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Effect of Pectoral Stretching in addition to standard breathing exercises on functional capacity and quality of life in elderly individuals

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Abstract:
Introduction:*Breathing exercises are included as a standard mode of treatment for the geriatric age group. Stretching of pectoral muscles helps in elongation of muscle fibres and reduces the chest wall tightness. Aim of the study was to study the effects of pectoral stretching on functional capacity and quality of life in elderly individuals.*
Materials and Methods: *A prospective experimental study of individuals aged between 60-75 years with 50 subjects in experimental and 50 in control group was conducted at a tertiary health care centre. The subjects in the experimental group received treatment in the form of stretching of pectoral muscles and breathing exercises thrice a week for a total duration of 6 weeks. The subjects in the control group received treatment in the form of breathing exercises for a total duration of 6 weeks.*
Results: *When both groups were compared it was found that pectoral stretching along with breathing exercises was more effective compared to breathing exercises alone in improving chest expansion, Peak Expiratory flow rate(PEFR) and six minute walk distance. Both treatments were equally effective in improving Quality Of Life (QOL).*
Conclusion*:Use of pectoral stretching in combination with breathing exercises is a better modality in improving chest expansion, PEFR and functional capacity in elderly individuals.*
Keywords:*Breathing exercises, chest expansion, Functional capacity, pectoral stretching, PEFR, QOL.*

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I. Introduction

Ageing is defined as the gradual biological impairment of normal function as a result of changes made in cells and structural components. These changes have a direct impact on the functional ability of organs and ultimately the organism as a whole.[1] At present, there is no standard numerical criterion for ageing, but the United Nations (UN) has suggested individuals above 60 years to be considered as elderly population. [2,3,4,5,6]The elderly experience a greater burden of ailments compared to other age groups .This disease burden among the Indian elderly places unique demands on the country's public healthcare system [7,8].

Due to the degenerative changes in the musculoskeletal system there is kyphosis and osteoporosis leading to the shortening of the pectoral muscles. These are large fan shaped accessory muscles of respiration which originate from the sternum and cover up to the eighth ribs. During arm movements i.e. glenohumeral abduction the unfolding of the muscle fibres takes place and they fold back when the armis moved back. Thus effective stretching of the pectoral muscles helps in elongation of the muscle fibres which have become shortened and help in reducing the chest wall tightness. Due to all the changes of ageing, there is easy fatigability and difficulty in sustaining activities for a prolong period of time.The aerobic or the functional capacity gets reduced affecting the QOL[9, 10].The concept of "successful aging" hence is coming into importance.Breathing exercises are included as a conventional mode of treatment in elderly. The need of the study arises as there have not been any comparative studies done on the effect of stretching the pectoral muscles and breathing exercises in elderly in Indian population.

II. Aim

The aim of the study was to evaluate the effect of pectoral stretching on functional capacity and QOL in elderly individuals.

III. Materials And Methodology

It was a prospective experimental study carried out at Topiwala National Medical College, Mumbai where 236 patients attending the geriatric outpatient department were screened and randomly recruited in two groups. (50 subjects in each group). Ethics Committee permission was taken before undertaking the study. The subjects were explained about the treatment procedure and an informed written consent was obtained from them. Baseline parameters of chest expansion, PEFR and 6MWD as per American Thoracic Society ("ATS") guidelines and QOL using SF 36 QOL Questionnaire were taken.The duration of the study was one year. The subjects in the experimental group received bothpectoral stretching and breathing exercises but the subjects in the control group received treatment in the form of breathing exercises only.

3.1 Subjects

Inclusion Criteria: Both male and female elderly individuals above 60 years of age

Exclusion Criteria: Subjects with any acute infection, neurological or cardiovascular or respiratory disease and subjects with prior training of breathing exercises or yoga were excluded from the study.

3.2 Measures

Measurement of Chest Expansion: Chest expansion was taken at the axillary level, nipple level and xiphisternum level in sitting position and measured using a measuring tape. Measurements were taken at the end of deep inspiration and expiration and the difference between the two numbers represented the subject's chest expansion[11, 12].

Measurement of PEFR:The measurement of PEFR was taken in standing using Wrights mini peak flow meter starting with the meter indicator at lowest level. The subject was asked to take in deep inspiration while standing. The mouthpiece of the device was placed in the subjects mouth with lips closed around it. The subject blows out forcefully and rapidly in a single exhalation. This was repeated two more times. The highest value from the three attempts was recorded[13, 14, 15, 16, and 17].

Measurement of Six-Minute Walk Distance (6MWD): The six minute walk distance was taken as per the ATS Guidelines. Baseline values of blood pressure (BP), Pulse Rate (PR), Respiratory Rate (RR) and Rate of Perceived Exertion was taken using the Borg's Scale. The subjects were instructed to walk as far as possible along a pathway. The total distance walked in 6 minutes was counted and the baseline parameters were repeated post the test and recovery time was taken [18, 19].

Measurement of Quality of Life (QOL): The Quality of Life was measured using the SF-36 Quality of life scale. The Physical Component Summary (PCS) and Mental Component Summary (MCS) were obtained using the SF-36 Scoring calculator software [20, 21, 22,23,24,25].

3.3 Treatment Procedure

Experimental group: Experimental group received treatment in the form of stretching of pectoral muscles followed by breathing exercisesfor three days a week for six weeks.

Pectoral muscle stretching: The subjects were made to sit on a stool. The shoulders were held in abduction position with elbows flexed and both the hands joined behind the neck. The subjects were asked to then contract the agonist muscles and hold it for 6 seconds while resistance was applied to the contraction. Then the shoulder was moved into the new range. A set of three consecutive stretches were given with a rest period of 30 sec and care was taken to prevent hyperventilation.The subjects were told to expire at the end of the stretch.

Control group: The subjects in the control group received treatment of breathing exercises only, which was performed for 20 minutes thrice a week [26].These Exercises include:

1. Apical Expansion Exercises: Subjects were asked to sit in a comfortable position, hands were placed over the clavicle and first rib and were asked to breathe using the upper chest.
2. Lateral Coastal Exercises: Subjects were asked to sit with hands placed over the lateral margin of lower ribs and asked to expand the lateral side of the chest wall.
3. Diaphragmatic Breathing Exercises: Subjects were told to keep their hands on the anterior aspect of chest wall just below the xiphisternum. The hands should move in and out during breathing.
4. Thoracic Expansion Exercises: Subjects were asked to breathe in while taking their shoulders in full flexion and breathe out while taking their hands down.

Subjects were told to perform the exercises at home on the rest of the days.

IV. Results

The graph pad Instat 3 software was used for data analysis. The data was tested for normality using the Kolmogorov-Smirnov test. The mean age in experimental group was 66±4.23 years and mean age in control group was 64.70±3.30 years. The values were matched in experimental and control group.

In the Experimental group, the pre post comparisons of chest expansion, PEFR, 6MWD, QOL score was done using the Wilcoxon Signed Ranks test.In the Control Group, the pre post comparisons of chest expansion, 6MWD, QOL score was done using the Wilcoxon Signed Ranks test. PEFR values pre and post were compared using the paired t test as it passed normality test.Mean of differences of chest expansion, PEFR, 6MWD, QOL score between the experimental and Control groups were compared using Mann Whitney U test as the data did not pass the normality test.

Table 1 Pre and post treatment measures in experimental group

	Mean	Standard deviation	Standard error	Median	Wilcoxon signed Test(W)	P value
1. Chest expansion at axillary level in experimental group						
Pre Rx	2.82	0.76	0.10	2.90	-706.00	<0.0001
Post Rx	2.92	0.71	0.10	3.05	Difference is significant	
2. Chest expansion at nipple level in experimental group						
Pre Rx	2.91	0.74	0.10	3.0	-724.00	<0.0001
Post Rx	3.19	0.69	0.09	3.5	Difference is significant	
3.Chest expansion at xiphisternum level in experimental group						
Pre Rx	3.34	0.69	0.098	3.4	-903.00	<0.0001
Post Rx	3.76	0.66	0.093	3.9	Difference is significant	
4.PEFR values in experimental group						
Pre Rx	291	58.42	8.2	295.0	-567.00	<0.0001
Post Rx	309	55.48	7.8	300.0	Difference is significant	
5.6MWD in experimental group						
Pre Rx	453.0	65.00	9.19	440	-684.00	<0.0001
Post RX	478.40	54.63	7.72	480	Difference is significant	
6.QOL –PCS in experimental group						
Pre Rx	48.62	7.56	1.07	48.0	-492.00	<0.0001
Post Rx	51.78	5.37	0.76	54.0	Difference is significant	
7.QOL- MCS in experimental group						
Pre Rx	35.46	9.28	1.31	35	-624.00	<0.0001
Post Rx	37.66	8.61	1.21	37	Difference is significant	

Table 1 shows that there was an improvement in chest expansion at axilla, nipple, xiphisternum level, PEFR, 6MWD and QOL post treatment in experimental group which was statistically significant ($p<0.0001$).

Table 2: Pre and post treatment measures in control group

	Mean	Standard deviation	Standard error	Median	Wilcoxon signed Test(W)	P value
1. Chest expansion at axillary level in control group						
Pre Rx	2.97	0.68	0.096	3.0	-231.00	<0.0001
Post Rx	3.10	0.66	0.093	3.0	Difference is significant	
2. Chest expansion at nipple level in control group						
Pre Rx	3.10	0.71	0.10	3.0	-270.00	<0.0001
Post Rx	3.22	0.64	0.09	3.2	Difference is significant	
3.Chest expansion at xiphisternum level in control group						
Pre Rx	3.40	0.71	0.10	3.5	-126.00	0.0013
Post Rx	3.49	0.63	0.08	3.5	Difference is significant	
4.PEFR values in control group(Paired t Test)						
Pre Rx	302.40	66.81	9.44	300	(t) 3.0	0.0042
Post Rx	308.80	66.84	9.45	300	Difference is significant	
5.6MWD in control group						
Pre Rx	427.60	70.23	9.93	440	-440.00	<0.0001
Post RX	437.60	65.42	9.25	440	Difference is significant	
6.QOL –PCS in control group						
Pre Rx	48.82	8.31	1.17	48.0	-362.00	<0.0001
Post Rx	51.34	6.23	0.88	53.0	Difference is significant	
7.QOL- MCS in control group						
Pre Rx	34.80	9.32	1.31	35	-861.00	<0.0001
Post Rx	38.16	7.90	1.11	38	Difference is significant	

Table 2 shows that there was an improvement in chest expansion at axilla, nipple, xiphisternum level, PEFR, 6MWD and QOL post treatment in control group which is statistically significant. (p<0.0001)

Table 3: Mean of Differences of measures in experimental and control group

	Mean of Differences	Standard deviation	Standard error	Median	Mann-Whitney Test (U)	p value
1. Chest expansion at axillary level						
Experimental group	0.16	0.21	0.03	0.2	952.50	0.0482
Control Group	0.12	0.18	0.02	0.0	Difference is significant	
2. Chest expansion at nipple level						
Experimental Group	0.28	0.25	0.03	0.2	754.00	0.0004
Control Group	0.12	0.19	0.02	0.0	Difference is significant	
3.Chest expansion at xiphisternum level						
Experimental Group	0.41	0.27	0.39	0.5	437.50	<0.0001
Control Group	0.08	0.10	0.02	0.0	Difference is significant	
4.PEFR values						
Experimental Group	18	18.07	2.55	2.0	759.00	0.0003
Control Group	6.4	15.08	2.13	0.0	Difference is significant	
5.6MWD						
Experimental Group	25.40	30.11	4.25	20.0	863.00	0.0065
Control Group	10.00	18.73	2.65	10.0	Difference is significant	
6.QOL –PCS						
Experimental Group	2.47	3.79	0.53	0.0	1168	0.36
Control Group	3.09	3.60	0.50	2.0	Difference is not significant	
7.QOL- MCS						
Experimental Group	2.20	2.18	0.30	2.0	1023.5	0.11
Control Group	3.36	3.55	0.50	3.0	Difference is not significant	

Table 3 shows that when both the groups were compared there was a statistically significant improvement in chest expansion at all three levels (At axilla p value=0.0482, at nipple level p value=0.0004 and at xiphisternum level p value<0.0001), PEFR p value=0.0003, 6MWD p value =0.0065.However the change in QOL was not statistically significant (QOL p value PCS=0.36 and MCS p value=0.11).

V. Discussion

Postural changes in the elderly include elevated, protracted or abducted scapulae with medially rotatedhumerus and kyphotic spinal deformities. It places the pectoralis major muscle in shortened position, increasing resistance of the chest wall to expansion, further increasing the work of breathing and the demand placed on the respiratory muscles. However as a muscle stretches, the actin-myosin overlap decreases allowing the muscle fibre to elongate. In our study we found that the chest expansion improved post stretching of pectoral muscles and breathing exercises in elderly individuals.The experimental group received treatment in the form of pectoral stretching and breathing exercises and control group received treatment in the form of breathing exercises only.

Our study showed that there was an improvement in the ventilatory function of the lungs as the PEFR improved post treatment in the experimental group. Peak expiratory flow rate is an important parameter of pulmonary function. The increased PEFR can be explained on the following basis, the respiratory muscles are stretched to their full extent and the respiratory apparatus is able to work to their maximal capacity.The six minute walk distance also improved post treatment in the experimental group. This improvement may have been due to changes in ventilatory capacity, increased thoracic expansion and improved respiratory patterns. The QOL Score also showed improvement post treatment in the experimental group which was statistically significant (P<0.001).**Julie A. Ekstrum, Lisa L. Black, and Karen A. Paschal**studied theeffects of a thoracic mobility and respiratory exercise program on pulmonary function and Functional Capacity in Older Adults (2009)[27].In their study a home exercise program (HEP) consisting of respiratory exercise and stretching of thoracic muscles was given andhow regular participation in this program affected pulmonary function, chest wall excursion, physical function, and quality of life in community-dwelling older adults was found. Thirty-seven volunteers (mean age 80.5 years) participated in a twice daily HEP for 6 weeks. Twenty-two subjects completed the program. Pulmonary function, chest wall excursion (CWE), the 6-minute walk test (6MWT), the physical performance tests (PPT), and RAND SF-36 quality of life survey (SF-36) were administered before and after the exercise program. Increases in CWE, 6MWT, and PPT were statistically significant. In conclusion, community-dwelling older adults participating in a 6-week stretching and respiratory exercise program demonstrated improved CWE and function. In our study we got similar results for chest expansion and six minute walk distance .QOL also showed statistically significant improvement in experimental group.

Subjects performing breathing exercises that is the control group showed improvement in chest expansion at all the three levels that are axillary, nipple and xiphisternum, PEFR, 6MWD and QOL. Breathing exercises relieves the body of stress and anxiety and makes the body energetic by allowing the flow of greater amount of fresh air into the body and subsequent blood-circulation. It also helps to drive away fatigue and tiredness from the body as well as the mind.

Comparison between experimental and control group showed statistically significant improvement in chest expansion at all three levels, PEFR and 6MWD. This implies that pectoral stretching along with breathing exercises was more effective than breathing exercises only in elderly individuals. The change in Quality of Life when compared for both physical and mental components was not statistically significant. This means that both the treatments proved to be equally effective to improve quality of life in elderly individuals.

This suggests that pectoral stretching along with breathing exercises is more effective in improving the chest expansion, PEFR and functional capacity compared to breathing exercises alone. Thus the result of the study supports the hypothesis that pectoral stretching has an effect on chest expansion, PEFR and 6MWD in elderly individuals. The difference in QOL scores when compared with pectoral stretching and breathing exercises vs. breathing exercises was not statistically significant. This suggests both the treatments were equally effective in improving QOL in elderly subjects.

VI. Clinical application

Aging is an inevitable process and decline occurs in all tissues and systems. Nonetheless, with a thoughtful lifestyle approach, it is possible to prevent or attenuate the severity of some diseases, and delay (possibly avoid) the condition of frailty. Inactivity should be considered as much a contributor to impairments and loss of function as pathology or disease. It is appropriate to consider the impact of age-related changes on the rehabilitation and wellness plan for elderly patients. There is a need to adjust the rehabilitation to meet the unique needs of the older patient. Pectoral stretching along with breathing exercises proves to be an effective way to reduce the chest wall tightness and improve the functional capacity of elderly individuals. Hence, it should be used as a modality of treatment in the elderly, thus improving the QOL.

VII. Suggestions

1. Large sample size can be studied.
2. Long term effects can be studied.
3. Lung capacity can be measured using pulmonary function test.

VIII. Conclusion

Pectoral stretching along with breathing exercises was more effective compared to breathing exercises alone in improving chest expansion, PEFR and six minute walk distance in elderly individuals. Both treatments were equally effective in improving QOL in elderly individuals.

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