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Priya Accal Thomas
Post Graduate, Student School of Medical Education, Kottayam, Kerala, India

A Nizar
M.P.T (Orthopaedics), Department of Physiotherapy, School of Medical Education, Kottayam, Kerala, India

Corresponding Author:
Priya Accal Thomas
Post Graduate, Student School of Medical Education, Kottayam, Kerala, India

Efficacy of autogenic drainage in pulmonary function in patients with bronchiectasis

Priya Accal Thomas and A Nizar

Abstract
Objectives: To study the efficacy of autogenic drainage as an adjunct to conventional therapy and conventional therapy alone in the management of patients with bronchiectasis.
Method: The study conducted was an experimental approach. A sample of 22 patients satisfying the inclusion criteria were divided into control group and experimental group. The control group received conventional therapy of postural drainage, percussion, coughing and breathing technique. For experimental group in addition to conventional therapy, autogenic drainage was given. Total treatment duration was 21 days. The patient was assessed using spirometry for pulmonary function. The pre-test values were taken on the 1st day and post-test values were taken on the 21st day of treatment.
Results: Statistical analysis using both dependent and independent 't' test showed that autogenic drainage along with conventional therapy improved FVC, FEV_1 and $FEF_{25-75\%}$. Conventional therapy increased FVC, FEV_1 and $FEF_{25-75\%}$. All the pulmonary function parameters above increased more in the experimental group than in the control group.
Conclusion: Autogenic drainage as an adjunct to conventional therapy can be used as an effective treatment in improving pulmonary function in patients with bronchiectasis.

Keywords: Autogenic drainage, postural drainage, bronchiectasis

Introduction
Bronchiectasis is defined by pathology and radiology as an abnormal and permanent dilation of bronchi and bronchioles which is characterized by progressive, irreversible destruction and dilation of airways, generally associated with chronic bacterial infection (David Currie, 2002, Steven E. Weinberger, Kolbe J, Wells AU) [63].
Although in Western countries the morbidity and mortality has declined, bronchiectasis continues to be a significant cause of morbidity and mortality in the Southern West Pacific areas and also in South East Asia regions. Factors such as poverty, substandard housing, malnutrition, barrier to medical care and inadequate education are all likely to have a major impact on prevalence and outcome for this disease (Kolbe J, Wells AU). In a review of the National Hospital Discharge Register in Finland, 842 patients were identified as bronchiectasis between age group 35-74 years (1982-1986). During a follow up period of 8-12.9 years (1993) the number of hospitalized patients varied widely. There were 239 deaths (28%), 319 deaths (38%) and 165 deaths (20%) among bronchiectasis, COPD and asthma respectively. The underlying disease was the primary cause of death in patients with bronchiectasis and COPD (Alan F. Barker). Infection was usually the precipitating cause of death (Willy E. Hammon, Scott Hasson). Cor-pulmonale a complication of diffuse long standing bronchiectasis, accounts for about 50% of deaths (Konietzki, Carton & Leroy 1969) [22].
It is difficult to offer a specific figure on the prevalence of the disease due to its varied causes (Jan Stephen Tecklin). But on routine radiology it was found to be 1.5 per 1000 in 1956 carried out in England and Wales during the tuberculosis eradication campaign (Douglas Seaton). Prevalence of bronchiectasis worldwide is unknown. There are high reports of prevalence in relatively isolated population with poor access to health care and high rates of respiratory tract infection during childhood (Alan F. Barker).
Airway clearance has been shown to benefit patients with bronchiectasis in mobilization of sputum (Mazzacco 1985, Gallon 1991) [28]. Healthy adults secretes ounces of mucus into the lungs daily. For them airway clearance is so routine, it is almost imperceptible.

In bronchiectasis, since their ciliary function is destroyed, there will be retention of secretions in their lungs resulting in declined lung functions.

Patients once diagnosed with bronchiectasis are entitled to a life long regime of an airway clearance technique, to mobilize the cycle of excess sputum production and airway damage. Repeated broncho pulmonary infection can contribute to worsening pulmonary function and an earlier death. Today, prognosis for each individual depends on the extent of the disease process at the time of diagnosis and on proper medical management. Patients with moderate localized disease, if treated properly, may have a relatively normal life expectancy (Willy E. Hammon, Scott Hasson).

Strenuous breathing and clearance efforts may be the first symptom of impaired airway clearance (Lynda Thomas *et al.*). Chest physiotherapy has for decades enjoyed the status of 'Gold Standard' chest physiotherapy in an airway clearance technique that combines postural drainage and manual percussion for mucus drainage along with cough and breathing technique for its clearance (AACPT).

This has been challenged recently (Lapin 1994) [23]. These traditional chest clapping and reclined prone on bed with head down should be replaced, since it is difficult and uncomfortable for many patients (Alan F. Barker). Caregivers have also been shown to suffer from the performance of percussion, that is, repetitive motion injury to the wrist have been documented as a result of regular performance of percussion (Ford, Godreau, Burns 1991) [14]. Lack of assistance to provide airway clearance can be another factor that prompts many patients to seek for another method other than postural drainage and percussion (Anne Mejia Downs).

Autogenic drainage is one such alternative technique that has been recently a rised out of need to find effective methods for patients not responding or tolerating traditional methods. This technique has been used for many years in European countries but more recently used in the United States (Anne Mejia Downs).

Methodology

Research approach

This is an experimental approach.

Research design

Study design adopted for the study was pre-test, post-test control group design

Outcome measurement

Spirometer is used to assess the severity of airflow obstruction.

John Hutchison introduced spirometry in 1846. Some time ago, noted physiologist Joseph Milic Emili wrote on 150 years of blowing citing the work of Hutchison, who coined the term Vital Capacity and Tiffeneau of Paris added the timed Vital Capacity (FEV_1) to spirometry (Thomas L. Petty MD).

It is important to ensure that reference values in pulmonary function test are applicable to the population being tested in relation to age, height and sex. Here reference values have been obtained from Ashok Fulmanbarker, MD, FCCP *et al.* (2004) [46].

Treatment procedure

A) Experimental group

Pretest with spirometer was taken after which conventional therapy and autogenic drainage was given. And initial 2 days, 1 hour training session was required to help the patient master the technique.

Preparation for Autogenic Drainage

1. Patient should be seated upright in a chair with a back support. The surrounding should be devoid of distraction, allowing the patient to concentrate on the breathing technique.
2. Upper airways should be cleared of secretions (nose and throat) by blowing or huffing.
3. Therapist should be seated at the side and slightly behind the patient, close enough to hear the patient breathing. One hand should be placed to feel the work of the abdominal muscles and the other hand on the upper chest.

Technique

1. In all phases inhalation should be done slowly through the nose using the diaphragm or lower chest. A 3 second breath hold should follow allowing collateral ventilation, to get air behind the secretions.
2. Exhalation should occur through the mouth with glottis open causing the secretions to be heard. The vibrations of the mucus are felt with the hands placed on the upper chest.
3. **Unsticking phase:** This mobilizes the mucus from the periphery to the lungs.
   - It is a low lung volume breathing
   - Patient is asked to breath slightly less than tidal volume
   - Followed by a deep expiration as far as possible by contracting the abdominal muscles to achieve it
4. **Collecting phase:** This collects the mucus into the middle airways.
   - It is from a low lung volume to a middle lung volume
   - Patient is asked to inspire in the tidal volume but not his maximum inspiratory capacity
   - Followed by forceful expiration to move a greater volume of air
5. **Evacuation phase:** The collected mucus is evacuated from the central airways.
   - It is from a middle to high lung volume.
   - Patient is asked to breath in as much as possible to his maximum inspiratory capacity.
   - Followed by forceful expiration which brings the secretions into the trachea ready to be expectorated.

Dosage

Each phase is given 3 minutes, with a total of 9 minutes and 1 minutes to relax by performing breathing control. This completes one cycle. This cycle is done three times that is a total of 30 minutes.

B) Control group

The commonest site affected are the lower lobe and lingual and then the middle lobe, it tends to affect the left lung more than the right lung. Although 50% of cases are bilateral. The upper lobes are least affected since they drain out efficiently with assistance of gravity.

Preparation for postural drainage

- Adequate intake of fluid to decrease the viscosity of secretion (30 minutes before therapy).
- Technique.

Lower lobe:

- **Apical segment:** Patient lies prone with head turned to one side, arms relaxed in a comfortable position by the side of the head and a pillow under the hips.
- **Anterior basal segment:** Patient lies supine, buttocks resting on a pillow and knee bent. Foot of the bed raised 46cm (18") from the ground. Chest tilted to an angle of 20°.
- **Posterior basal segment:** Patient lies prone head turned to one side, arms in a comfortable position by the side of the head and a pillow under the hips. Foot of the bed raised 46cm (18") from the ground. Chest tilted to an angle of 20°.

All the above positions done for both left and right lungs together.

- **Lateral basal for left lung:** Patient lie on right side with pillow under the hips and foot of the bed raised 46cm (18"). Chest tilted to an angle of 20°.
- **Lateral basal for right lung:** Patient lies on left side with pillow under the hips and foot of the bed raised 46cm (18"). Chest tilted to an angle of 20°.

The side more affected has to be treated first, then turned to the other side.

Middle lobe

- **Lingual:** Patient lies on his body quarter turned to the right maintained by a pillow under the left side from shoulder to the hip and arms relaxed by the side. Foot end raised to 35 cm (14") from the ground. The chest tilt to an angle of 15°.

Middle lobe (right side)

- The patient lies on his back with his body quarter turned to left maintained by a pillow under the right side from shoulder to hip and the arms relaxed by the side. Foot end raised to 35 cm (14") form the ground. The chest tilt to an angle of 15°.

Dosage

Each position is maintained for 5 minutes along with percussion.

Percussion

Percuss each localized area for 5 minutes. A rhythmical force is applied by the therapist's cupped hands with thumb adducted against the chest over the affected lung segment, trapping air between the patient's thorax and the therapist's hands. It is performed both during inspiratory and the expiratory phase. Percussion aims to loosen the retained secretions from the airways. The rate of manual percussion is normally 100-480 times/minutes.

Coughing

Patient is asked to take a deep breath in, tighten the abdominal muscles and forcefully breath out with a closed glottis.

Dosage

Done 3-5 times. If more secretion present, given a gasp of 5-10 seconds for breathing control before the next cycle of coughing is performed.

Breathing control

This is normal tidal breathing using the lowest chest with relaxation of the upper chest and shoulder. This used to be know as 'Diaphragmatic breathing'. To teach the patient breathing control, patient should be in a comfortable well supported, sitting position. The patient is encouraged to relax his upper chest, shoulder and arms while using the lower chest. Both hands can be positioned lightly on the upper abdomen. As the patient breaths in, the hands should be felt to raise up and out as the patient breaths out hands sinks down and in.

Dosage

Done for 5-10 seconds.

Statistical analysis

Demographic presentation of age

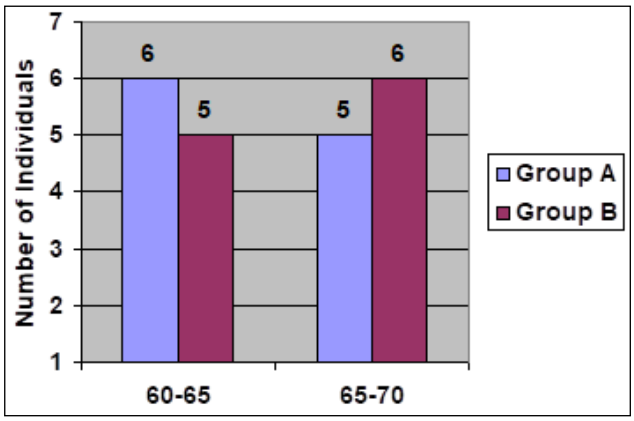

Fig 1: Demographic Presentation of Age

Demographic presentation of sex

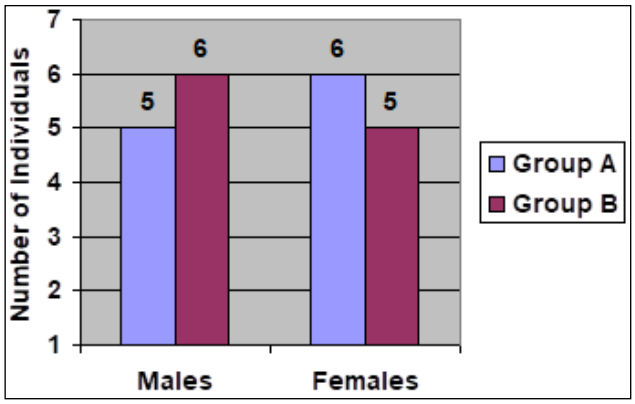

Fig 2: Demographic Presentation of Sex

Demographic presentation of BMI

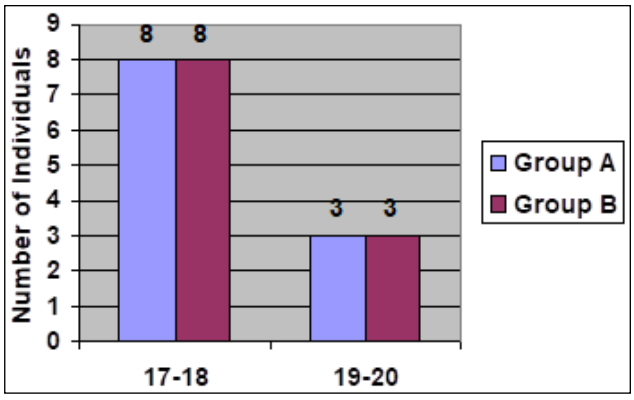

Fig 3: Demographic Presentation of BMI

4.1.5(b) Statistical Analysis and Results of FVC Values in Pulmonary Function Test of Control and Experimental group.

Table 6: Statistical Analysis and Results of FVC Values in Pulmonary Function Test of Control and Experimental group

Group	Initial FVC Values in litres	Unpaired 't' values	Final FVC values in litres	Unpaired 't' values	Paired 't' values
Group A	1.683	0.829	1.757	2.338	15.588
Group B	1.720		1.860		21.191

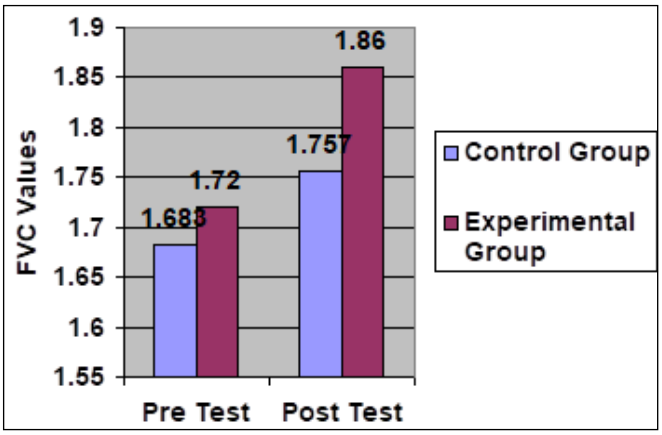

Fig 5: Comparison of FVC Mean Values

4.1.6(b) Statistical Analysis and Results of FEV_1 Values in Pulmonary Function Test of Control and Experimental group.

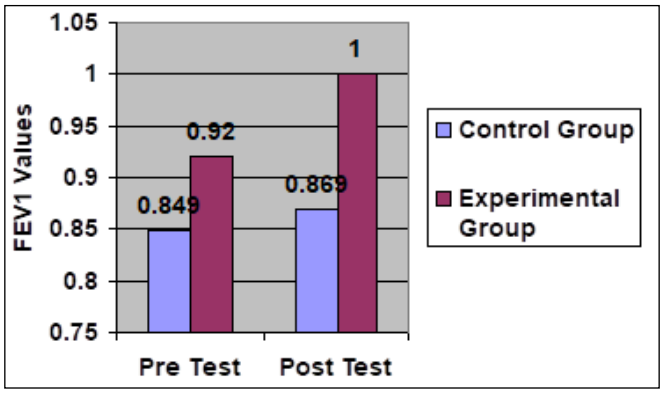

Fig 6: Comparison of FEV_1 Mean Values

Demographic presentation of $FEF_{25-75\%}$ values in pulmonary function test of control and experimental group

4.1.7(a) Pre and Post Test Mean $FEF_{25-75\%}$ Values in Pulmonary Function Test of Control and Experimental group.

Table 9: Pre and Post Test Mean $FEF_{25-75\%}$ Values in Pulmonary Function Test of Control and Experimental group

Group	Mean Values for $FEF_{25-75\%}$			
	Pre Test	Sd.	Post Test	Sd.
Group A	0.404	± 0.047	0.455	± 0.050
Group B	0.433	± 0.105	0.569	± 0.102

4.1.7 (b) Statistical Analysis and Results of FEF $_{25-75\%}$ Values in Pulmonary Function Test of Control and Experimental group.

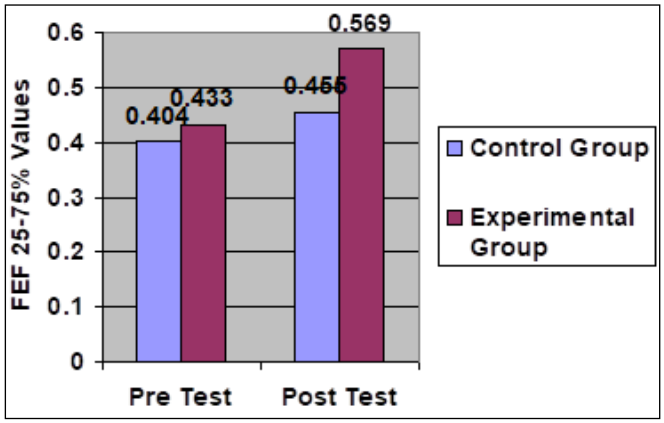

Fig 7: Comparison of $FEF_{25-75\%}$ Mean Values

Analysis and interpretation of FEV_1 Values unpaired 't' test

Pre-test mean

- The average of FEV_1 value for control group before treatment was 0.849. Similarly for experimental group was 0.92.
- After application, test shows that calculated 't' test value (1.142) is not greater than the table value for 't' at 95% significance (t =1.725) showing that there is no significant difference between the two groups.

Post-test mean

- The post test data taken at the end of 21st day of treatment shows that average FEV_1 value of control group was 0.869. Similarly for experimental group was 1.0.
- The calculated 't'value (2.195) is greater than the table value for 't' at 95% significance (t =1.725) showing that there is significant difference between the two groups.

So the null hypothesis is rejected.

Paired 't' test

Control group

- The mean value for FEV_1 pre-test data is 0.849 and post-test is 0.869.
- The calculated 't'value (10.488) is greater than the table value for 't' at 95% significance (t =1.812) meaning that there is significant difference with the given conventional treatment.

Experimental group

- The mean value for FEV_1 pre-test data is 0.92 and post-test is 1.0.
- The calculated 't' value (17.889) is greater than the table value for 't' at 95% significance (t =1.812) meaning that there is significant difference with the given autogenic drainage in combination with conventional treatment.

Analysis and interpretation of $FEF_{25-75\%}$ values unpaired 't' Test

Pre-test mean

- The average of $FEF_{25-75\%}$ value for control group before treatment was 0.404 similarly for experimental group was 0.433.
- After application, test shows that calculated 't' test value (0.833) is not greater than the table value for 't' at 95% significance (t =1.725) showing that there is no significant difference between the two groups.

Post-test mean

- The post test data taken at the end of 21st day of treatment shows that average $FEF_{25-75\%}$ value of control group was 0.455. Similarly for experimental group was 0.569.
- The calculated 't'value (3.303) is greater than the table value for 't' at 95% significance (t =1.725) showing that there is significant difference between the two groups.

So the null hypothesis is rejected.

Paired 't' test

Control group

- The mean value for $FEF_{25-75\%}$ pre-test data is 0.404 and post-test is 0.455.
- The calculated 't' value (14.861) is greater than the table value for 't' at 95% significance (t =1.812) meaning that there is significant difference with the given conventional treatment.

Experimental group

- The mean value for $FEF_{25-75\%}$ pre-test data is 0.433 and post-test is 0.569.
- The calculated 't' value (25.629) is greater than the table value for 't' at 95% significance (t =1.812) meaning that there is significant difference with the given autogenic drainage in combination with conventional treatment.

Discussion

This study is an experimental approach to find the efficacy of autogenic drainage when given as an adjunct to conventional therapy in pulmonary function in patients with bronchiectasis.

The control group receives conventional therapy of postural drainage, percussion, coughing and breathing technique. While the experimental group receives an additional autogenic drainage with conventional therapy. The total treatment schedule was for 21 days with a single session every day.

Pre-test evaluation of the control and experimental group shows that there is no significant difference between the groups before the treatment. When pre-test and post-test analysis of pulmonary function was done within the group, both the control and experimental group shows significant improvement in pulmonary function.

On analysis of the post test results of the control and experimental group it is being evident that the experimental group had a statistically significant improvement in pulmonary function after autogenic drainage was given along with conventional therapy. The results of the present study indicates that patients with bronchiectasis who were given autogenic drainage along with conventional therapy had a statistically significant improvement in pulmonary function. The better results in experimental group may be attributed to the autogenic drainage.

Bronchiectasis is a consequence of inflammation and destruction of the structural components of the bronchial wall. The normally occurring bronchial wall elements-epithelium, cartilage, smooth muscle and glands would be replaced by fibrous tissue. Pathogenesis of bronchiectasis is commonly related to severe inflammation. Infection results in severe inflammatory reaction within the bronchi causing exudative response by the mucus secreting glands, thereby viscous secretions accumulation this causes obstruction of the airways distal to the point of exudation causing atelectasis distal and dilation proximal to obstruction. The infection often interferes with normal mucociliary function, and obstruction prevents adequate expiratory airflow to enable the patient to cough effectively and thereby remove secretions. As obstruction becomes greater and as secretion develop, forced expiratory flow rates decrease.

The mechanism of postural drainage is considered to be a direct effect of gravity on bronchial secretions. Positioning the patient to enable gravity to assist the flow of bronchial secretions from the airways has been a standard treatment for some time in patients with retained secretions. The proposed mechanism of action of percussion is transmission of a wave of energy through the chest wall into the lungs. The resulting motion loosens the secretions from the bronchial wall and move them proximally.

Autogenic drainage was instructed in three phases the first phase starts with inspiration, followed by breath hold for 2-4 seconds to ensure equal filling of lung segments by collateral filling and then a deep exhalation into the expiratory reserve volume range. By lowering mid tidal volume below functional residual capacity level, secretions from peripheral lung regions are mobilized by compression of peripheral alveolar ducts. The second phase consist of tidal volume breathing so that breathing is changed gradually from expiratory reserve volume to inspiratory reserve volume range to mobilize secretions from the apical parts of the lungs. The third phase consist of deeper inspiration into the inspiratory reserve volume, with huffing often used to help in evacuating the mobilized secretions. Mucus is removed by slug flow mechanism which means that semisolid mucus plug obstructing or partially obstructing airway can be pushed from behind the obstruction by airflow.

The functional principle of autogenic drainage technique is based on airway caliber changes in conjunction with a special breathing and cough procedure. It is believed to improve mucus clearance from peripheral airways to more central airways due to airway caliber changes in combination with a special breathing technique (Ernst M. App *et al.*).

Autogenic drainage was found to be at least as effective as conventional treatment and the patients had a marked preference for autogenic drainage (Davidson *et al.*). The flow volume loop is frequently used to support the theory of an increase in airflow with the unforced expiratory maneuver of autogenic drainage (Schoni 1989) [69].

In a short term effect of postural drainage with clapping vs. autogenic drainage where patients with cystic fibrosis were either given postural drainage or autogenic drainage showed no significant difference in pulmonary function test results with either treatment. O_2 saturation also did not fall during autogenic drainage (Donald R Giles *et al.*).

The result obtained after analysis shows 8.14% improvement in FVC in experimental group compared to 4.37% improvement in control group, 8.70% improvement in FEV_1 in experimental group compared to 2.36% improvement in control group and 31.24% improvement in $FEF_{25-75\%}$ in experimental group compared to 12.58% improvement in control group.

Hence the discussion can be summarized as:- Autogenic drainage along with conventional therapy is effective in improving pulmonary function in patients with bronchiectasis.

Conclusion

Bronchiectasis is a condition that requires a life-long regime in enhancing maximum pulmonary hygiene. The present study provides an evidence that autogenic drainage as an adjunct to conventional therapy can be used as an effective treatment in improving pulmonary function in patients with bronchiectasis. In this context, autogenic drainage may be

considered as an essential technique in improving pulmonary hygiene in patients with retained secretions. Supplementing this technique in the rehabilitation programme in bronchiectasis patients may be helpful in independence of both the patients and therapist. This technique does not require any accessories to perform and therefore it is considered as cost effective. Hence autogenic drainage should be included as a part of treatment in the rehabilitation programme of patients with bronchiectasis.

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