalized in the intensive care unit. The study included all hospitalized patients who met the inclusion criteria. In order to random allocate, the method of block randomization was used. Random allocation software, fifteen blocks with a volume of four were designed, and a randomization list was provided.

Based on the information from Alamdarloo and colleagues' study, considering the mean difference between the sleep quality of the studied groups equal to 2.4 and the standard deviations of 1.46 and 1.73, also the first type error of 0.01 and the second type error of 0.05, the minimum required sample size was estimated as 25 patients in each group. Considering the attrition rate, 30 patients were enrolled in each group (19).

Data collection tools include a researcher's checklist for recording demographic information, measuring pain (McGill questionnaire), and patients' sleep quality (Pittsburgh questionnaire). The questionnaires were completed in the pre-intervention stages immediately, one month later, for evaluation by the researcher. The McGill questionnaire measures pain perception in four dimensions: sensory, emotional, pain assessment, and various pains, and the overall pain intensity can be calculated by summing the scores of the four dimensions. This questionnaire has a Cronbach's alpha coefficient of 0.94, and its validity in all the domains is more than 0.91 (25).

Pittsburgh sleeps quality questionnaire has 19 questions with seven dimensions of sleep quality, delayed onset of sleep, sleep duration, sleep efficiency, sleep disorders, sleeping drugs, and daily dysfunction of the individual. The scores of zero to three indicate normal sleep, poor,

moderate, and severe problems, respectively, and scores of five and above indicate poor sleep. The sensitivity and specificity of the tool were reported at 89.6% and 86.5%, respectively, and Cronbach's alpha coefficient for this questionnaire was reported as 0.77. (26).

In the relaxation group, patients were educated orally during a two-hour session. The researcher monitored the patient's work to ensure the correct execution (when the person senses and recounts the difference between muscle contraction and expansion). Patients completed a self-report checklist with 60 items for each technique (twice a day for 30 days) and a note of start and end times and their experiences during and after the intervention.

The progressive relaxation method was such that the patient sat on a bed or chair in a position in which he felt relaxed with comfortable clothes or lay down and took out the watch, bracelet, belt, etc. Close his/her eyes and, if possible, keep them closed until the end of the technique. Continue the technique according to the following steps from the toes to the muscles of the head and neck, and in all limbs and stages, hold the contraction for ten seconds and then slowly count to ten and release. Start with a deep breath, press his/her toes and heels to the ground, press firmly for a few seconds (with a few deep breaths), and then release. Then bend his/her legs inwards to hold his/her toes towards his/her head, continue the technique with his/her right foot to put pressure on the thigh muscles, and repeat on the left leg and thigh. Then slowly contract his/her abdomen inward and then release, taking a deep breath, holding for ten seconds, and then slowly counting to 10, release the arms (clench his fists), tighten the arms by pulling the forearm toward the shoulder and tighten the biceps, raise the shoulders at the neck and shoulders to touch the corners, open the mouth enough (hold for 10 seconds) and release. Finally, close his/her eyelids tightly, raise his/her forehead and eyebrows as high as he/she can, and finish the exercise with a few deep breaths. It should be noted that to prevent the patient from being distracted in the ward and to ensure that the procedure was performed correctly by him/her at home, audio files containing the teacher's instructions were provided. Patients performed this procedure twice daily for 45 minutes for up to a month (27-29).

Descriptive statistics were reported as mean ± SD or frequency (%). In each of the dimensions of quality, sleep, and pain, the Wilcoxon test was used for within-group comparisons, and the Mann-Whitney test was used for intergroup comparisons. A paired *t* test was used to compare the mean scores before and after the intervention in the total quality, sleep, and pain scores. Analysis of covariance was used to compare the mean scores of quality, sleep, and pain of patients after the intervention while controlling the effect of pre-intervention values. All the analyses were performed in SPSS software version 21, and $P < 0.05$ was considered statistically significant.

Results

Demographic variables of under-study patients were reported in Table 1. Most patients in both groups were male, diploma, and housewives. The mean age of patients in the control group and the relaxation group were 57.53 ± 11.60 and 60.00 ± 15.26, respectively. There is no significant difference between the two groups of relaxation and control regarding age, gender, occupation, and education levels.

The mean sleep quality score in the control group was not significantly reduced after the intervention. However, the mean sleep quality in the relaxation group before (13.90 ± 2.23) and after the intervention was (8.03 ± 2.01) significantly decreased ($P < 0.001$). Also, the pain score was significantly reduced after the progressive relaxation group in the intervention group ($P < 0.001$, Table 2).

Results of intra-group and inter-group comparisons in different dimensions of sleep quality were summarized in Table 3. Although the two groups were the same in all the dimensions before the intervention, significant differences were observed between the groups after the intervention.

Results of intra-group and inter-group comparisons in different dimensions of pain were reported in Table 4. All the dimensions of pain were significantly lower in the

Table 1. Comparison of demographic variables between the two groups

Variable	Subgroup	Control	Progressive relaxation	*P* value
Gender	Male (n = 39)	18 (60.0)	21 (70.0)	0.58
	Female (n = 21)	12 (40.0)	9 (30.0)	
Education	< diploma (n = 21)	10 (33.3)	11 (36.7)	0.56
	Diploma (n = 25)	11 (36.7)	14 (46.7)	
	> diploma (n = 14)	9 (30.0)	5 (16.7)	
Job	Employed (n = 11)	6 (20.0)	5 (16.7)	> 0.99
	Unemployed (n = 1)	0 (0)	1 (3.3)	
	Housewife (n = 37)	18 (60.0)	19 (63.3)	
	Retired (n = 11)	6 (20.0)	5 (16.7)	
History of approved disease	Yes (n = 34)	14 (46.7)	20 (66.7)	0.24
	No (n = 26)	16 (53.3)	10 (33.3)	
Age		57.53 ± 11.60	60.00 ± 15.26	0.23

Table 2. Comparison of sleep quality and pain scores before and after the intervention in the two groups

Variables	Group	Before intervention	After intervention	*P* value
		Mean ± SD	Mean ± SD	
Sleep quality	Control	13.73 ± 1.62	12.00 ± 1.49	0.85
	Progressive relaxation	13.90 ± 2.23	8.03 ± 2.01	<0.001
Pain	Control	55.60 ± 4.67	53.03 ± 4.57	0.74
	Progressive relaxation	55.17 ± 3.47	47.20 ± 3.95	<0.001

[a] Analysis of covariance.

Table 3. Results of intra-group and inter-group comparisons in different dimensions of sleep quality

Variable	Group	Before intervention		After intervention		*P* value
		Median	Interquartile range	Median	Interquartile range	
Mental quality of sleep	Control	2.00	0	2.00	1.00	0.02
	Progressive relaxation	2.00	1.25	1.00	1.00	<0.001
	P value		0.92		<0.001	
Delay in falling asleep	Control	20.00	1.25	2.50	1.00	0.10
	Progressive relaxation	2.00	2.00	1.00	1.00	<0.001
	P value		0.68		<0.001	
Sleep time	Control	2.00	1.00	2.00	1.00	0.52
	Progressive relaxation	2.00	1.25	1.00	1.00	0.02
	P value		0.21		<0.001	
Sleep efficiency	Control	2.00	1.25	2.00	1.00	<0.001
	Progressive relaxation	2.00	2.00	1.00	1.00	<0.001
	P value		0.55		<0.001	
sleep disorders	Control	2.00	0	2.00	1.00	<0.001
	Progressive relaxation	2.00	2.00	1.00	2.00	<0.001
	P value		0.42		<0.001	
Use of sleeping pills	Control	1.50	1.00	1.00	1.00	<0.001
	Progressive relaxation	2.00	1.25	1.00	1.00	<0.001
	P value		0.50		<0.001	
Daily functional disorders	Control	2.00	0	2.00	1.00	<0.001
	Progressive relaxation	2.00	1.00	1.00	1.00	<0.001
	P value		0.94		<0.001	

Table 4. Results of intra-group and inter-group comparisons in different dimensions of pain

Variable	Group	Before intervention		After intervention		*P* value
		Median	Interquartile range	Median	Interquartile range	
Sensory perception of pain	Control	30.50	3.00	30.00	3.00	<0.001
	Progressive relaxation	31.00	2.25	29.00	4.25	<0.001
	P value		0.82		<0.001	
Emotional perception of pain	Control	11.00	3.25	10.00	3.00	<0.001
	Progressive relaxation	10.5	2.00	9.00	2.25	<0.001
	P value		0.58		<0.001	
Perception of pain assessment	Control	3.00	0.25	2.00	1.00	<0.001
	Progressive relaxation	3.00	2.00	2.00	1.00	<0.001
	P value		0.69		<0.001	
Various pains	Control	11.00	4.00	11.00	4.00	<0.001
	Progressive relaxation	11.00	2.00	9.00	3.00	<0.001
	P value		0.92		<0.001	

progressive relaxation group compared to the control group after the intervention.

Discussion

The results show that in the intra-group comparison in the control and progressive muscle relaxation groups, the pain score in different dimensions in the post-test was significantly lower than in the pre-test. Also, the quality of sleep was increased in the post-test. There was no significant difference between the groups at first. However, after the intervention, the pain scores of the patients in the progressive muscle relaxation group were significantly lower, and the sleep quality was higher than in the other group. Biabani et al (30) performed progressive muscle relaxation on dialysis patients and evaluated their pain in both control and intervention groups with the McGill instrument. They showed that the mean pain intensity score in the intervention group was significantly reduced after the intervention. The effect of progressive muscle relaxation on pain, fatigue, and quality of life of dialysis patients also was investigated in the study of Kaplan Serin and colleagues (31). They showed a significant reduction in the pain scores of patients in the intervention group (3 ± 1.9, 1.1 ± 1.7). Moreover, the study of Shaban et al, who studied progressive muscle relaxation in the pain of cancerous patients, showed that this method is more effective than music therapy (32).

In Sadoughi's study (33), the effectiveness of progressive muscle relaxation and stress management training in patients with chronic tension headaches was investigated. The results showed that the frequency and severity of headaches in the progressive relaxation group dropped (3.01 ± 0.66, 58.1 ± 0.46). Also, the headache duration was reduced (3.74 ± 0.88, 2.02 ± 0.68), which was consistent with the present study. The study of Izgu et al (34) was devoted to assessing the role of progressive muscle relaxation and meditation on pain, neurological fatigue, and vital signs of patients with type 2 diabetes. After the intervention, the pain score and fatigue of patients in the intervention group were reduced significantly. In the study of Kazak and Ozkaraman in 2018, which used the muscle relaxation method on pain of sickle cell anemia patients with the majority of female participants, and in the study of Dikmen et al that examined the effectiveness of the muscle relaxation on pain, fatigue, and sleep quality during the chemotherapy among cancerous patients were evaluated, favorable outcomes were reported (35,36).

The effectiveness of progressive muscle relaxation on improving muscle relaxation, pain, the quality of sleep, and limitation of physical activity after the cesarean section was approved by Ismail and Elgzar (37). Hasanpour-Dehkordi and colleagues (38) evaluated the progressive muscle relaxation on the anxiety and pain status of surgical patients compared to a control group. They showed a significant difference between before and after the intervention. Also, they showed a significant difference in intra- and inter-group comparisons. The quality-sleep score in the muscle relaxation and progressive group was significantly lower than in the control group patients.

Tahanian also examined progressive muscle relaxation on emergency personnel's sleep quality. They showed that the general sleep quality was improved, and even in the intervention group, no one used hypnotic drugs after relaxation. It was considered effective in improving the quality of sleep, and also, in the present study, after the intervention, there was a decrease in the use of sleeping pills (16). Aksu et al assessed progressive muscle relaxation and sleep quality of patients undergoing lung resection using a Pittsburgh questionnaire and stated that these patients did not have an unfavorable condition in sleep quality before surgery and that surgery and inpatient conditions impaired patients' sleep quality. After performing the intervention twice a day, the results showed an improvement in sleep quality in all dimensions in line with the present study. They considered the quality of sleep adequate; therefore, the results were in line with the present study (39).

Zargarani and colleagues (40) 1396 evaluated progressive muscle relaxation on quality, sleep, and fatigue of multiple sclerosis patients. Among them, 84% were female, and 52% were housewives. They showed that the sleep quality score after the intervention in the control and the intervention groups were 12.04 ± 0.91 and 6 ± 0.083, respectively. This method improved the overall score of sleep quality and all the dimensions except sleep duration compared to the control group. These results were in line with the present study and have shown that progressive muscle relaxation effectively improves patients' sleep quality.

Seyedi Chegeni et al promoted muscle relaxation in patients with chronic obstructive pulmonary disease. He approved that the above-mentioned method reduces patients' fatigue levels and improves sleep quality and subscales, including mental sleep quality, sleep delay, sleep duration, and sleep efficiency. However, no improvement was observed in other sleep scales. Lack of improvement in sleep disorders and the use of sleeping pills and daily functioning can be attributed to chronic lung disease, which requires extended intervention to achieve more significant results. Attacks such as shortness of breath and nocturnal seizures cause sleep disturbances and the need to take medication and reduce daily function (41).

In other studies that have examined progressive muscle relaxation on sleep quality in different groups -- such as the Saeedi et al that patients undergoing hemodialysis, and Roozbahani and colleagues' study, which examined students at a pre-university in Malayer -- progressive muscle relaxation has been introduced to be effective in improving the overall quality, sleep and all dimensions studied in the Pittsburgh questionnaire except for the use of drugs, the habit of taking sleeping pills can be one of the causes (42,43).

Conclusion

The results of this study indicate that the implementation

of progressive muscle relaxation has improved the pain and sleep quality of patients who have had their heart valve replaced, reducing the use of analgesics and hypnotics and their side effects. The treatment programs should include training in progressive muscle relaxation for the patient and family caregivers after surgery. Also, holding programs such as classes and workshops for staff and students is necessary to address this issue.

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Authors' Contribution

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Competing Interests

The authors declare that there is no conflict of interest.

Ethical Approval

Ethical considerations in this study included obtaining permission from the Ethics Committee of the Shahrekord University of Medical Sciences (Ethical code: IR.SKUMS.REC.1400.128) and obtaining written consent to participate in the study from the participants.

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