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Effects of Stretching Exercises on Upper Crossed Syndrome in Women after a Coronary Artery Bypass Graft

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Abstract

Objectives: Upper crossed syndrome (UCS) can exert adverse effects on rehabilitation after a coronary artery bypass graft (CABG). Hence, the present study aimed to investigate the effects of stretching exercises on UCS in women undergoing CABG.

Materials and Methods: The present quasi-experimental study was carried out on 30 women in Shahid Madani hospital of Tabriz, Iran. According to a similar study, the participants were selected through a convenience sampling method and randomly assigned to two groups of A and B. Those in group A participated in an 8-week intervention of stretching exercises (3 sessions per week) in accordance with the existing protocol. The data were statistically analyzed using analysis of covariance, the dependent t test, and the Wilcoxon test at the significance level of 0.05.

Results: The results indicated a significant difference between the two groups in terms of kyphosis angle (P=0.001) and forward head angle (P=0.019) after the intervention. The data analysis also showed that stretching exercises had no significant effect on the improvement of angles of left and right shoulders (P=0.109 and P=0.111) respectively.

Conclusions: The study findings suggest that corrective and stretching exercises might improve head forward posture and kyphosis angle, but do not affect shoulder angle.

Keywords: Coronary artery bypass graft, Upper crossed syndrome, Stretching exercises

Introduction

Cardiovascular diseases have increased dramatically in recent years, with the prevalence of over 20% in most Middle Eastern countries. Coronary artery disease is the leading cause of death in Iran among people over 35 years of age. One of the main therapies for these patients is surgery. In this disease, the arthritis with acne cannot supply oxygen to the muscle of the myocardium; therefore, coronary artery bypass graft (CABG) surgery is performed for these patients (1,2). Patients undergoing surgery experience uncomfortable complications after surgery; one of which is the upper cross syndrome (UCS). There is no specialized information on the epidemiology of this syndrome, however there is a risk of CABG due to bad posture when sitting or standing after surgery (3).

UCS occurs in the upper one-fourth of the trunk and affects head, neck, and shoulders (4). In this syndrome, the increased activity of accessory muscles of respiration disturbs the breathing, and the temporomandibular joint (TMJ) may develop osteoarthritis, resulting in chronic neck pain (5). The main risk factors and underlying causes of UCS include continual poor postures, long surgeries, disability and weakness, aging, and female gender (6). Many studies have reported the positive effects of exercises on UCS treatment (7, 8).

Post-CABG inactivity can reduce physical capacity, as well as ability to perform daily activities. Regarding the importance of body posture and its association with pain in shoulders, vital capacity of patients undergoing CABG, undesirable and unwanted complications that can affect such patients and influence postoperative results, and considering that exercises can have positive effects on the improvement or prevention of this syndrome after CABG, the present study aimed to investigate the effects of stretching exercises on UCS in women undergoing CABG.

Materials and Methods

The present quasi-experimental study with a pretest-posttest design was conducted in Shahid Madani Hospital of Tabriz, affiliated to Tabriz University of Medical Sciences, from December 27, 2018 to May 5, 2019. To this end, 30 women undergoing CABG were selected as the sample through the convenience sampling method.

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Considering α=0.05, β=0.05, and the exercise program effect of greater than 0.80, the sample size was determined to be 30 (8). The participants were randomly assigned to the test group (group A) and the control group (group B). The inclusion criteria were having at least 40 years of age and undergoing CABG. The exclusion criteria included participation in corrective exercises within the last 6 months, irregular participation in exercises during the intervention, diabetes or bedsores, drug or alcohol addiction, obesity, and fracture or dislocation in the shoulder girdle.

Forward head and forward shoulder angles were measured using body profile imaging. This method, according to Rostamizalani et al, has a good repeatability (8). In this study, the intergenerational correlation coefficient for the measurement of forward head and forward shoulder angles was obtained 0.92. In this method, three anatomical signs including auricle, the right acromion tuberosity, and the seventh cervical vertebra spinous process should be marked. To this end, the participants were asked to stand in a position near the wall at a distance of 23 cm so that their left arm would be toward the wall. In addition, a digital camera on a tripod as tall as the participants' right shoulder was placed at a distance of 256 cm from the wall (9). Then the participants were asked to bend forward three times, keep their hands above their heads three times, stand comfortably, and look at a hypothetical point on the opposite wall (eyes along the horizon). After a 5-second pause, the examiner took an image of their body profile. The resulting image was inserted into AutoCAD in order to measure the angle between the imaginary line connecting the auricle to the seventh cervical vertebra and a vertical line (forward head angle) and the angle between the imaginary line connecting the seventh cervical vertebra and acromion process and a vertical line (forward shoulder angle). In the next step, thoracic curvature was measured using a flexible ruler. To this end, two spinous processes of the second and the twelfth thoracic vertebrae were determined as the upper and lower points of the augmented thoracic curvature. To calculate the augmented thoracic curvature angle, the height and depth of the augmented thoracic curvature were measured using the flexible ruler. Then the following formula was used (10):

$$\theta=4[Arc\ tag(2H/L)]$$

Where, H and L represent the deepest part of the curvature and the line connecting two ends of the curvature, respectively.

It is noteworthy that the forward head angle was measured using a special goniometer in order to screen the participants at baseline. A head posture spinal curvature instrument was attached to the fixed arm of the goniometer to keep it right and provide correct information. The participants were asked to stay comfortably and tilt their neck three times to eliminate abnormal muscle conditions. Then the forward head angle was measured while the head was in a comfortable position. The examiner stayed at the left side of the participants and kept the fixed arm of the goniometer perpendicular to the ground, the goniometer axis parallel with the seventh cervical vertebra spinous process from the side view, and the movable arm on the anterior ear cartilage. The angle between the movable arm and the horizontal line crossing the seventh cervical vertebra was recorded as the craniovertebral angle (11,12).

Women in the test group participated in an 8-week intervention after the surgery and those in the control group received no intervention.

Exercises were performed by a trained physiotherapist three times a week for 8 weeks (a total of 24 sessions). Lasting for 35-55 minutes, each session included 10-15 minutes of initial warmup, 20-30 minutes of rehabilitation exercises, and 5-10 minutes of final cooldown. All exercise sessions were conducted under direct supervision of the examiner to ensure the accuracy of exercises. Moreover, all variables were measured using valid instruments and methods and the volume of exercises (repetition and duration) were gradually increased over the 8 weeks depending on the individual characteristics of each participant. The participants were asked to perform stretching exercises in a way that feel the tension in their muscles (near the pain threshold) for 10-15 seconds and return to the starting position. After a short rest, they repeated the same exercise. The tension time was gradually increased from 10 to 15 seconds and the number of repetitions was gradually increased from 6 to 12 over the 8 weeks. The rest time between sets was determined by the duration of each set (13). Table 1 shows the exercise program protocol (14). Each person's information was recorded in a special form of her by the researcher (in the form of a pen and paper), following completing the statistical software.

All the patients were briefed on the research objectives and procedure, and they were assured that they can leave the study at any stage. Then, an informed written consent was obtained from them. In addition, necessary arrangements were made with the authorities and matrons of the studied hospitals (15-20). The data were statistically analyzed using descriptive statistics (mean and standard deviation) to investigate the characteristics of participants and research variables, and analytical statistics (analysis of covariance, the dependent t-test, and the Wilcoxon test) to compare inter- and intra-group results. The significance level was determined as $P<0.05$.

Results

The mean age, height, and weight of participants were equal to 48.12±6.28 years, 176.29±15.01 cm, and 65.19±2.11 kg, respectively. Table 2 shows the demographic information of participants.

The results of the dependent t-test indicated that CABG caused a significant difference between the two groups

Table 1. Exercise Protocol

Number	Type of Movement	Procedure	Repetition
1	Stretching chest muscles	Stand in the corner of the wall and hold hands in front of the body and push forward to feel the tension in the chest	2 sets of 10 min (1st and 2nd weeks) 2 sets of 15 min (3rd and 4th weeks) 3 sets of 20 min (5th and 6th weeks) 3 sets of 25 min (7th and 8th weeks)
2	Stretching cervical extensor muscles	Lie down in a supine position and bring the head slowly close to the chin until tension is felt	2 sets of 10 min (1st and 2nd weeks) 2 sets of 15 min (3rd and 4th weeks) 3 sets of 20 min (5th and 6th weeks) 3 sets of 25 min (7th and 8th weeks)
3	Strengthening the cervical flexor muscles	Lie down in a supine position and actively and gently attach the chin to the chest and repeat it	2 sets of 10 min (1st and 2nd weeks) 2 sets of 15 min (3rd and 4th weeks) 3 sets of 20 min (5th and 6th weeks) 3 sets of 25 min (7th and 8th weeks)
4	Strengthening the pectoral-dorsal extensor muscles	Lie down in a prone position and try to close the shoulders against resistance (like a weight)	2 sets of 10 min (1st and 2nd weeks) 2 sets of 15 min (3rd and 4th weeks) 3 sets of 20 min (5th and 6th weeks) 3 sets of 25 min (7th and 8th weeks)

Table 2. The Mean and Standard Deviation for Demographic Information

Group	Age (y) Mean ±SD	Height (cm) Mean ±SD	Weight (kg) Mean ±SD
Test (n=15)	47.29±6.33	171.75±14.21	65.10±2.22
Control (n=15)	49.10±6.19	179.20±15.33	65.41±2.19

Table 3. The Dependent t-test Results for Pretest and Posttest Indicators

Indicators	Pretest and posttest	Test group Mean ±SD	Control Group Mean ±SD	*df*	T value	*P* Value
Kyphosis angle	Pretest	58.7±95.99	53.6±7.21	9	3.61	0.006*
	Posttest	63.8±35.90	59.1±93.40			
Forward head angle	Pretest	38.4±3.22	35.1±5.81	9	-2.71	0.025*
	Posttest	33.2±2.99	33.2±6.1			
Forward shoulder (right)	Pretest	12.1±93.80	13.0±95.36	9	3.03	0.019*
	Posttest	13.0±95.25	13.1±96.20			
Forward shoulder (left)	Pretest	12.9±88.20	13.1±93.45	9	3.03	0.018*
	Posttest	14.1±92.35	13.9±95.20			

Note: * indicates significance.

before and after the intervention (Table 3).

Moreover, the Wilcoxon test showed that there was no significant difference between pretest and posttest values of forward shoulder angle (right) (P=0.071, z=1.79). As the results of one-way ANCOVA demonstrated, there was a significant difference between the two groups after the intervention in terms of kyphosis angle. In addition, a significant difference was observed between pretest and posttest values of kyphosis angle (eta-squared=52.95%). Furthermore, the results suggested a significant difference between the two groups in terms of the forward head angle after the intervention. Additionally, the data analysis demonstrated that stretching exercises significantly improved the shoulder angle (both left and right) (Table 4).

Discussion

The present study aimed to investigate the effects of stretching exercises on UCS in women undergoing CABG. Incorrect sitting posture in the long run, recurrent and false positive rate of the upper limb, upper limb extremity sports, shoulder surgery, and long-term surgeries are recognized as risk factors for this syndrome (6). There is a risk of developing UCS after CABG, around which there are few studies. However, it is clear that after CABG, since the patient's chest has been split in CABG, the patient should lie down in a supine position. If such patients sleep in a lateral position, the chest will incur great pressure and the sternum does not mend as quickly as expected. For the reduction of chest pain and acceleration of the sternum mending, patients will continue to live with a curvature in the spinal cord. Psychosocial stress can also be a heavy burden on patients (21). After surgery, antigravity muscles are exhausted after a while and do not have the ability to maintain the body posture. As a result, the body gets out of its proper alignment and the head tilts forward. Reduction in craniovertebral angle causes an increase in the torque

Table 4. The Results of One-Way ANCOVA

Variable	Sum of Squares	Degree of Freedom	Mean Squares	F Value	P Value	Eta-Squared Effect Size
Kyphosis angle	550.90	1	550.90	18.71	0.001	0.529
Forward head	105.55	1	105.55	7.60	0.019	0.33
Forward shoulder (right)	2.051	1	2.051	2/88	0.109	0.145
Forward shoulder (left)	2.031	1	2.031	2.86	0.111	0.144

of extensor muscles around the cervical vertebrae, and the high isometric contraction of extensor muscles is required to balance gravitational force (22). This increase in muscle activity may potentially lead to musculoskeletal pain or discomfort (23). The curvature of the upper back increases tension in muscles of the cervical and lumbar spine (21). In fact, poor body posture after this type of surgery is a chain reaction across the spine (24).

UCS can cause abnormal kyphosis, biomechanical changes in the glenohumeral joint, and chest and shoulder pain. Ain et al. showed that exercises that strengthen chest muscles can correct kyphosis. Consistent with the findings of the present study, they also stated that weight training helps fix the spine. It seems that resistance exercises (e.g., stretching exercises) can cause shoulders to get closer to each other and reduce kyphosis angle in patients undergoing CABG (25). Other studies have reported optimal effects of corrective movements and exercises on the improvement of kyphosis angle and forward head (9,26).

Weak shoulder position and muscle imbalance around the shoulder are the main risk factors for shoulder abnormalities and chronic pain syndromes after chest surgeries. Shoulder position affects the chest and its abnormal position leads to the movement system impairment. These biomechanical changes caused by abnormal body alignment can influence the pressure applied to the joint, mechanical function of muscles, and proprioceptive function. These items may change CABG results. In the present study, corrective exercises did not lead to favorable changes after the intervention. This is not consistent with the findings of previous studies (27, 28).

In a study to compare the effects of strength, stretching, and combination exercises on UCS, Hajihosseini et al demonstrated that all three types of exercises improved UCS (forward head, kyphosis, and forward shoulder) (29). This is consistent with the findings of the present study, except for the forward shoulder angle that did not change significantly after the exercises.

Conclusions

The study findings suggested that corrective and stretching exercises improved the head forward posture and kyphosis angle, but had no effect on shoulder angle. Since stretching exercises strengthen the shoulder girdle muscles, the improvement of UCS is expected to affect CABG results. Performing this intervention in patients after CABG has a positive effect on the improvement of UCS and is recommended for being included in rehab programs.

Limitations of the Study

One of the main limitations of this study was that daily activity of participants out of the hospital and their mental states were not controlled.

Suggestions for Future Studies

Conducting further research based on the removal of current constraints in more groups with longer duration is suggested. It is also recommended that the following exercises be performed before surgery and its effects on post-surgical outcomes be evaluated.

Conflict of Interests

Authors have no conflict of interests.

Ethical Issues

The research project was approved by the Ethics Committee of Tabriz University of Medical Sciences (ethics no. IR.TBZMED.REC.1397.1059) and the trial was registered in Iranian Registry of Clinical trials (identifier: IRCT20120605009948N6).

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