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RESEARCH ARTICLE

EFFECT OF PULMONARY REHABILITATION ON EXERCISE TOLERANCE AND COUGH- RELATEDQUALITY OF LIFE IN NON-CYSTIC FIBROSIS BRONCHIECTASIS PATIENTS: A SHORT TERM AND LONG TERM EFFECT

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ABSTRACT

Background: Bronchiectasis unrelated to cystic fibrosis (non-CF bronchiectasis) is a chronic respiratory condition characterized by bronchial dilatation secondary to airway inflammation, infection and dysfunction of mucociliary clearance. patient with bronchiectasis may have reduced QOLand increase anxiety and depression , reduced exercise tolerance due to prolong episode of dyspnea, excessive sputum production, breathlessness, exercise limitation and recurrent infection. Many patients experience recurrent exacerbations, with more frequent exacerbations predicting a poorer prognosis. Pulmonary rehabilitation is multidisciplinary approach which incorporates self-management strategies to promote treatment adherence and this approach has been advocated for bronchiectasis. Ground-based walking training improves quality of life and exercise capacity in patient with pulmonary disease. The aim of this study is to evaluate the short term and long term effect of PR and ground based walking on exercise tolerance and cough related quality of life in non-cystic fibrosis bronchiectasis patient, and to compare effect of ground base walking and PR on exercise tolerance and cough related quality of life in non-cystic fibrosis bronchiectasis patient.

Method: patient who were referred by pulmonologist and already diagnosed as having non-cystic fibrosis on CT-scan investigation were assessed before recruitment in the study.46 patient who matched inclusion and exclusion criteria were included in the study. subjects were allocated into two equal group using random table that is control group and experimental group. experimental group was treated with PR and control group treated with ground base walking for 8-weeks.outcome measure were taken at base line and after 8-week of study. After two month of study, frequency of acute exacerbation were measured .patient were asked to maintain record of acute exacerbation for 2-month.this data will collected by telephone interview.

Result: Results showed a significant improvement in both the groups but, more improvement was seen in experimental group compared to control group.

Conclusion: 8-week of PR is more beneficial than ground based walking in patient with non-cystic fibrosis bronchiectasis. Frequency of acute exacerbation was reduced in PR group than control group after 2 month of follow-up.

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INTRODUCTION

Bronchiectasis is a chronic (often suppurative) lung disease characterized by airflow obstruction and symptoms including cough, sputum production, wheeze, dyspnoea, and decreased exercise tolerance (Newall, 2005; King *et al*., 2006). Bronchiectasis is pathologically defined as permanent dilatation of one or more bronchi, secondary to bronchial inflammation and infection (Martinez-Garcia, 2005; Koulouris, 2003).

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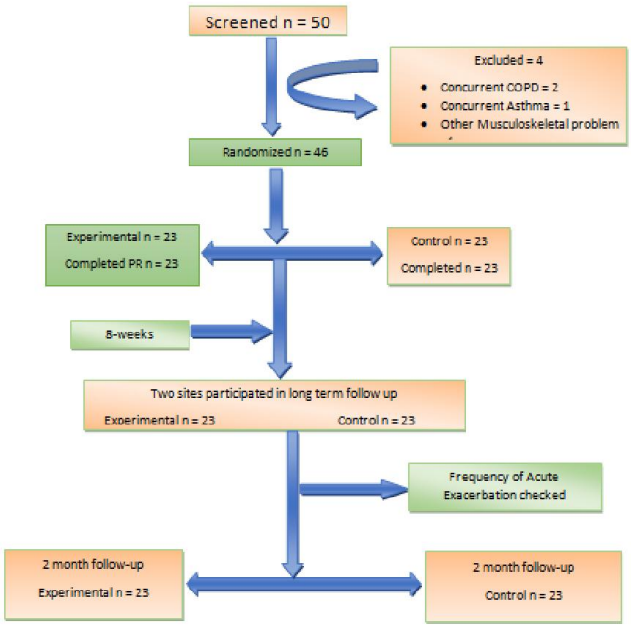
Predominant symptoms include cough with sputum production, dyspnoea and fatigue. The incidence of bronchiectasis is decreasing. It was common and often fatal in the pre antibiotic era and is still common in developing countries. The decrease in bronchiectasis is believed to be due to greater availability of antibiotics for the treatment of respiratory tract infections and widespread use of immunization in childhood against pertussis (whooping cough) and measles (Hillegass, 2001).The cause of bronchiectasis may be congenital for example primary ciliary dyskinesia, cystic fibrosis, sequestrated lung segments or Pertussis, measles, tuberculosis and pneumonia may also cause bronchiectasis but with early medical intervention the Incidence following these conditions has fallen.

This clinical profile contributes to progressive deconditioning, which gives rise to reduced exercise tolerance and diminished health-related quality of life (HRQoL) (Lee *et al*., 2010) Decreased peripheral muscle strength and endurance have also been found. One of the hallmark symptoms of patients with bronchiectasis is the chronic production of purulent sputum, the clearance of which may be improved by physiotherapy, antibiotic treatment and, in patients with cystic fibrosis, by exercise training. (Santamato *et al*., 2012) Many patients experience recurrent exacerbations, with more frequent exacerbations predicting a poorer prognosis. International guidelines recommend the inclusion of people with bronchiectasis in pulmonary rehabilitation to improve physical capacity and HRQoL (Holland *et al*., 2013; Ozalp and Calik). High-resolution computed tomography is the imaging method of choice as a diagnostic tool in bronchiectasis (Singh, 2007).

Physiotherapy may help in the treatment of patients problems of excess bronchial secretions, breathlessness, reduced exercise tolerance and chest wall pain of musculoskeletal origin (Pryor, 2001). Sally L Wotton had done study on Ground-based walking training improves quality of life and exercise capacity in COPD. They found that ground-based walking training is an effective training modality that improves quality of life and endurance exercise capacity in people with COPD. (SL, 2014) Walk training improve peak walking capacity, cycle capacity, and quality of life. Pulmonary rehabilitation is recognized as a core component of the management of individuals with chronic respiratory disease (Martijn, 2013). Pulmonary rehabilitation is defined as an "evidence- based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decrease daily life activities. Integrated into the individualized treatment of the patient, pulmonary rehabilitation is designed to reduce symptoms, optimize functional status, increase participation, and reduce healthcare costs through stabilizing or reversing systemic manifestations of the disease (Glynna *et al*., 2007). Ms. Sulenur, had proved that, the ISWT can be considered a valid and reliable test to assess maximal exercise capacity in individuals with chronic respiratory diseases (Sulenur, 2013). de Camargo had done study on Incremental Shuttle Walking Test: A Reproducible and Valid Test to Evaluate Exercise Tolerance in Adults With Non-cystic Fibrosis Bronchiectasis, found that The ISWT is reliable, represents functional capacity, and induces greater desaturation than cycling. Age, body composition, pulmonary function, dyspnea, and physical activity in daily life are determinants of the distance walked on the ISWT (de Camargo *et al*., 2014). For detection of both obstructive and restrictive lung impairment, FEV1/FVC is reliable tool (Toda, 2009). Health-related quality of life is a potentially important marker for evaluating existing and new therapies in bronchiectasis. The Leicester Cough Questionnaire (LCQ) is a symptom specific questionnaire designed to assess the impact of cough severity, a major symptom of bronchiectasis (Toda, 2009; Ma *et al*., 2009; Murray *et al*., 2007; Huisman, 2007; Birring *et al*., 2003) so ISWT, LCQ AND FEV1/FVC are good tool to assess exercise tolerance and cough-related quality of life in non-cystic fibrosis bronchiectasis patients. So, The aim of this study is to evaluate the short term and long term effect of PR and ground based walking on exercise tolerance and cough related quality of life in non-cystic fibrosis bronchiectasis patient. And to compare the effect of ground base walking and PR ON exercise tolerance and cough related quality of life in non-cystic fibrosis bronchiectasis patient.

MATERIALS AND METHODS

Study Algorithm



Methods of collection of data

Patient who were referred by pulmonologist and already diagnosed as having non-cystic fibrosis on CT-scan investigation were assessed before recruitment in the study. Out of 50 patient, 46 patients who matched inclusion and exclusion criteria were Included in the study. An informed and written consent were obtained from each of the patient in which the patients were agree to participate in the study. Stop watch, Metronome, Pulse oxymeter, Paper, Pen, Computerizes PFT instrument, Standard measure tap, Chair and Table were used during study.

Inclusion criteria

Exertional dyspnoea (Modified Medical Research Council (MMRC) score ≥ 1), Patient have a diagnosis of non-cystic fibrosis bronchiectasis that is, confirmed radio logically on high resolution computed tomography, They must be clinically stable, with no evidence of an exacerbation of bronchiectasis orchanges in medical therapy in the previous four weeks, A history of at least two exacerbations per year over the past two years.

Exclusion criteria

Smoking history ≥ 10 pack years or physician diagnosis of COPD, a clinical diagnosis of asthma, interstitial lung disease(clinical/radiological diagnosis) ,Medical conditions which could place the individual at risk during exercise testing or training (eg. unstable cardiovascular disease) or conditions

that may restrict the participant's ability to exercise (eg. severe orthopedic or neurologic impairments. Participation in a PR program within the last 12 months. Other concurrent respiratory diseases, including interstitial lung disease (ILD) or asthma (clinical diagnosis and reversibility > 12%).

Duration of the study

8-weeks (1october-1december) and follow up after two month.

Outcome measures

1. Incremental shuttle walk test (ISWT) 2. Pulmonary function test (FEV1/FVC) 3. Leicester Cough Questionnaire (LCQ). To measure exercise tolerance and cough related quality of life, above mentioned test were used at the baseline and after post-training.

Procedure

Subjects who has clinical features like dyspnea, excessive sputum production, reduced exercise tolerance, recurrent infection, fatigue, and reduced quality of life were correlated with high resolution computed tomography finding. Then the subject were included in the study if the clinical finding were matched with CT-scan finding. Based on this, patient were screened for inclusion and exclusion criteria. Subjects fulfilling the inclusion criteria were requested to participate in the study. Informed consent form were obtained from the subjects. Subjects were allocated into two equal groups using simple random table in to Experimental group and control group.

Experimental group was treated with pulmonary rehabilitation and control group was treated with ground base walking for 8-weeks and follow up were taken after 2- month of exercise. Outcome measures were taken at base line and after 8-weeks of exercise programme. After 2 month of the study, frequency of acute exacerbation were measured. Patient were asked to maintain a record of their acute exacerbation for 2-month. At the end of 2-month the data will be collected by telephone interview.

Group-I: (Experimental group)

Experimental group were given pulmonary rehabilitation.

F: Twice /week
I: 75% maximal speed achieved in incremental shuttle walk test
T: 45 minute- 1 hour
T: pulmonary rehabilitation.

Pulmonary rehabilitation were include education, aerobic exercise, breathing exercises, Chest mobility and lower limb & upper limb strengthening exercises. Exercise training consisted of an individually prescribed exercise program and included land based walking, with the initial intensity set to 75% of the maximal speed achieved on the incremental shuttle walk test (ISWT) and upper and lower limb strength training using free weights and/or body weight. They were given health education regarding the disease.

Resistance training includes 1 to 3 sets of 8 to 12 repetitions should be undertaken on 2 days each week. Initial loads equivalent to either 60 to 70% of the one repetition maximum (i.e., the maximal load that can be moved only once over the full range of motion without compensatory movements) or one that evokes fatigue after 8 to 12 repetitions are appropriate. The exercise dosage must increase over time (the so-called overload) to facilitate improvements in muscular strength and endurance. This increase occurs when an individual can perform the current workload for 1 or 2 repetitions over the desired number of 6 to 12, on 2 consecutive training sessions. Overload can be achieved by modulating several prescriptive variables: increasing the resistance or weight, increasing the repetitions per set, increasing the number of sets per exercise, and/or decreasing the rest period between sets or exercises. Exercises were progressed each session according to patient symptom ratings (modified Borg scale for dyspnoea and perceived exertion). Attendance of at least 12 out of 16 exercise sessions was considered completion of the exercise intervention. Following the establishment of a safe exercise regimen, a home exercise program was prescribed in week one, with the aim of achieving three to five unsupervised sessions per week with sessions recorded in an exercise diary.

In PR educational program include following:

Normal pulmonary anatomy and physiology, Pathophysiology of chronic resp iratory disease, Communicating with the health care provider, Interpretation of medical testing, Breathing strategies, Secretion clearance techniques, Benefits of exercise and physical activities, Energy conservation during activities of daily living Healthy food intake, Irritant avoidance, Early recognition and treatment of exacerbations, Leisure activities, Coping with chronic lung disease Participants were instructed to maintain this routine during the follow up period and were reminded via monthly telephone calls over the follow up period.

Group-II: (Control group)

Control group were given advised regarding 30-min of daily walking for general health benefit along with health education. Health education include same as pulmonary rehabilitation educational program. The control group did not receive supervised exercise training but were informed at baseline that undertaking 30 minutes of moderate intensity physical activity most days of the week was associated with health benefit. During the eight week intervention, participants were contacted by telephone twice-weekly, to provide support and general advice with no discussion of exercise or physical activity. All the participants will be evaluated till 2 month regarding acute exacerbation symptoms by telephone interview.

At the end of study both the group were evaluated for incremental shuttle walk test, FEV1/FVC and Leicester Cough questionnaires. Patient's follow-up were taken after 2 month, in which acute exacerbation were measured. Patient were asked to maintain a record of their acute exacerbation for 2-month. At the end of 2-month the data were collected by telephone interview.

All participants maintained a daily diary recording regarding changes in symptoms. This symptom record was used to identify an exacerbation, which was defined as the presence of ≥ four signs and symptoms (including change in sputum amount, thickness or color, hemoptysis, increased cough, tiredness, shortness of breath or 38 degrees Celsius).For two or more consecutive days with and without prescription of new antibiotics. To ensure adherence to diary completion, participants in both groups were contacted by telephone every weekly over the follow up period. Exacerbation data were extrapolated from diary records by an independent assessor blinded to group allocation, which was then verified with the participant's general practitioner or hospital records.

Unpaired t-test were used to determine significance difference in outcome measure between two groups. Paired t-test were used to determine significance difference in outcome measurements before and after the intervention. Each calculates t-value was compared with t- table value to test hypothesis at 0.05 level of significance. Data were analyzed with the help of using graph pad prism 5.03 statistical tools.

DISCUSSION

Bronchiectasis has a heterogeneous clinical profile, secondary to the multiple etiologies from which it may originate.

Table 1. Baseline characteristics of data

Characteristic	Exercise group	Control group
Total number of patient	23	23
Age (year)	50.71	49.26
Male	12	11
Female	11	12
Incremental shuttle walk test distance(m)	323.0	328.86
FEV_1/FVC	73.87	72.61
LCQ-Physical	38.13	36.87
LCQ-Psychological	35.83	35.65
LCQ-Social	20.70	19.78

Table 2. Inter group comparison of ISWT distance, FEV1/FVC, LCQ

Outcomes		EXPERIMENTAL		CONTROL		p-value	Df
		MEAN	S.D.	MEAN	S.D.		
ISWT Distance	POST	534.35	158.11	440.87	140.84	0.0001	22
FEV1/FVC	POST	82.52	5.38	76.13	7.54	0.0009	22
LCQ-Physical	POST	44.96	4.04	40.26	44.62	0.0001	22
LCQ-psychological	POST	40.70	3.15	35.65	3.23	0.0001	22
LCQ-Social	POST	23.22	3	21.26	2.32	0.0001	22
Episode of acute exacerbation	POST	0.13	0.34	0.17	0.39	0.68	44

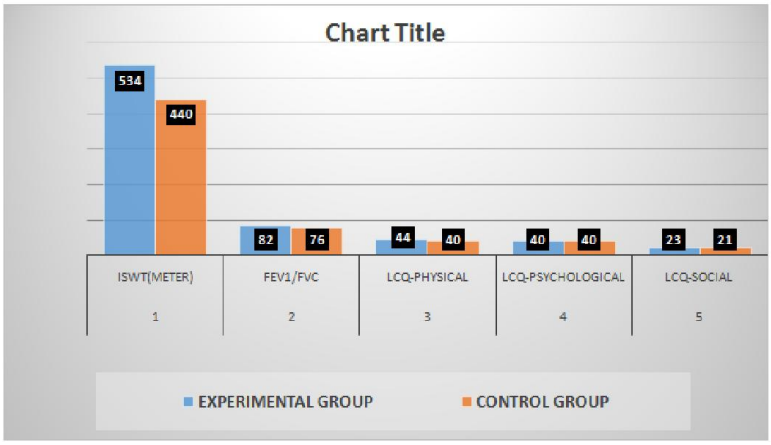


Chart 1. Inter group comparison of ISWT distance, FEV1/FVC, LCQ

Statistical Analysis

This study was to analyze the effect of the pulmonary rehabilitation in the patient with non-cystic fibrosis bronchiectasis by using incremental shuttle walk test distance, FEV1/FVC, and LCQ. 46 patients were taken and were divided in two equal group, i.e. 23 in experimental group and 23 in control group.

Although the precise global prevalence is unknown, bronchiectasis remains a cause of excessive morbidity. In the current climate of limited health resources, it is important to provide interventions which not only contribute to improved HRQoL, but positively impact on disease progression and prognosis (Lee *et al*., 2010). Results from this study will help to determine the efficacy of supervised twice-weekly pulmonary rehabilitation upon exercise capacity and quality of life in

patients with bronchiectasis and will contribute to clinical practice guidelines for physiotherapists in the management of this population. The present study was done to find the effect of pulmonary rehabilitation on exercise tolerance and quality of life in non-cystic fibrosis bronchiectasis patients. An experimental approach was chosen for conducting the study with pre-test and post-test design which is experimental in nature. Random sampling technique was used for selecting the sample of n=23 subjects in experimental group and n=23 subjects in control group giving a total sample size of 46. Following a 8-week intervention, both group showed significant improvement in incremental shuttle walk distance, FEV_1/FVC, Leicester Cough Questionnaire (LCQ).In LCQ there was significant difference in all three component of questionnaires' i.e. physical, psychological and social but when post- intervention values of both the group were compared, pulmonary rehabilitation group (experimental) showed significantly increase in ISWT distance, FEV1/FVC, LCQ in compare to control group.

The study shows the effects of exercise training in patients with bronchiectasis. It has shown that the improvements in exercise capacity are similar to those obtained after pulmonary rehabilitation in patients with COPD. Pulmonary rehabilitation, incorporating high intensity exercise training, was effective in improving ISWT distance, LCQ, and FEV1/FVC in patients with non-cystic fibrosis bronchiectasis. Study conducted on effects of exercise training in non-cystic fibrosis bronchiectasis – a randomized controlled trial. They concluded that exercise training in bronchiectasis is associated with short term improvement in exercise capacity, dyspnoea and fatigue and fewer exacerbations over 12 months (Lee *et al*., 2014). Study conducted a study on "Pulmonary rehabilitation inpatients with bronchiectasis: pulmonary function, arterial blood gases, and the 6-minute walk test."They concluded that the reappears to be beneficial impact of PR on PFT in certain groups of patients with bronchiectasis. In addition, PR indications and rotocols for patients with bronchiectasis may need to be adapted to accommodate specific patients, so that expressive exercise capacity improvement can be achieved (Zan Zellar *et al*., 2012). Study conducted on "Effects of pulmonary rehabilitation in bronchiectasis:

Ninety five patients with bronchiectasis completed the 6 to 8 weeks PR. 6-minute walk distance (6MWD) and Chronic Respiratory Disease Questionnaire (CRQ). Significant improvements immediately following PR. In patients with complete follow-up (n = 37), these improvements remained significantly higher than baseline at 12 months). The time trend and changes in the 6MWD and CRQ scores were not significantly different between the bronchiectasis and the COPD groups (Ong, 2011). PR does not reverse the disease but reduces symptoms, disability, and mortality, resulting in a decrease in hospital stay and reduction in hospital admissions, thus lowering the cost burden on health care system (Birring *et al*., 2003). A study the Pulmonary rehabilitation for patients with bronchiectasis shows ,the improvements in both exercise capacity and health status observed at the end of the PR program were maintained in a 6-month follow-up after the cessation of training with also a reduction of acute bronchial exacerbations. These results highlighted the potential role of PR in patients with bronchiectasis (Santamato *et al*., 2012). We have demonstrated short term gains in exercise capacity as well as improvement in symptoms of cough related quality of life, but these benefits were not sustained beyond program completion. Mean improvement in the ISWD in experimental group was 148.09 m in compare to control group which was 118 m. pulmonary rehabilitation, an increase in physical activity is evident, but the magnitude is small, with suggestions that a longer duration of treatment is necessary to encourage behavioral change. The distance walked (6 minute walk distances, [6MWD]) has demonstrated strong correlation with peak rate of oxygen uptake and maximum work rate in patients with chronic respiratory disease. To allow for familiarization (or learning effect), two tests will be conducted using a standardized protocol with the greatest distance recorded. The 6MWT is responsive to PR (Lee *et al*., 2010). The research found that symptoms of chronic cough, sputum production and fatigue, based on the St George's Respiratory Questionnaire were associated with reduced exercise capacity in patients with mild to moderate bronchiectasis.

This implies that strategies such as a PR program which incorporates self-management and adherence to ACT may have an equally positive impact on both diminished exercise capacity and clinically relevant dimensions of HRQoL, both of which will be important outcomes for all patients with bronchiectasis. Given the relationship between exacerbation rate and decline in pulmonary function, it would be highly significant if PR were to impact on the incidence of acute exacerbations in bronchiectasis. As both declining respiratory function and reduced physical activity are associated with increased mortality in this population, achieving a reduction in the incidence of pulmonary exacerbations would result in PR being one of the few available treatments with the potential to modify the disease course and prognosis in bronchiectasis and may be an inexpensive complement to existing medical care (Lee *et al*., 2010). Exercise training was associated with a greater improvement in cough related quality of life. All domains of LCQ- were had significant improvement. Exercise training was associated with a greater improvement in FEV_1/FVC. Improved immune function has been demonstrated with moderate intensity exercise in healthy elderly individuals; a similar mechanism may be present in this study. In bronchiectasis, the increase in expiratory flow and promotion of annular airflow during a single session of exercise has been associated with improved mucociliary clearance, although the long term effects are unknown (Newall, 2005). Acute exacerbation at the end of two month follow up didn't show any significant difference compare to control group.

Conclusion

This study concluded that 8-weeks of pulmonary rehabilitation programme is more beneficial than ground based walking in patient with non-cystic fibrosis bronchiectasis. Frequency of acute exacerbation was reduced in pulmonary rehabilitation group than in the control group after 2- month of follow-up.

In the present study null hypothesis is accepted and alternative hypothesis is rejected.

Limitation of the Study

- This study can be performed with large number of population.
- This study was only restricted to Non-cystic bronchiectasis patients,
- The study has not been done for long term effect of pulmonary rehabilitation on Non-cystic fibrosis can be checked if longer duration is choose.
- This is the short duration study, the population included in the study was taken from only Anand district.

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