

NON-PHARMACOLOGIC THERAPIES AND AIRWAY CLEARANCE TECHNIQUES IN BRONCHIECTASIS

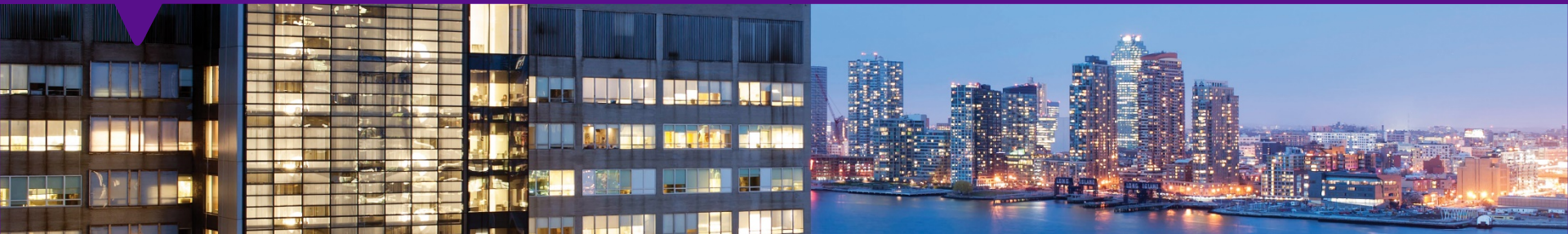
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NTM Patient Education Program

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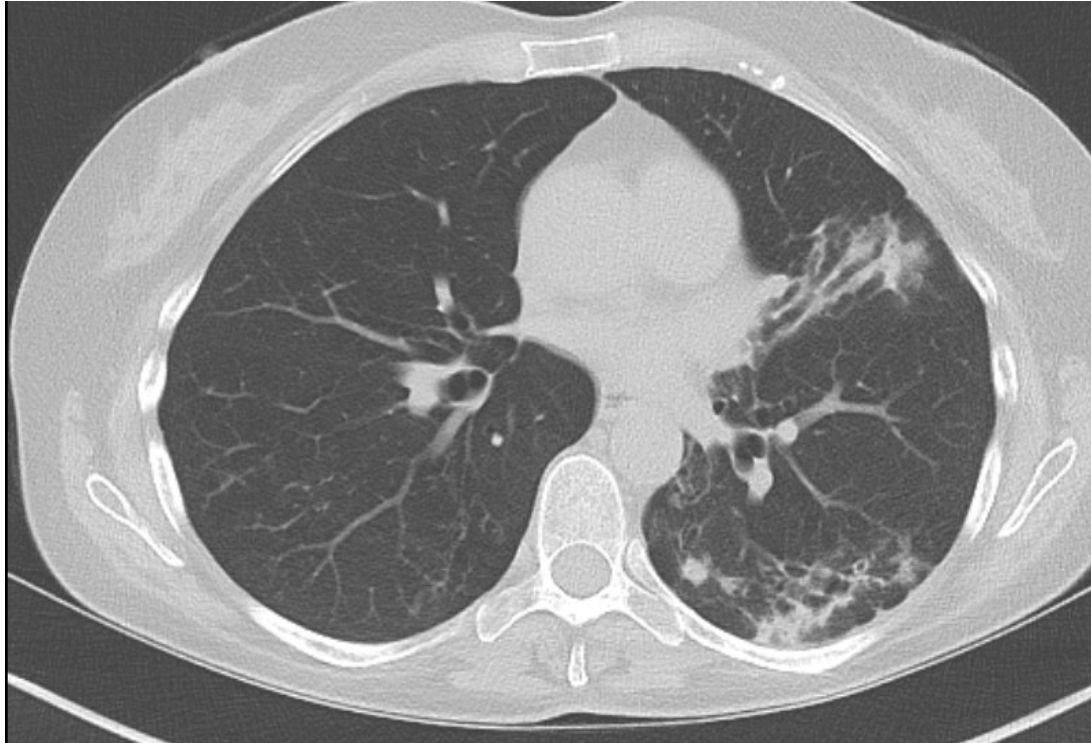


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- COPD foundation grant on airway clearance

Case presentation

- 66 year-old female with a history of prior pneumonia 15 years ago presents with productive cough.
- She has mild shortness of breath. No fevers, no hemoptysis. She has gained two pounds over the year.
- No other prior medical history, and currently not taking any medications
- Initial workup including autoimmune serologies and quantitative immunoglobulin levels were negative.
- You check AFB, bacterial and fungal sputum cultures.
- She has 2 out 3 cultures positive for MAC.



What's the next best step in management?

- A) Start 3 drug antibiotic therapy for MAC
- B) Initiate airway clearance with nebulized hypertonic saline and a positive expiratory pressure device
- C) Start antibiotics for MAC and initiate airway clearance
- D) Closely monitor without initiation of treatment

GOALS OF AIRWAY CLEARANCE

Short term goals

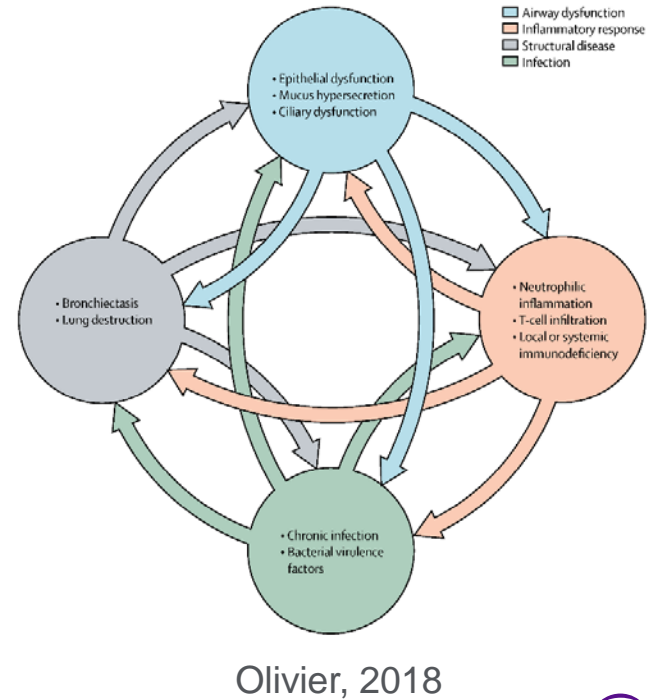
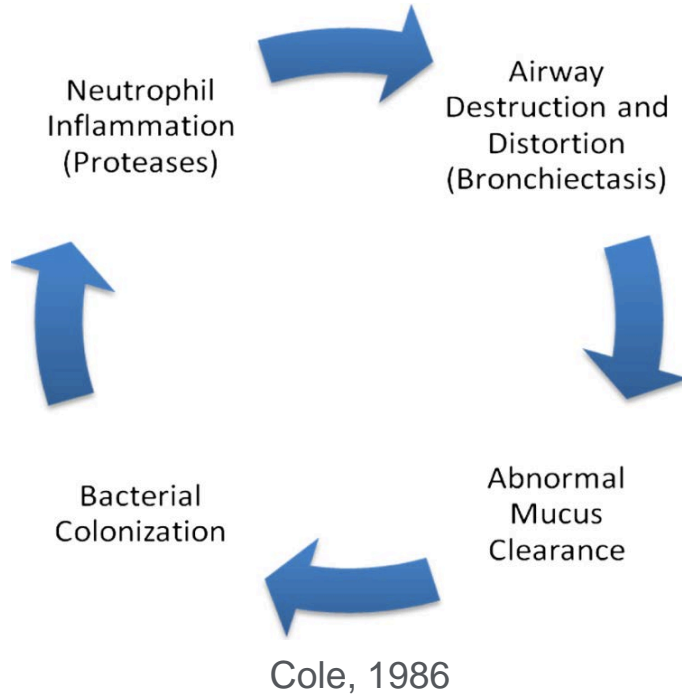
- Provide more effective sputum clearance that improves ventilation
- Reduce cough and breathlessness

Long term goals

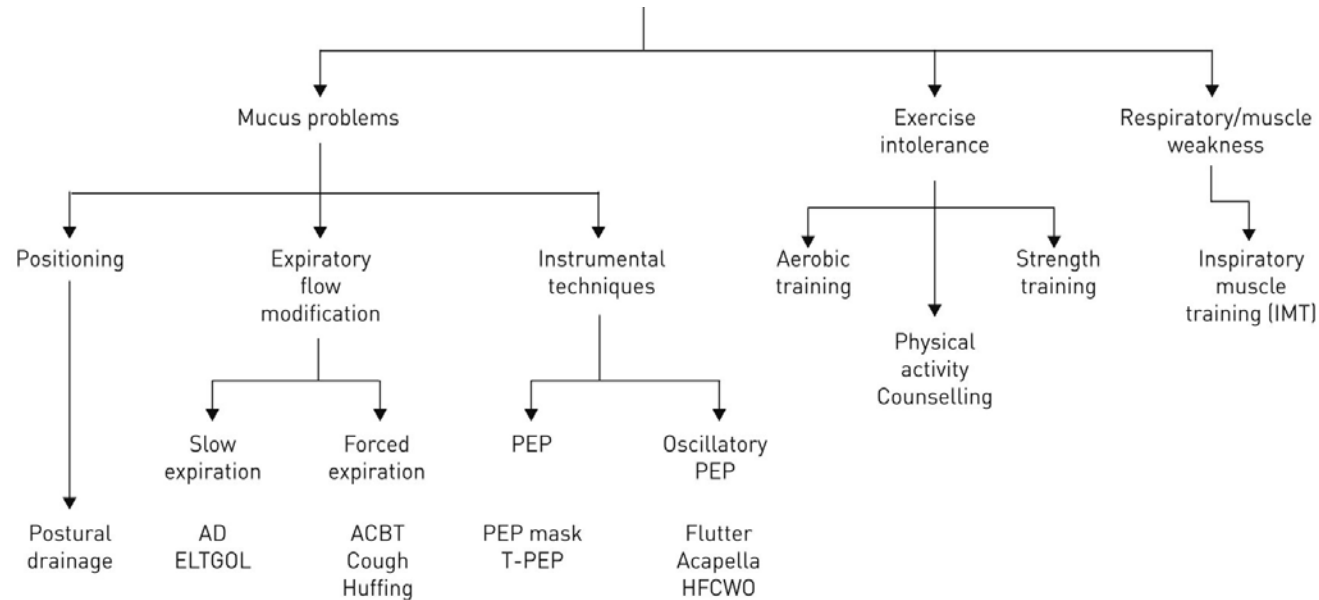
- Reduce further airway damage by halting the vicious cycle
- Reduce pulmonary exacerbations
- Improve quality of life

O'Neill, et al. Respiriology, 2019

The vicious cycle and vortex



European Respiratory Society guidelines for the management of adult bronchiectasis



Polverino et al. Eur Respir J 2017

European Respiratory Society guidelines for the management of adult bronchiectasis

- Patients with chronic productive cough or difficulty to expectorate sputum should be taught an airway clearance technique (ACT) by a trained respiratory physiotherapist to perform once or twice daily.
- Adult patients with bronchiectasis and impaired exercise capacity should participate in a pulmonary rehabilitation programme and take regular exercise.
- Long-term mucoactive treatment (≥ 3 months) in adult patients with bronchiectasis who have difficulty in expectorating sputum and poor quality of life and where standard ACTs have failed to control symptoms should be offered.
- We recommend not to offer recombinant human Dnase.

Polverino et al. Eur Respir J 2017



Treating Cough Due to Non-CF and CF Bronchiectasis With Nonpharmacological Airway Clearance

CHEST Expert Panel Report



- For children and adults with productive cough due to bronchiectasis related to any cause, we suggest that they be taught ACTs by professionals with advanced training in ACTs.
- We suggest that the frequency of ACTs should be determined by disease severity and amount of secretions.
- We suggest that ACTs are individualized as there are many different techniques.

Adult Bronchiectasis Patients: A First Look at the United States Bronchiectasis Research Registry

Timothy R. Aksamit, MD  , Anne E. O'Donnell, MD, Alan Barker, MD, Kenneth N. Olivier, MD, Kevin L. Winthrop, MD, M. Leigh Anne Daniels, MD MPH, Margaret Johnson, MD, Edward Eden, David Griffith, MD, Michael Knowles, MD, Mark Metersky, MD, Matthias Salathe, MD, Byron Thomashow, MD, Gregory Tino, MD, Gerard Turino, MD, Betsy Carretta, MPH, Charles L. Daley, MD, for the Bronchiectasis Research Registry Consortium

- 1826 patients
- Non-pharmacologic measures were used in 56% of patients.
- 48% used flutter or PEP device
- Chest percussion and postural drainage were utilized in 15% and 16% of patients, respectively.
- Mucoactive agents were used in 24% of patients; of these, 76% used hypertonic saline.
- Those with NTM were more likely to use non-pharmacologic measures.

Aksamit, et al, CHEST, 2017

Airway Clearance in Non-Cystic Fibrosis Bronchiectasis: Analysis from the United States Bronchiectasis Research Registry

- Adult patients with productive cough and bronchiectasis, excluding CF and those on antibiotics for NTM
- 1320 patients
- 66.7% of subjects utilized airway clearance at baseline.
- Subjects were more likely to utilize airway clearance at baseline if they had experienced an exacerbation (75% vs 59%, $p < 0.0001$) or hospitalization for pulmonary illness (28% vs 21%, $p < 0.05$) in the prior two years.
- Of those with at least one-year follow-up data, 57% of subjects did not utilize airway clearance at follow-up.

Basavaraj, et al. ATS abstract, 2019

Why is airway clearance not utilized more often?

- Providers may not be prescribing it.
- Patients may not perceive a benefit from it.
- May become a burden to the patient, limiting compliance.
- Research on the efficacy of airway clearance is limited.

Airway clearance

- Improvement in exercise capacity and quality of life (QOL) in patients using an oscillatory device vs. management without chest therapy. (Murray, 2009)
- Improved symptoms, pulmonary function, and reduced CRP and sputum neutrophils in HFCWO vs. PEP device. (Nicolini, 2013)
- Improvements QOL and Leicester cough questionnaires, and fewer exacerbations, in those that performed ELTGOL (slow expiration with the glottis opened in the lateral position. (Munoz, 2018)

Airway clearance

- General consensus is that no one ACT is superior in terms of clinical outcomes.
- Selection of ACT should be based on the patient's individual characteristics.

Mcilwaine, et al. Eur Resp Rev, 2017

Mechanical devices

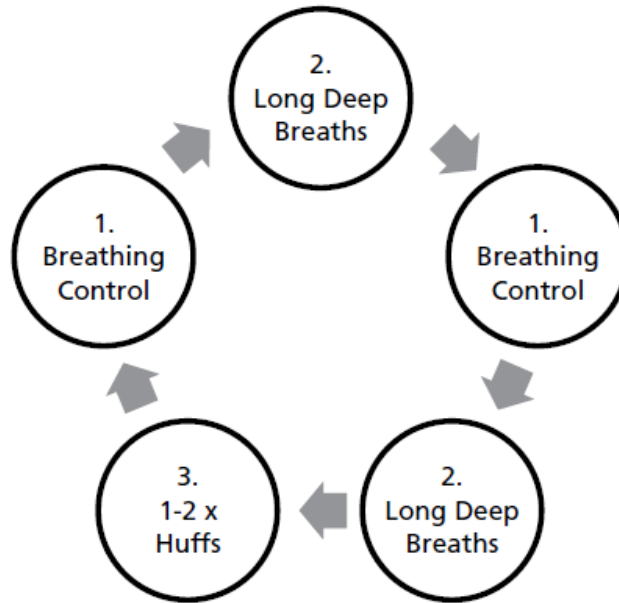
Positive expiratory pressure device



High frequency chest wall oscillation



Active cycle of breathing technique



Manual techniques

- Postural drainage
- Manual chest therapy
- Hydration and humidification
- Optimum functionality of mucociliary clearance requires a temperature of 37 °C.
- Humidity levels below 50% change the particle size making mucociliary clearance less effective (Williams et al 1996).

Mucoactive agents

1. Expectorants

- Induce discharge or expulsion of mucus from the respiratory tract
- Examples include hypertonic saline and guaifenesin.

2. Mucoregulators

- Regulate mucous secretion or interfere with the DNA/F-actin network.
- Examples include carbocisteine and anticholinergic agents.

3. Mucolytics

- Decrease mucous viscosity
- Examples include N-acetylcysteine, erdosteine and DNase.

4. Mucokinetics

- Increase mucociliary clearance by acting on the cilia.
- Examples include bronchodilators and surfactants.

O'Neill, et al. Respiriology, 2019

Hypertonic saline

- Directly stimulates coughing.
- Lowers sputum viscosity, leading to a higher weight of expectorated sputum.
- Helps to humidify airways and enhance ciliary function.
- Appears to be well-tolerated in bronchiectasis patients (Kelly, 2001).



Nebulised 7% hypertonic saline improves lung function and quality of life in bronchiectasis

Fiona Kellett ^{a,*}, Niven M. Robert ^b

- 30 patients with non-CF bronchiectasis
- Randomized to 7% hypertonic saline or placebo (0.9% normal saline) for 3 months
- Excluded patients with pseudomonas
- Improvement in SGRQ scores in 7% hypertonic saline vs 0.9% normal saline

Table 2 Changes in lung function over treatment periods (% change from pre-treatment baseline).

| Phase | Active (HS) | Placebo (NS) | P value |
|--------------------------------------|------------------|-----------------|---------|
| FEV ₁ % change (95% C.I.) | 15.1 (8.2;22.0) | 1.8 (-8.9;10.7) | <0.01 |
| FVC % change (95% C.I.) | 11.23 (8.6;13.9) | 0.72 (-7.4;8.9) | <0.01 |

Table 3 Outcome of exacerbations/health care utilization.

| | Baseline retrospective recall | Active prospective | Placebo prospective | P value active: placebo |
|--|-------------------------------|--------------------|---------------------|-------------------------|
| Annualised antibiotic use <i>n</i> /year | 2.11 | 2.43 | 5.43 | <0.05 |
| Annualised exacerbations <i>n</i> /year | 2.60 | 2.14 | 4.85 | <0.05 |

The long term effect of inhaled hypertonic saline 6% in non-cystic fibrosis bronchiectasis

Caroline H.H. Nicolson ^{a,*}, Robert G. Stirling ^b, Brigitte M. Borg ^c,
Brenda M. Button ^b, John W. Wilson ^b, Anne E. Holland ^d

- 40 patients randomized to 6% hypertonic saline or 0.9% normal saline daily for 12 months
- Significant improvements in QoL, FEV₁, and reduction in sputum colonization in both groups, no difference between the groups.

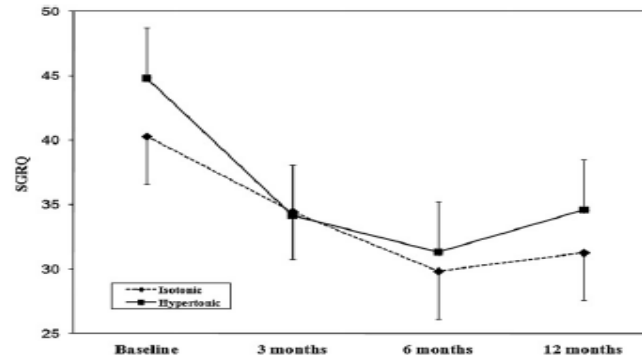


Figure 2 SGRQ Totals. No significant difference between groups at any time point.

Nicolson, et al. *Respiratory Medicine*, 2012

Pulmonary Rehabilitation

- Can help with mucociliary clearance.
- Short-term improvements in exercise capacity and QOL with a combination of endurance, strength and inspiratory muscle training (Newall, 2005).
- May increase time to first exacerbation (Lee, 2014).



Airway clearance techniques for bronchiectasis

Annemarie L Lee^{1,2,3}, Angela Burge⁴, Anne E Holland^{2,3,5}

- ACTs appear to be safe for individuals with stable bronchiectasis.
- There may be improvement in sputum expectoration, selected measures of lung function and health-related QOL.
- The role of these techniques in people with an acute exacerbation of bronchiectasis is unknown.
- More data is needed to establish the clinical value of ACTs on patient outcomes, and differences between various ACTs.

Lee At, et al. Cochrane database syst rev. 2013.

The CLEAR trial

- A large UK multicenter trial
- To determine the clinical and cost -effectiveness of hypertonic saline HTS (6%) and carbocisteine for airway clearance versus usual care over 52 weeks in bronchiectasis using a 2x2 factorial randomized open label trial design.
- The primary objective is to determine whether HTS (6%) and/or carbocisteine reduce the mean number of exacerbations over 52 weeks post randomization.

<http://www.nictu.hscni.net/clear-trial/>

ENaC

- An epithelial sodium channel present on cilia that regulates composition of airway surface liquid via sodium resorption.
- It is downregulated by functional CFTR and its consequent upregulation in Cystic Fibrosis patients contributes to viscous mucus.
- Downregulation of ENaC may be a potential therapeutic strategy for reducing mucus viscosity and improving clearance of lower airway secretions.
- ENaC inhibitors are being investigated in the primary ciliary dyskinesia population (NCT02871778).

Physiotherapy

[Home / Physiotherapy](#)

Principles of airway clearance



- Airway Clearance in the Normal Lung
- Hydration and humidification
- Management Plan
- Choosing a technique
- Case Study

Techniques



- Videos of physiotherapy techniques
- The active cycle of breathing technique
- Forced Expiration Technique
- Positive Expiratory Pressure Therapy
- Oscillating Positive Expiratory Pressure Therapy
- Autogenic Drainage
- Gravity Assisted Drainage
- Manual Techniques
- Inhalation Therapy via a Nebuliser

Exercise



- Why prescribe exercise in bronchiectasis
- Exercise prescription

Summary

- Airway clearance is an important management strategy in bronchiectasis.
- Techniques include positive expiratory pressure devices, HFCWO, breathing techniques, manual chest therapy, mucoactive agents and pulmonary rehabilitation.
- Utilization is limited and patient adherence can be poor.
- Further research is needed.



THANK YOU



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