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A Study on Functional Effects of Pulmonary Rehabilitation among Patients with Ankylosing Spondylitis (AS)

Dr. Swapan Kumar Mishra[1], Dr. Tushar Kanti Saha[2]
[[1]Associate Professor, Department of Physical Medicine & Rehabilitation; [2]Assistant Professor, Department of Community Medicine] North Bengal Medical College, Sushrutanagar, Darjeeling
Corresponding Author: *Dr. Tushar Kanti Saha*

Abstract:
Introduction: *Till today the rehabilitation management of Ankylosing Spondylitis (AS) primarily focuses on the musculoskeletal system in spite of the fact that a substantial proportion of the patients suffers from respiratory complications. But studies on rehabilitation strategies prioritising respiratory system is lacking in available literatures.*
Aims & Objectives: *To assess the change of pulmonary functions in Ankylosing Spondylitis patients after the pulmonary rehabilitation and to investigate the possible role of rehabilitation programme on the improvement of quality of life.*
Materials & Methods: *Thirty patients of Ankylosing Spondylitis, diagnosed according to Modified NewYork Criteria, was selected for this prospective study and treated with both pharmacological and non-pharmacological measures including specific pulmonary rehabilitation protocol, mainly based on home exercise schedule. Outcome measurement tools like parameters of pulmonary function (e.g.VC, TLC, FEV_1, FEV_1/FVC Ratio) and aerobic capacity (e.g. MET Score & 6-Minutes' Walk Distance), disease activity (BASDAI) and functional index (BASFI) of Ankylosing Spondylitis, were used to assess the patients and were evaluated for all patients before starting treatment and at 3-months, 6-months & 9-months after initiation of the treatment programme.*
Results: *Significant improvement ($p<0.0001$) in the pulmonary functional parameters as well as the aerobic capacity is observed in all patients. Improvement of functional activity as assessed by BASFI and disease activity as assessed by BASDAI were also statistically significant ($p<0.0001$ and $p<0.001$ respectively).*
Conclusions: *Pulmonary rehabilitation programme improve cardiorespiratory functions and when coupled with other rehabilitation measures, it can lead to improvement in the disease activity and overall functional activity.*
Key Words: *Ankylosing Spondylitis, Pulmonary Rehabilitation, Pulmonary Function*

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I. Introduction:

Even in this era of modern medicine, the patients who are suffering from Ankylosing Spondylitis are spending their days with disabilities both at home and in the work place with resultant social and occupational handicap. Their disabilities are primarily related to and caused by limitations in physical functions which in turn depend on both musculoskeletal and cardiorespiratory systems. In spite of the advent of newer pharmacologic agents like biologics, the cornerstone of treatment of Ankylosing Spondylitis, particularly from the disability point of view, remains non-pharmacological management and therapeutic exercises play the pivotal role in disability limitation. Till today the rehabilitation protocols are primarily targeting the musculoskeletal system with the main goal to preserve the spinal flexibility, to prevent postural deformity, to improve the strength and stamina and to reduce the pain as well. But large numbers of patients suffering from Ankylosing Spondylitis are struggling due to the associated pulmonary complications in terms of diminished respiratory compliance due to reduced chest wall movement and resultant diminished endurance. Chest wall expansion as assessed by measuring the difference of chest wall circumferences during inspiration and expiration at the level of 4^{th} intercostals space in males & just below the breast at xiphisternum level in females gradually reduces causing restriction of pulmonary function in patients with Ankylosing Spondylitis. Rehabilitation strategies prioritising the respiratory and cardiovascular system in patients suffering from Ankylosing Spondylitis are much less often advised and studies and evidences on pulmonary rehabilitation is lacking in various textbook as well as available literatures. This study is planned and conducted with an attempt to address these grey areas and to find out the effect of pulmonary rehabilitation strategies on functional limitations due to the restrictive pulmonary disease pattern associated with Ankylosing Spondylitis.

II. Materials & Methods:

This prospective study was conducted in the department of Physical Medicine & Rehabilitation, Sambhu Nath Pandit Hospital, Kolkata during the period from January 2008 to October 2008. Informed consent was obtained from all thirty patients (twenty-four males and six females) included in the study. Ethical clearance was taken from the institutional human ethical committee. All patients were in early stages of AS with mild pulmonary functional abnormality. Patients in late stages, patients with permanent chest deformity, patients having history of smoking, patients on methotrexate and steroid, patients having cardiac complications who cannot tolerate rehabilitation protocol and patients having contraindications to therapeutic exercise were excluded from the study.

After initial assessment for both muscle strength & joint flexibility and pulmonary function, all patients were advised to follow the pulmonary rehabilitation programme. The programme consists of aerobic exercises for upper limbs and lower limbs, generalised muscle strengthening exercises, spinal exercises & mobility programme like cervical mobility training and thoracolumbar mobility training, breathing exercises like chest expansion training, respiratory muscle strengthening exercises, ventilatory muscle training for improving endurance, breathing reeducation in the form of diaphragmatic breathing and purse lip breathing. After proper training, guidance and supervised exercises, all patients were advised to continue the programme at home as it was basically a Home Exercise Programme (HEP) and they were advised to attend OPD for the scheduled assessment with exercise log containing heart rate, respiratory rate, exercise parameters, problems encountered during exercises,if any. Twenty - seven patients followed the protocol and completed the study. Patient education in the form of training for self-assessment, self-management and energy saving techniques was also given to the patients.

Outcome measurement tools like parameters of pulmonary function (e.g.VC, TLC, FEV_1, FEV_1/FVC Ratio) and aerobic capacity (e.g. MET Score & 6-Minutes' Walk Distance) were measured before initiation of the treatment (Day 0) and at all three follow up visits at 3, 6 and 9 months after initiation of the rehabilitation programme. Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and Bath Ankylosing Spondylitis Functional Index (BASFI) were also assessed before starting treatment and at 3-months, 6-months & 9-months after initiation of the treatment programme.

Results were statistically analysed using Stat Soft, Inc. (2001), STATISTICA (data analysis software system), version 6. Www.statsoft.com. San Francisco, California: Graph Pad Software Inc. (2005) Graph Pad Prism version 4.

III. Results:

Parameters directly measuring the lung functions like Vital Capacity (VC) and Total Lung Capacity (TLC) showed statistically significant improvement ($P < 0.0001$) at 3, 6 & 9 months as compared to initial assessment (Day 0); at 6 & 9 months as compared to 3 months; and at 9 months as compared to 6 months. The improvement in chest expansion was also statistically significant ($P < 0.001$) over a minimum period of 6 months (at 6 and 9 months as compared to Day 0; at 9 months as compared to 3 months). The observation that improvement over shorter intervals was not found to be significant is expected from clinical view point and shows the importance of long term rehabilitation.

Metabolic Equivalence (MET) Score data showed statistically significant improvement over time (p-value < 0.001) in all comparisons (Number of Groups =4, $F = 332.96$). Six Minute Walking Distance (6MWD) data showed results ($P < 0.001$, Number of Groups =4, $F = 253.23$) similar to MET score, another aerobic capacity parameter. Pearson's correlation coefficient (r-value) shows good correlation between VC with MET achieved and VC with 6-Minutes Walking Distance (6-MWD) at the Baseline and also in all follow up periods i.e. in 3, 6 & 9-months as well. BASDAI and BASFI scores also showed statistically significant improvement ($P < 0.001$) in all observations which may be correlated with the comprehensive management instituted in the study.

IV. Discussion:

According to Kelly's Text Book of Rheumatology[1], lung involvement is a rare and late manifestation of ankylosing spondylitis. It is characterized by slowly progressive fibrosis of the upper lobes of the lungs, appearing, on average, two decades after the onset of AS. Evidence shows restrictive lung disease (RLD) may occur in patients with late-stage ankylosing spondylitis, with costovertebral and costosternal involvement causing limited chest expansion. Bilateral apical pulmonary fibrosis rarely occurs only in the setting of severe disease[2]. But enough evidences are there to believe that pulmonary involvement starts in early stage of AS as shown by Sevin Baser et al[3]. Study done by Nils Feltelius et al[4] has shown that randomly selected patients with AS without symptoms of lung disease suffer from reduced lung volumes as defined by reduced vital capacity (VC) and reduced total lung capacity (TLC). This study also showed reduced VC, reduced TLC and normal FEV1/ FVC ratio. These lung findings corroborate well with restrictive type of lung problems. These findings were well documented by I. Romagnoli et al[5] in a study (Chest wall kinematics and respiratory

muscle action in ankylosing spondylitis patients) and they have concluded that the diaphragm/abdomen compartment plays a prominent role in the production of chest wall tidal volume, regardless of disease severity. Pulmonary rehabilitation programme of our study addressed this problem by including special breathing technique.

Pulmonary rehabilitation is well documented to be effective to improve lung function parameters. In a study, at the end of exercise program, VC was decreased in the control group; however, significant increases in VC were observed in the exercise group at the end of the exercise programme[6]. In our study we have also showed statistically significant improvement of vital capacity and TLC in all follow ups. The previous study showed that multimodal exercises enhance the quality of life of patients with Ankylosing Spondylitis[6] which corroborates with the results found in our study.

MET score is a standard tool to assess the exercising ability and aerobic capacity of the patient. Pulmonary rehabilitation has shown to be effective in improving exercise endurance and the quality of life in group of patients with significant restrictive lung disease[7]. Patients with RLD respond very well after 12 weeks of pulmonary rehabilitation, and even better results were seen after 24 weeks. Clinically significant improvements were obtained in the majority of the patients after 24 weeks[8]. In this study also significant improvement of exercise endurance noted as evidenced by consistent and statistically significant improvement of achieved MET score.

A short 6-minute walk distance (6MWD) almost accurately predicts morbidity and mortality from heart or Lung disease[9]. Ortancil et al[10] tried to determine the effects of a 6-week home-based exercise programme on the respiratory muscle and energy cost in AS. Chest expansion, maximal inspiratory pressure, and maximal expiratory pressure values and Bath Ankylosing Spondylitis Functional Index (BASFI) scores of patients significantly increased after 6 weeks ($P < 0.001$). Six-minute walking distance and physiologic cost index values did not change at the end of the 6 weeks ($P > 0.05$)[11]. But our study showed statistically significant improvement ($P < 0.0001$) of distance covered in 6 minutes time along with improvement in other parameters.

BATH index like BASDI, BASFI, BAS-G etc are very reliable for the assessment of Ankylosing Spondylitis patients according to various studies done by J. R. Gu et al[11], Jean-Marie Berthelot et al[12], A. Waldner et al[13]. According to e-medicine, sulfasalazine has been shown to be effective in ankylosing Spondylitis, particularly in reducing spinal stiffness and the ESR, but no evidence shows that spinal mobility or physical function is benefited. In this study there was reduced disease activity possibly due to disease modifying agents (sulfasalazine) and spontaneous course of disease. On the other hand functional status is supposed to be reduced over a time period. But interestingly in this study there is not only statistically significant improvement of functional index (BASFI) but disease activity (BASDAI) is also significantly improved. This is probably due to rehabilitation protocol. In the study "A new approach to define disease status in Ankylosing Spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index", conducted by Garrett S et al[14], p value <0.0001 of BASDAI score was found after intensive in-patient physiotherapy for the treatment of Ankylosing Spondylitis. Another study on" BASDAI-Bath Ankylosing Spondylitis Disease Activity Index" stated that, improvement of BASDAI score is statistically significant (16.4% with p value< 0.009) after 3 weeks of physiotherapy course. Present study also shows that nonpharmacologic measures in the form of therapeutic exercise can result into improvement in disease activity as well as functional status in AS.

Therefore it can be said that our study has contributed to the increasing pool of evidences supporting the fact that pulmonary rehabilitation is efficacious not only in improving the respiratory function and aerobic capacity but can also modify the disease activity and overall functional status.

V. Conclusion:

Pulmonary rehabilitation measures are beneficial not only in terms of improvement in lung function parameters and aerobic capacity & endurance, but also in terms of modification of disease activity and functional index in AS patients. The comprehensive rehabilitation with pharmacological and non-pharmacological agents for AS should include specific pulmonary rehabilitation programme and it should be instituted early in all patients diagnosed with AS to optimise the potential benefit.

References:

[1]. Kelly's Text Book of Rheumatology, 9th edition.
[2]. Ankylosing Spondylitis & Undifferentiated Spondyloarthropathy-E Medicine Rheumatology
[3]. PULMONARY INVOLVEMENT STARTS IN EARLY STAGE OF ANKYLOSING SPONDYLITIS…(1A) : Sevin Baser MD* Sibel Cubukcu MD Sibel Ozkurt MD Nuran Sabir MD Beyza Akdag MD Erdal Diri MD Pamukkale University Medical School, Denizli, Turkey.
[4]. Annals of the Rheumatic Diseases 1986, 45, 736-740-Pulmonary involvement in ankylosing spondylitis;NILS FELTELIUS, 1 HANS HEDENSTROM, 2 GUNNAR HILLERDAL, 3 AND ROGER HALLGREN', From the Departments of 'Internal Medicine, 2Clinical Physiology, and 3Lung Medicine, University Hospital, Uppsala, Sweden.

[5]. Eur Respir J 2004; 24:453-460, Copyright © ERS Journals Ltd 2004 - Chest wall kinematics and respiratory muscle action in ankylosing spondylitis patients; I. Romagnoli[1], F. Gigliotti[1], A. Galarducci[1,2], B. Lanini[1], R. Bianchi[1], D. Cammelli[2] and G. Scano, Don C. Gnocchi Foundation, Section of Respiratory Rehabilitation, Pozzolatico, and Dept of Internal Medicine,
[6]. Gonca Ince, Tunay Sarpel, Behice Durgun and Seref Erdogan: Research Reports: Effects of a Multimodal Exercise Program for People with Ankylosing Spondylitis; PHYS THER: Vol. 86, No. 7, July 2006, pp. 924-935.
[7]. J. Braun, T. Pincus: Mortality, Course of disease and prognosis of patients with Ankylosing Spondylitis: Clin Exp Rheumatol 2002; 20 (Suppl. 28):S16-S22.
[8]. Pulmonary Rehabilitation: eMedicine; Physical Medicine & Rehabilitation.
[9]. Paul L Enright MD , Dr Enright, Paul L Enright MD, : The Six-Minute Walk Test; RESPIRATORY CARE, AUGUST 2003 VOL 48 NO 8 783
[10]. Ortancil, Ozgur MD; Sarikaya, Selda MD; Sapmaz, Perihan MD; Basaran, Aynur MD; Ozdolap, Senay MD: The Effect(s) of a Six-Week Home-Based Exercise Program on the Respiratory Muscle and Functional Status in Ankylosing Spondylitis; JCR: Journal of Clinical Rheumatology: March 2009 - Volume 15 - Issue 2 - pp 68-70;
[11]. J. R. Gu· Z. T. Liao· Z. M. Lin and R. Srirajaskanthan: Quality of Life in Ankylosing Spondylitis and Undifferentiated Spondyloarthropathy: Chinese Perspectives: Hand Book of Disease Burden and Quality of Life Measure: 10. 1007/978-0-387-78665-0_230: pages 3955-3964.
[12]. Jean-Marie Berthelot· Lætitia Tortellier, Delphine Lavy-Bregeon, Benoît Le Goff and Yves Maugars: High intraindividual week-to-week variability in BASDAI and BASFI values: Are several evaluations needed before starting or stopping TNFα antagonist therapy for spondyloarthropathies? Joint Bone Spine: Volume 75, Issue 2, March 2008, Pages 167-171.
[13]. A. Waldner; H. Cronstedt; C. H. Stenströ Om: The Swedish version of the Bath Ankylosing Spondylitis disease activity index. Reliability and validity: Scand J Rheumatol Suppl. 1999; 111:10-6.
[14]. GARRETT S, JENKINSON TR, KENNEDY LG, WHITELOCK HC, GAISFORD P, CALIN A: A new approach to defining disease status in Ankylosing Spondylitis. The Bath AS disease activity index. J Rheumato*l* 1994; 21: 2286-91.

TABLE-1: VITAL CAPACITY (VC)

Tukey's Multiple Comparison Test*	Mean Diff.	q	***P* value**	95% CI of diff
VC-Day-0 vs VC -3-Months	-1.4444	1.1054	***P* < 0.0001**	-6.3072 to 3.4183
VC -Day-0 vs VC -6-Months	-5.5926	0.19841	***P* < 0.0001**	-4.6035 to 5.1220
VC -Day-0 vs VC -9-Months	-6.2593	4.7902	***P* < 0.0001**	-5.122 to -1.3965
VC -3-Months vs VC -6-Months	-4.7037	1.3038	***P* < 0.0001**	-3.1590 to 6.5664
VC -3-Months vs VC -9-Months	-4.8148	3.6847	***P* < 0.0001**	-9.6775 to 0.047899
VC -6-Months vs VC -9-Months	-5.5185	4.9886	***P* < 0.0001**	-11.381 to -1.6558

P <0.0001, Number of Groups =4, F = 128.18
VC (% of Predicted) data shows statistically significant improvement over time

TABLE-2: TOTAL LUNG CAPACITY (TLC)

Tukey's Multiple Comparison Test*	Mean Diff.	q	***P* value**	95% CI of diff
TLC-Day-0 vs TLC -3-Months	-1.8148	9.0226	***P* < 0.001**	-2.5633 to -1.0663
TLC -Day-0 vs TLC -6-Months	-3.6296	18.045	***P* < 0.001**	-4.3782 to -2.8811
TLC -Day-0 vs TLC -9-Months	-5.6296	27.989	***P* < 0.001**	-6.3782 to -4.8811
TLC -3-Months vs TLC -6-Months	-1.8148	9.0226	***P* < 0.001**	-2.5633 to -1.0663
TLC -3-Months vs TLC -9-Months	-3.8148	18.966	***P* < 0.001**	-4.5633 to -3.0663
TLC -6-Months vs TLC -9-Months	-2.0000	9.9433	***P* < 0.001**	-2.7485 to -1.2515

P <0.0001, Number of Groups =4, F = 144.20
TLC (% of Predicted) data shows statistically significant improvement over time

TABLE-3: CHEST EXPANSION (CE)

Tukey's Multiple Comparison Test*	Mean Diff.	q	***P* value**	95% CI of diff
CE-Day-0 vs CE -3-Months	-0.053704	1.8501	*P* > 0.05	-0.16173 to 0.054319
CE -Day-0 vs CE -6-Months	-0.17593	6.0607	***P* < 0.001**	-0.28395 to -0.067904
CE -Day-0 vs CE -9-Months	-0.28333	9.7609	***P* < 0.001**	-0.39136 to -0.17531
CE -3-Months vs CE -6-Months	-0.12222	4.2106	*P* < 0.05	-0.23024 to -0.014200
CE -3-Months vs CE -9-Months	-0.22963	7.9108	***P* < 0.001**	-0.33765 to -0.12161
CE -6-Months vs CE -9-Months	-0.10741	3.7002	*P* > 0.05	-0.21543 to 0.00061514

P <0.0001, Number of Groups =4, F = 19.119
CHEST EXPANSION (in Centimeter) data shows statistically significant improvement over time (at least 6 months)

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