Airway Clearance Therapy for the Patient with Bronchiectasis

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Objectives

- Why should we do airway clearance therapies?
- How do we perform airway clearance therapies?
- What other therapies augment clearance of airway secretions?

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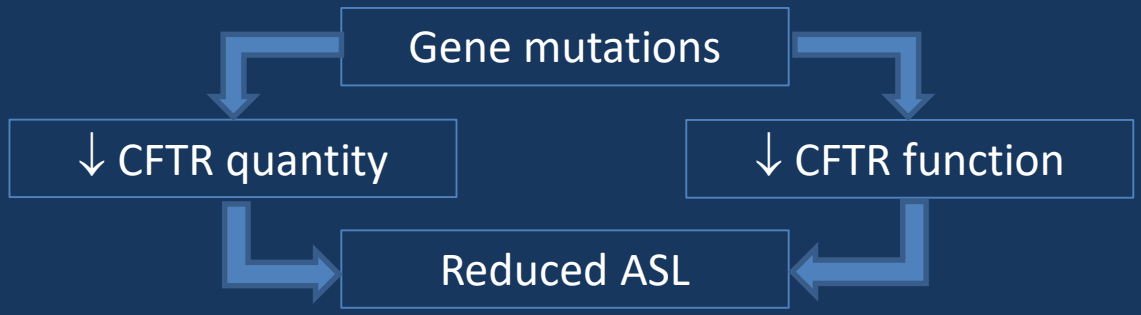
Indications for Airway Clearance

- excessive sputum production
- ineffective cough
- evidence of retained airway secretions
- atelectasis caused by mucus plugging
- presence of foreign body in airways

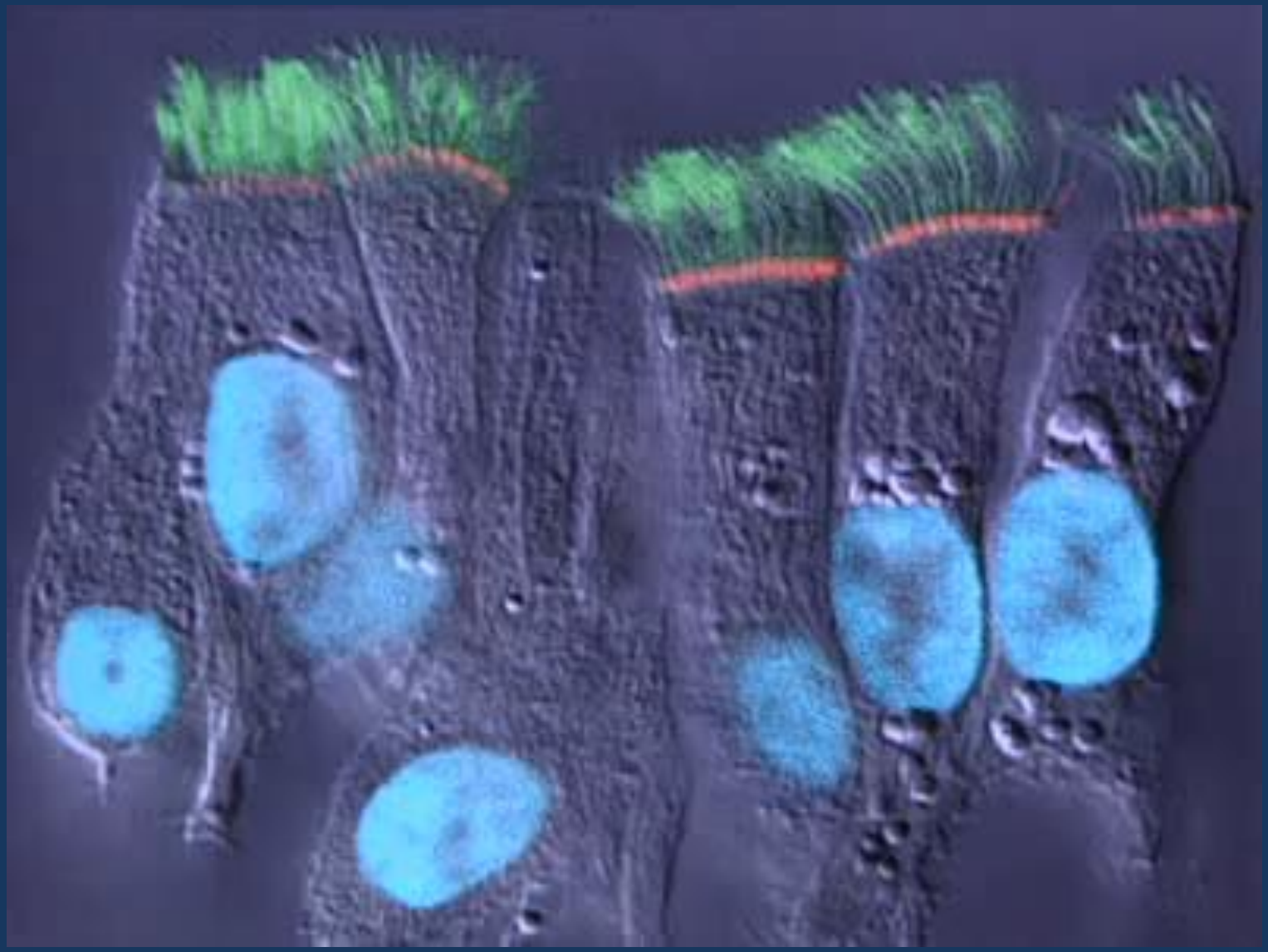
Disease States That May Benefit From Airway Clearance

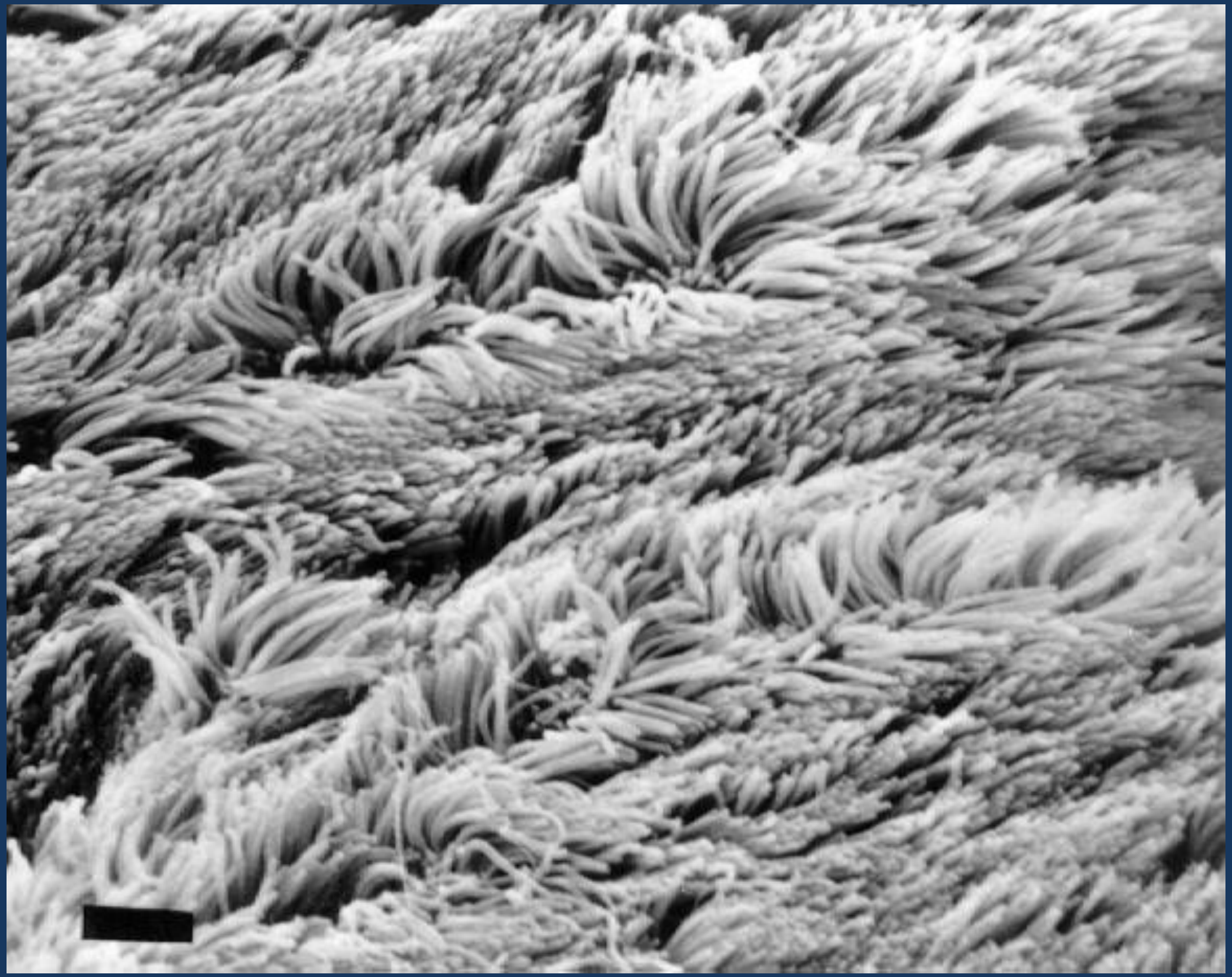
- cystic fibrosis
- bronchiectasis
- asthma
- chronic bronchitis
- neuromuscular weakness/paralysis
- mechanical ventilation

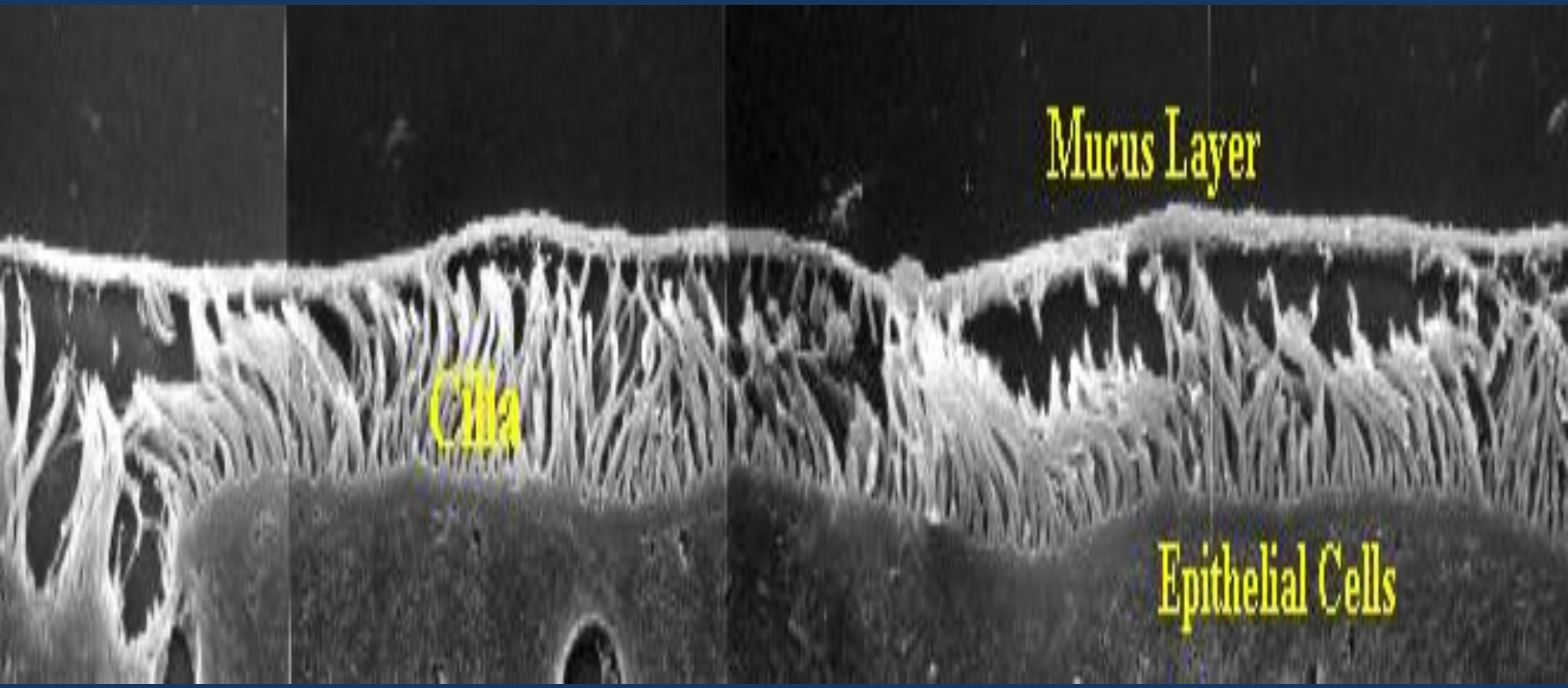
Pathogenesis of CF Lung Disease



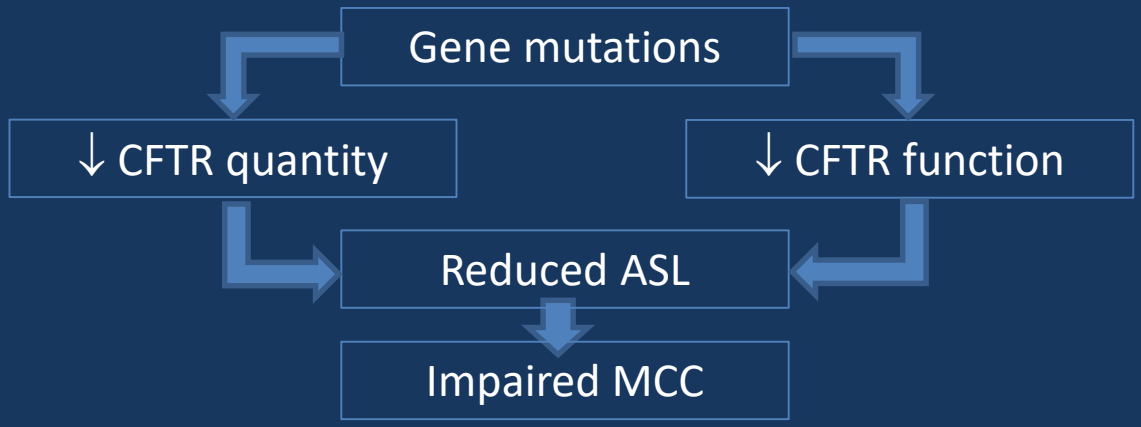
ASL and Mucociliary Clearance



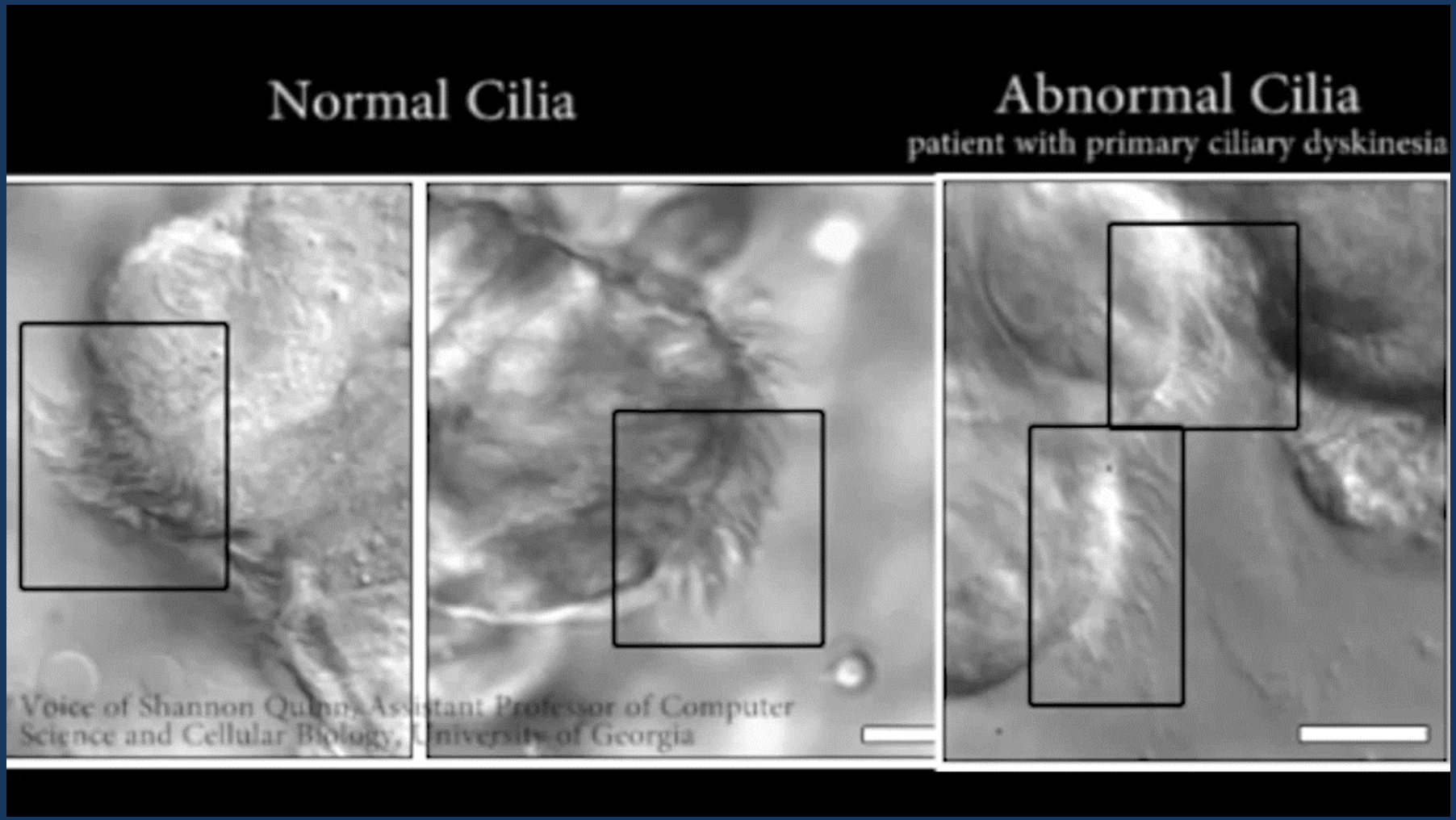



Mucus Layer
Cilia
Epithelial Cells

Pathogenesis of CF Lung Disease

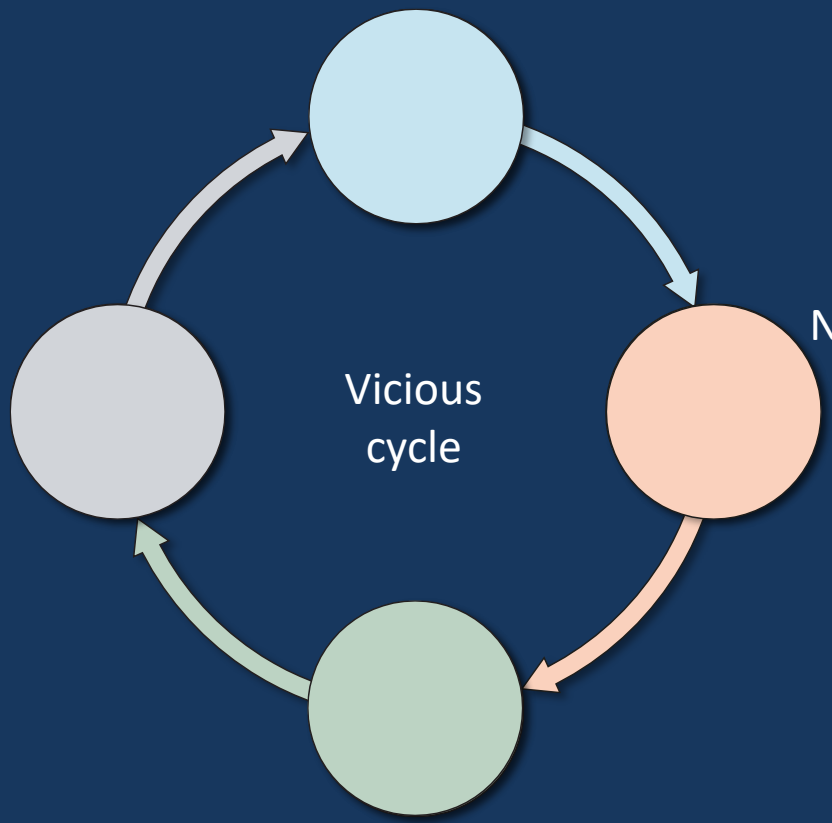


Ciliary Dyskinesias



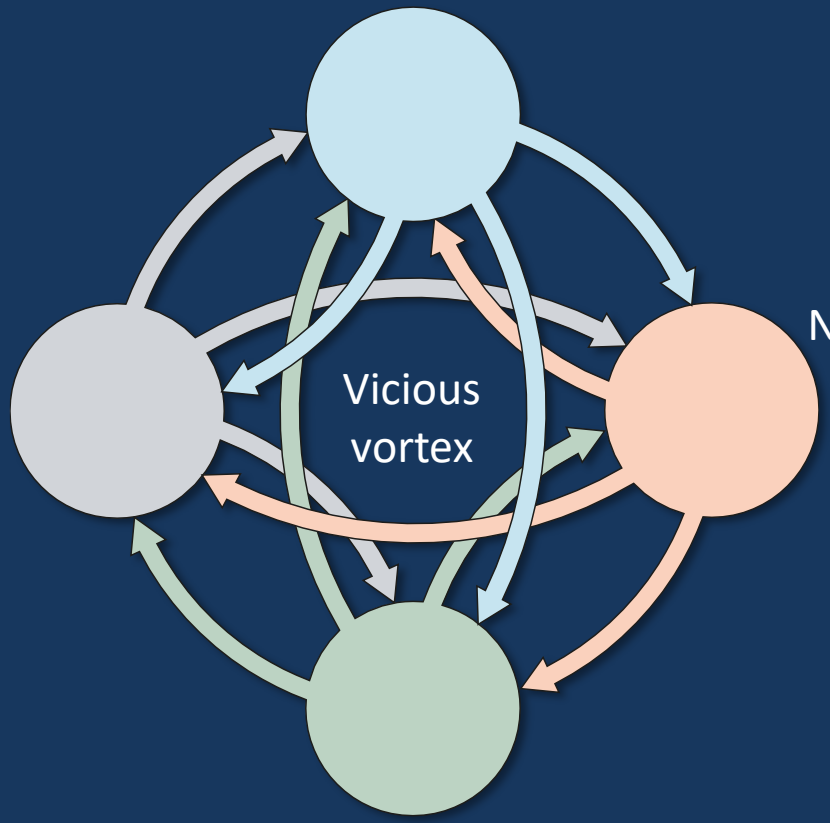
https://www.youtube.com/watch?v=5jfxh2SuZGE.

Pathogenesis of bronchiectasis



Pathogenesis of bronchiectasis

Epithelial dysfunction
Mucus hypersecretion
Ciliary dysfunction



Bronchiectasis
Lung destruction

Neutrophilic inflammation
T-cell infiltration
Local/systemic immunodeficiency

Chronic infection
Bacterial virulence factors

Flume PA, et al. Lancet. 2018; 392: 880-890

CF Airways Phlegm

- Obstruct airflow
- Impair gas exchange
- Contain inflammatory mediators:
  - bacteria and their products
  - proteases
  - oxygen radicals
  - cytokines

Airway Clearance Therapy: CF Guidelines

1. Airway clearance therapy is recommended for all patients with cystic fibrosis.
2. In general, there are no therapies of airway clearance that have been demonstrated to be superior to others.
3. For the individual, one form of airway clearance therapy may be superior to the others. The prescription of airway clearance therapy should be individualized based on factors such as age, severity of pulmonary disease, patient preference, among others.
4. Aerobic exercise is recommended for patients with cystic fibrosis as an adjunctive therapy for airway clearance and its additional benefits to overall health.

Flume PA, et al. Respir Care 2009; 54: 522-537

Airway Clearance Therapy: Bronchiectasis

1. Airway clearance therapies appear to be safe in patients with stable bronchiectasis.
2. The role of airway clearance therapies in acute exacerbation is unknown.
3. More data are needed.

Lee AL, Burge A, Holland AE. Cochrane Database of Systematic Reviews 2013, Issue 5.

1. Airway clearance therapies increase sputum expectoration, improve cough-related health status, quality of life and exercise capacity in patients with bronchiectasis and chronic sputum expectoration.
2. Teach individuals with bronchiectasis to perform airway clearance.

Hill AT et al. British Thoracic Society Guideline for bronchiectasis in adults. Thorax 2019; 74 (suppl 1): 1-69.

Objectives

- Why should we do airway clearance therapies?
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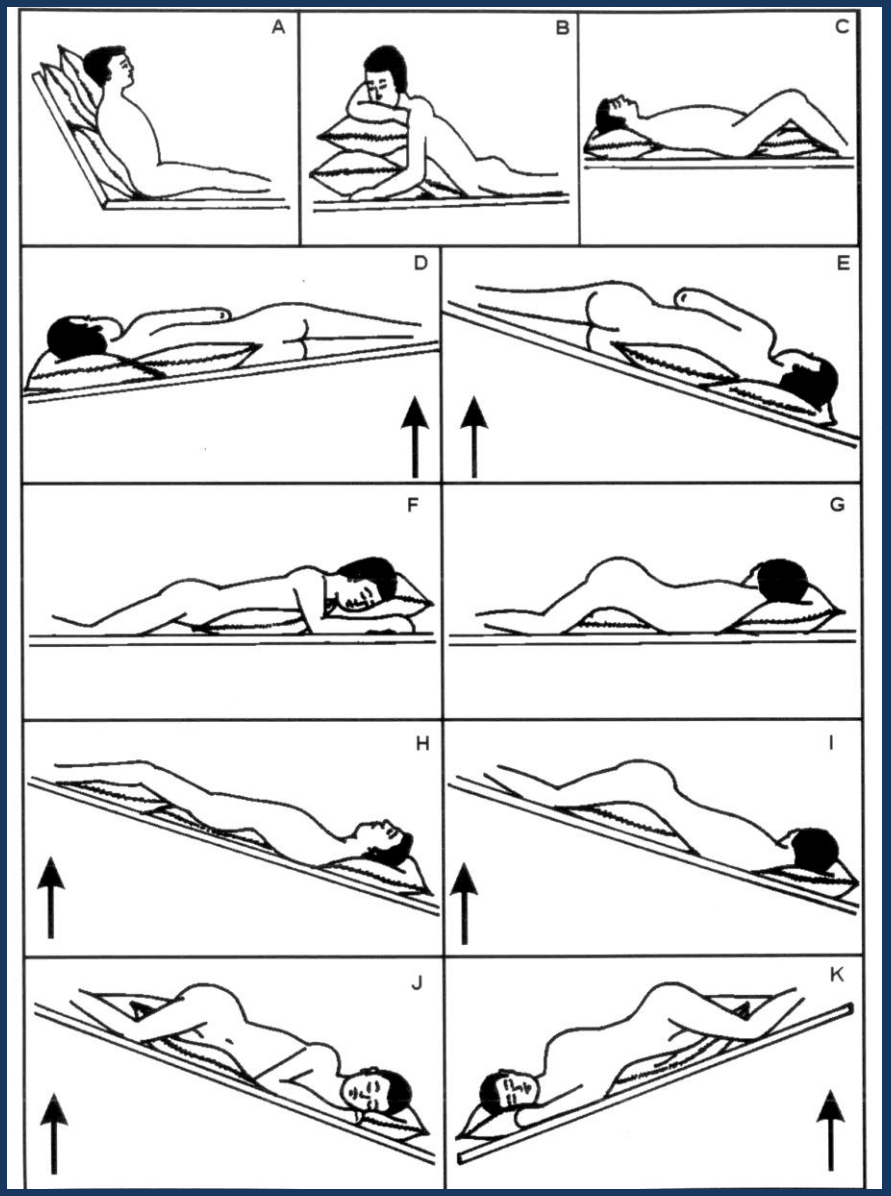
- What other therapies augment clearance of airway secretions?

Airway Clearance Therapies

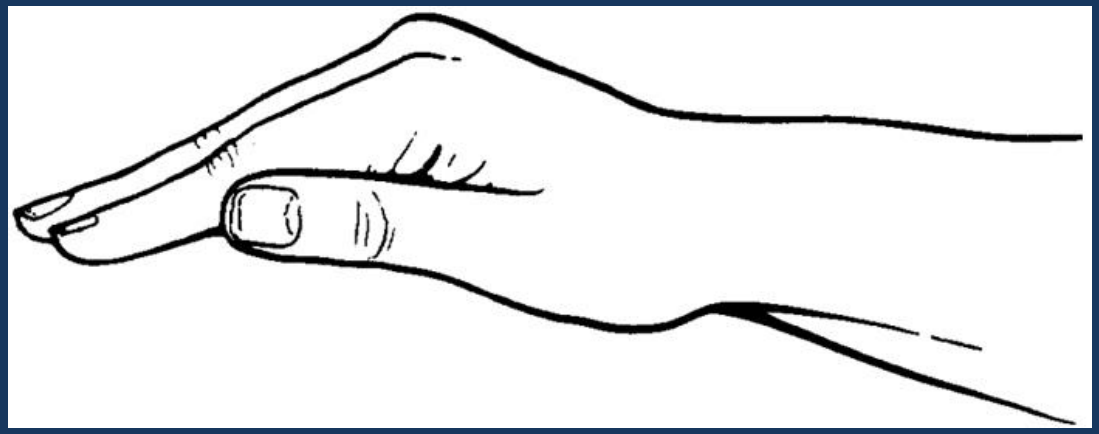
- Percussion and Postural Drainage (P&PD)
- Cough
- Forced Expiratory Technique
- Active Cycle Breathing (ACBT)
- Autogenic Drainage
- Positive Expiratory Pressure (PEP)
- Oscillating PEP
- High Frequency Chest Wall Compression
- Intrapulmonary Percussive Ventilation (IPV)
- Exercise

Percussion & Postural Drainage



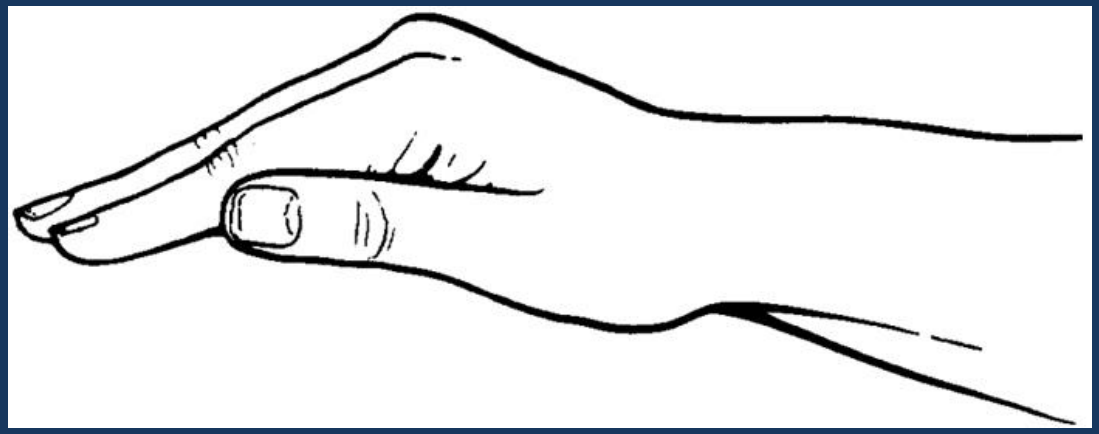
Percussion & Postural Drainage

This is not how it works



This is how you do it

Percussion & Postural Drainage



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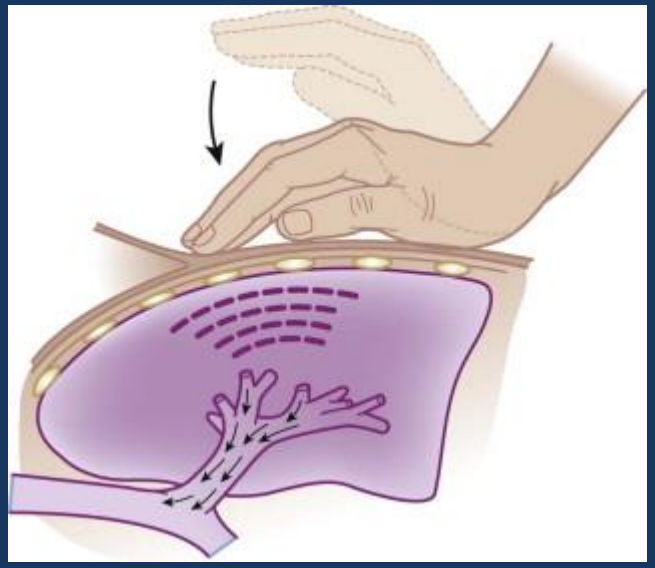
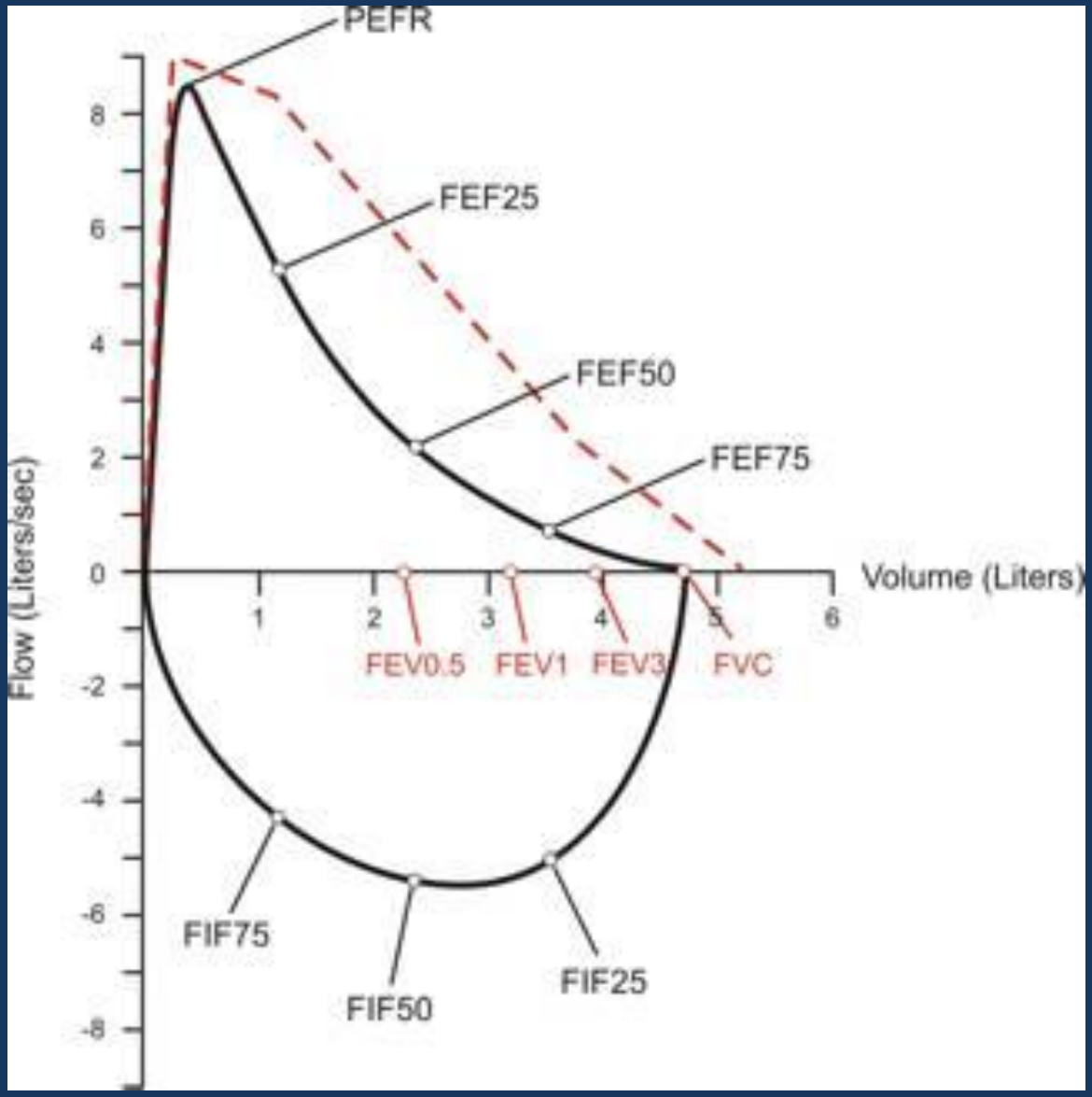


Percussion & Postural Drainage -complications and challenges-

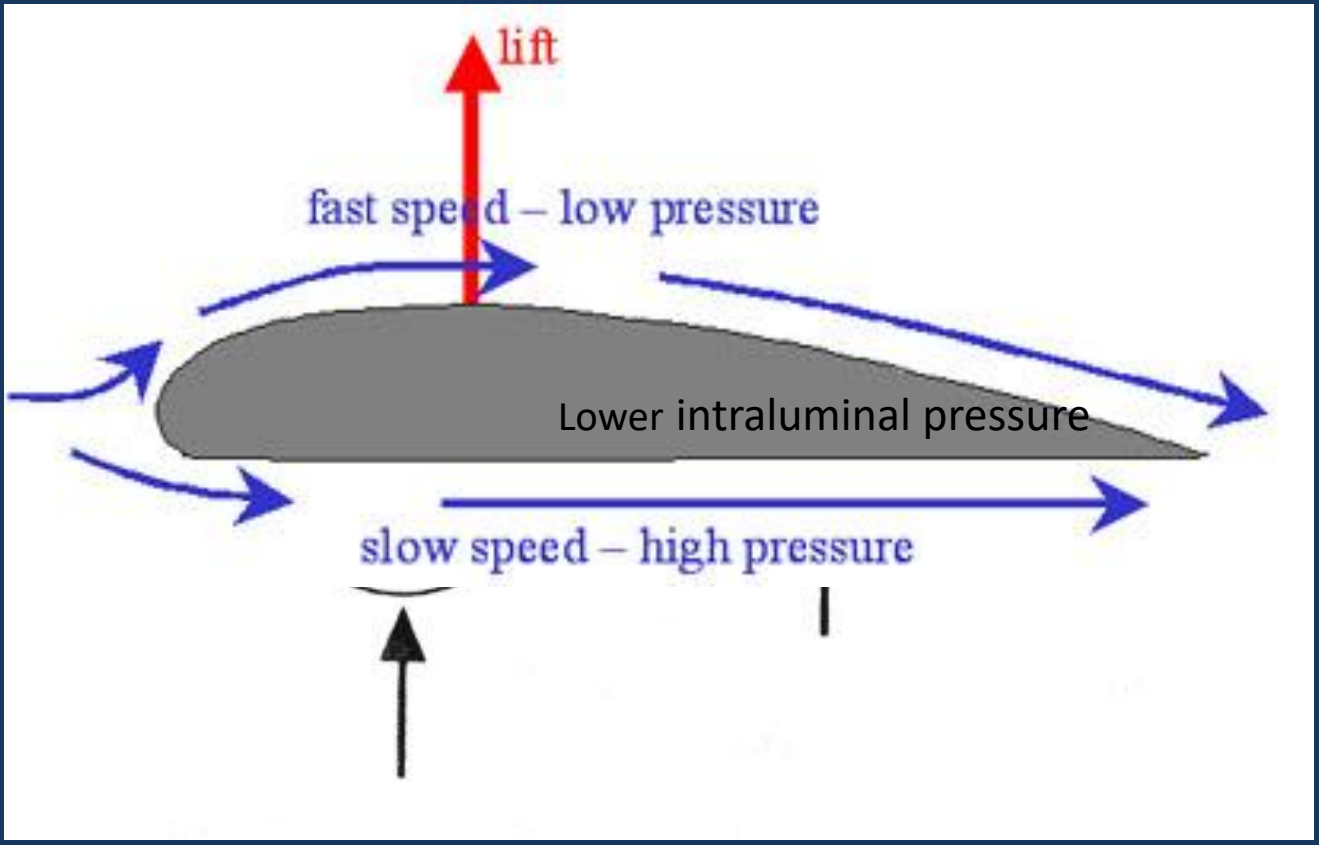
- Requires second caregiver
- Procedure can be fatiguing and painful for persons with MSK problems
- Patient may not tolerate positional changes
  - GERD
  - arterial oxygen desaturation

The problem with airways obstruction



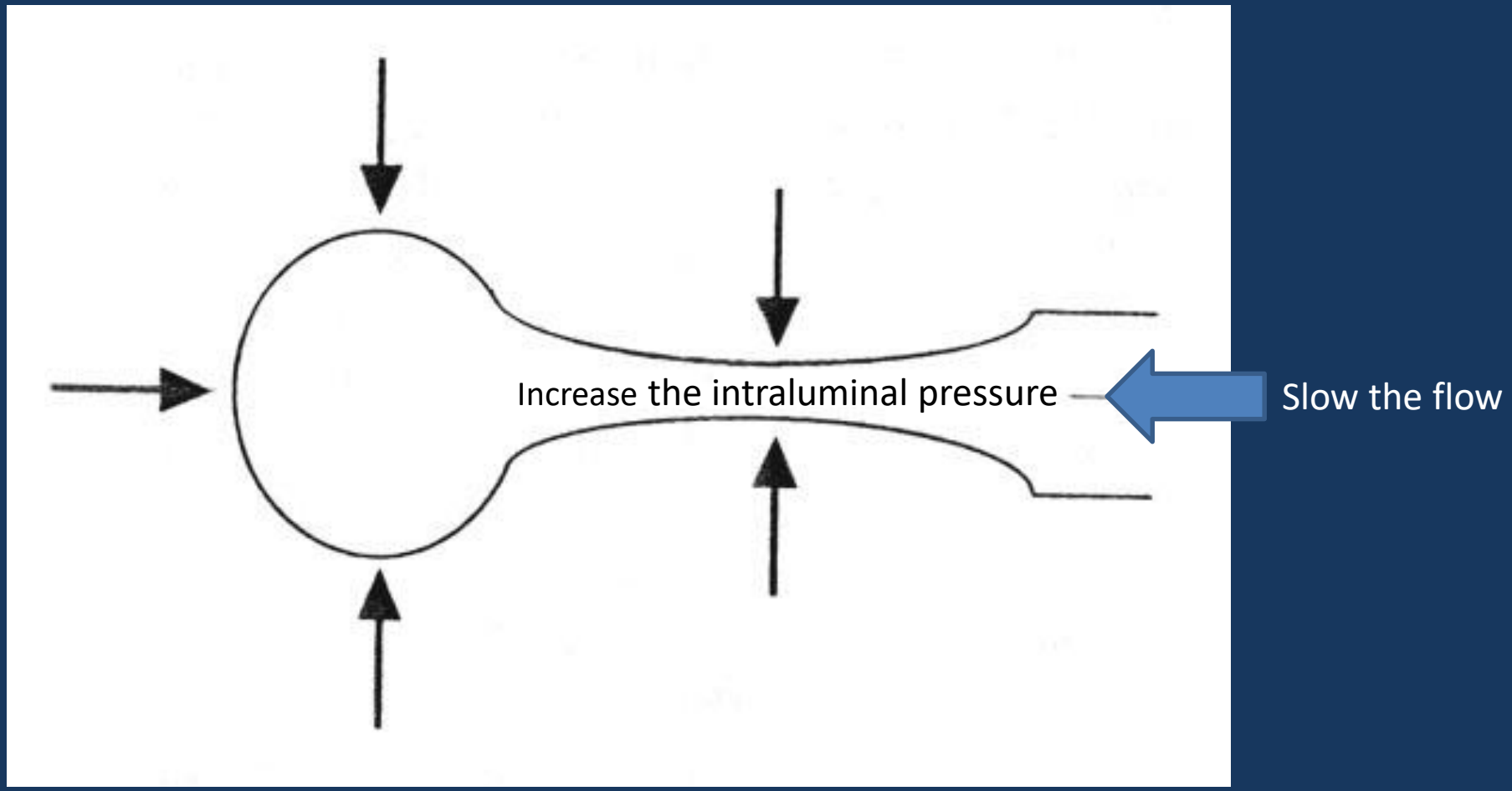
The problem with airways obstruction

Bernoulli's principle:
As the speed of a fluid goes up, its pressure goes down



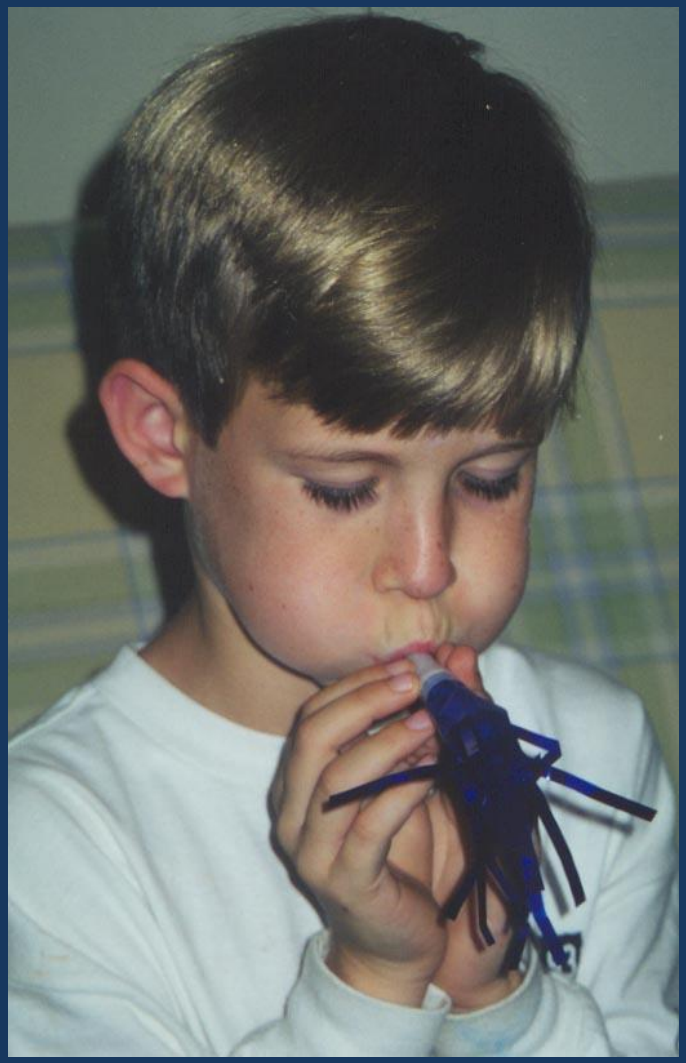
Why use PEP therapy?

Expiratory retard creates back pressure that splints airway open during exhalation

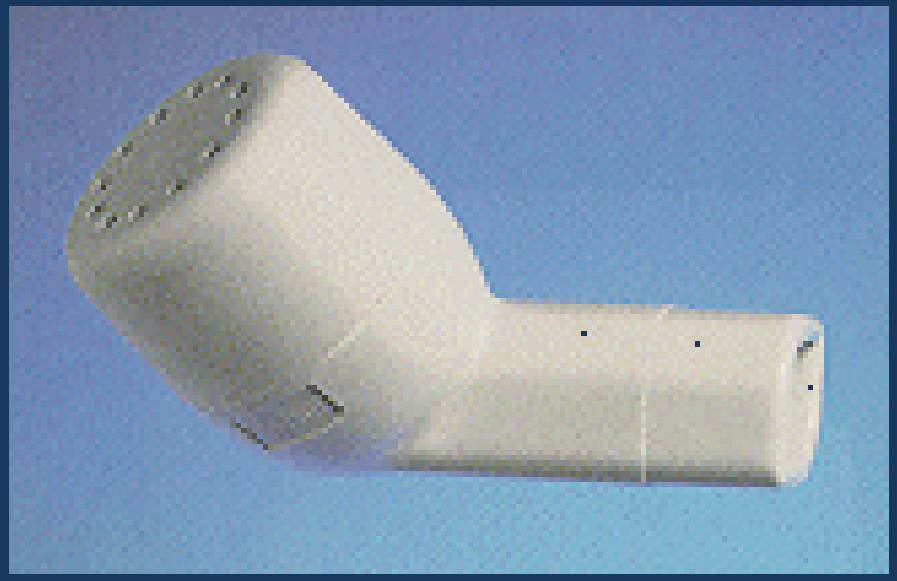


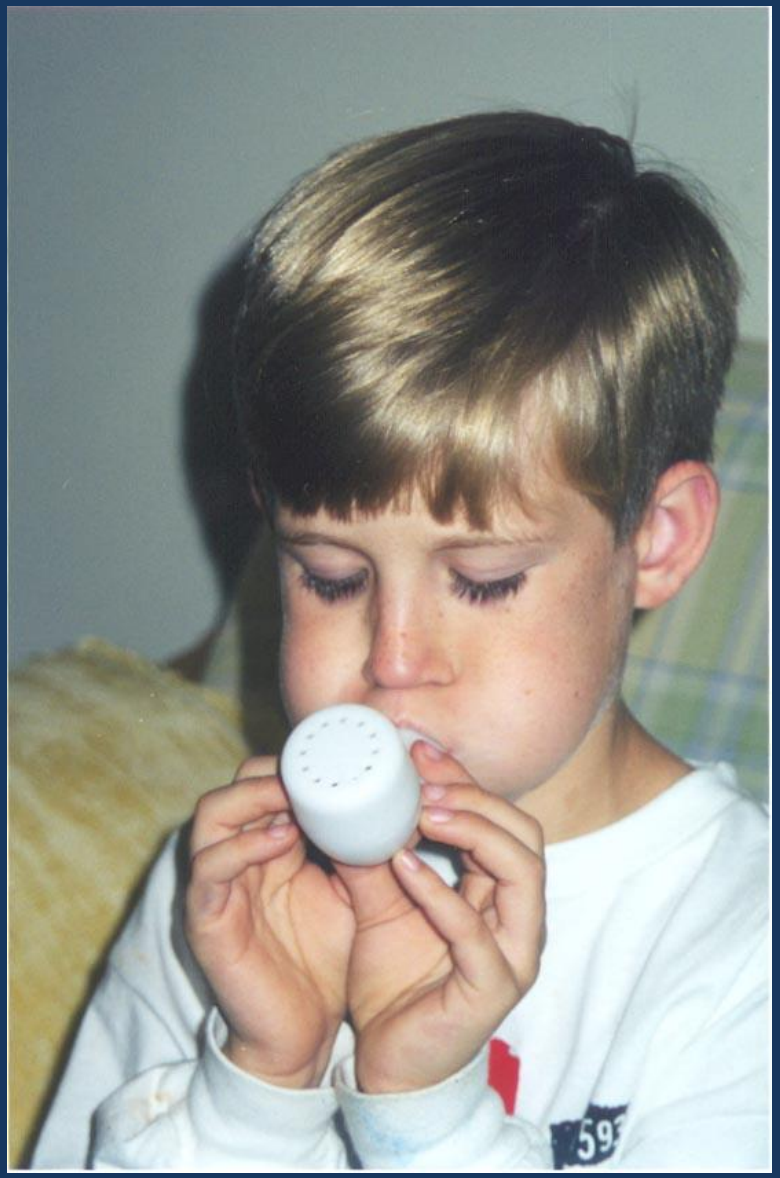
PEP therapy

Other forms of PEP therapy



Oscillating PEP Therapy





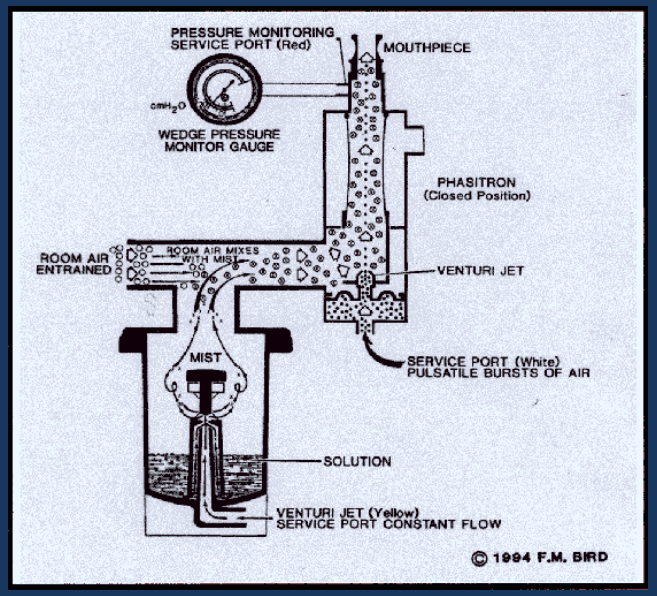
Oscillating PEP Therapy

High Frequency Chest Wall Compression

High Frequency Chest Wall Compression

Intrapulmonary Percussive Ventilation

- Combination of IPPB/PEP with aerosolization
- Compressed gas delivered in frequent bursts
  - rates of 100-225 bursts/minute
  - duration of cycle controlled by patient or therapist



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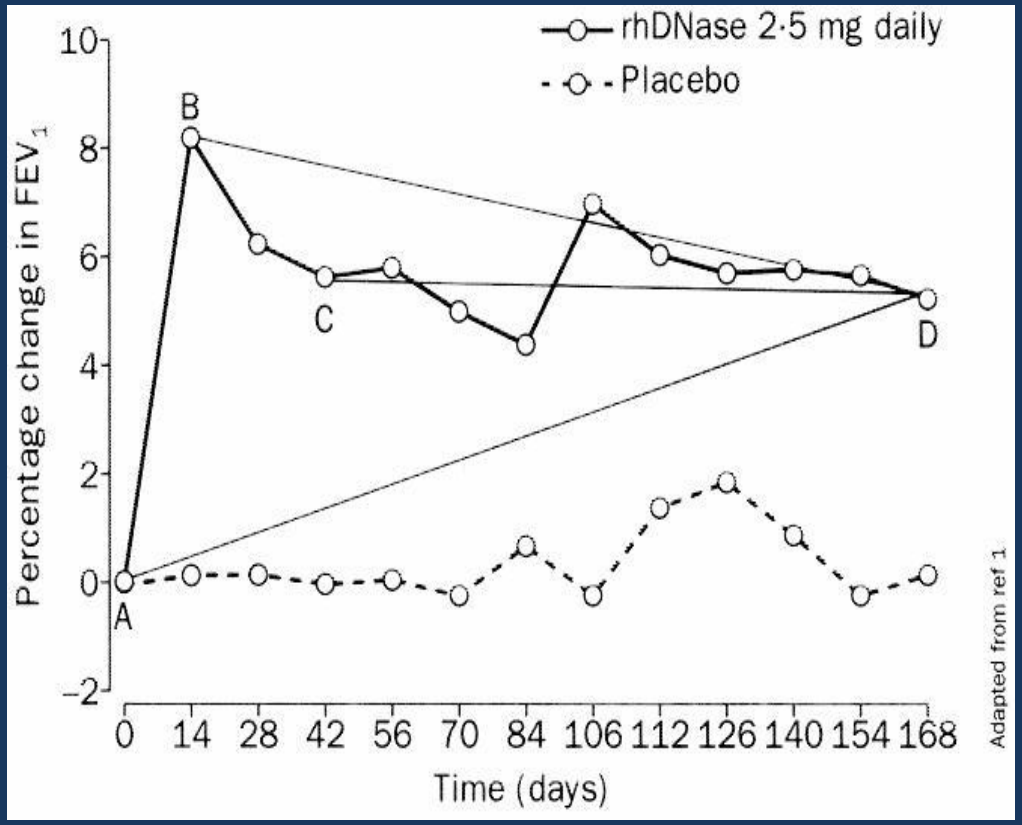
Medications to augment ACT

- Bronchodilators
- Mucolytics
- Hypertonic saline/osmotics

Altering phlegm: dornase alfa



Fuchs et al, NEJM 1994; 331: 637–642

Treatment of idiopathic bronchiectasis with aerosolized dornase alfa

- DB, PC multicenter study over 24 weeks
- Inclusion criteria
  - Non-CF bronchiectasis
  - Daily sputum production (>15 ml/day)
  - FEV_1 >30% and <80% predicted
- Primary Endpoints
  - Reduction in exacerbations
  - Change in FEV_1

O'Donnell et al. Chest 1998; 113: 1329-1334

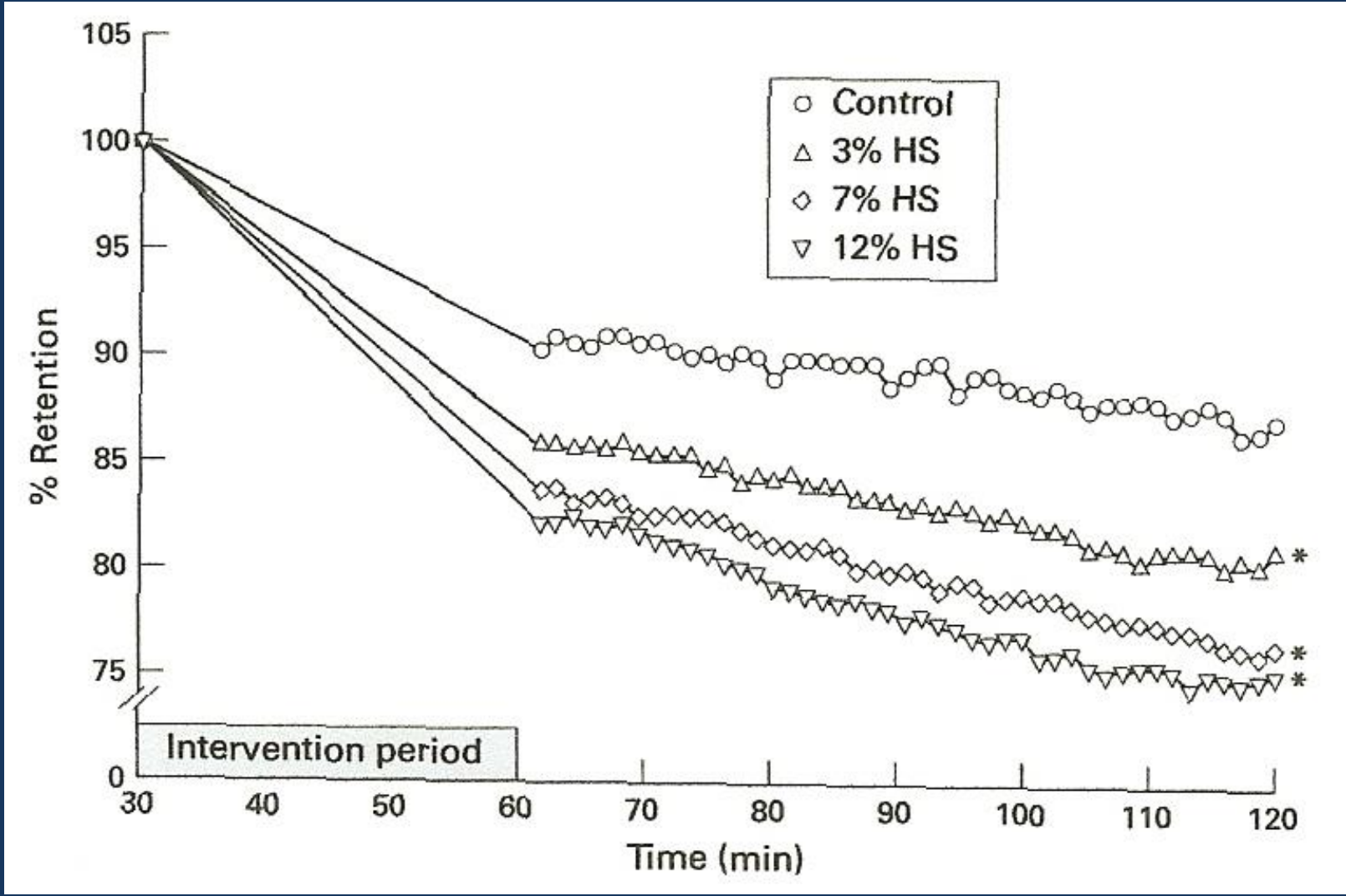
Treatment of idiopathic bronchiectasis with aerosolized dornase alfa

	Placebo	rhDNase	p value
FVC (% change)	0.3	-3.4	NS
FEV (% change	-1.7	-3.6	NS

	Placebo Rate	rhDNase Rate	Relative Risk	95% CI
Protocol defined exacerbations	0.56	0.66	1.17	0.85-1.65
Non-protocol defined exacerbations	0.14	0.29	2.01	1.15-3.50
Total exacerbations	0.71	0.95	1.35	1.01-1.79

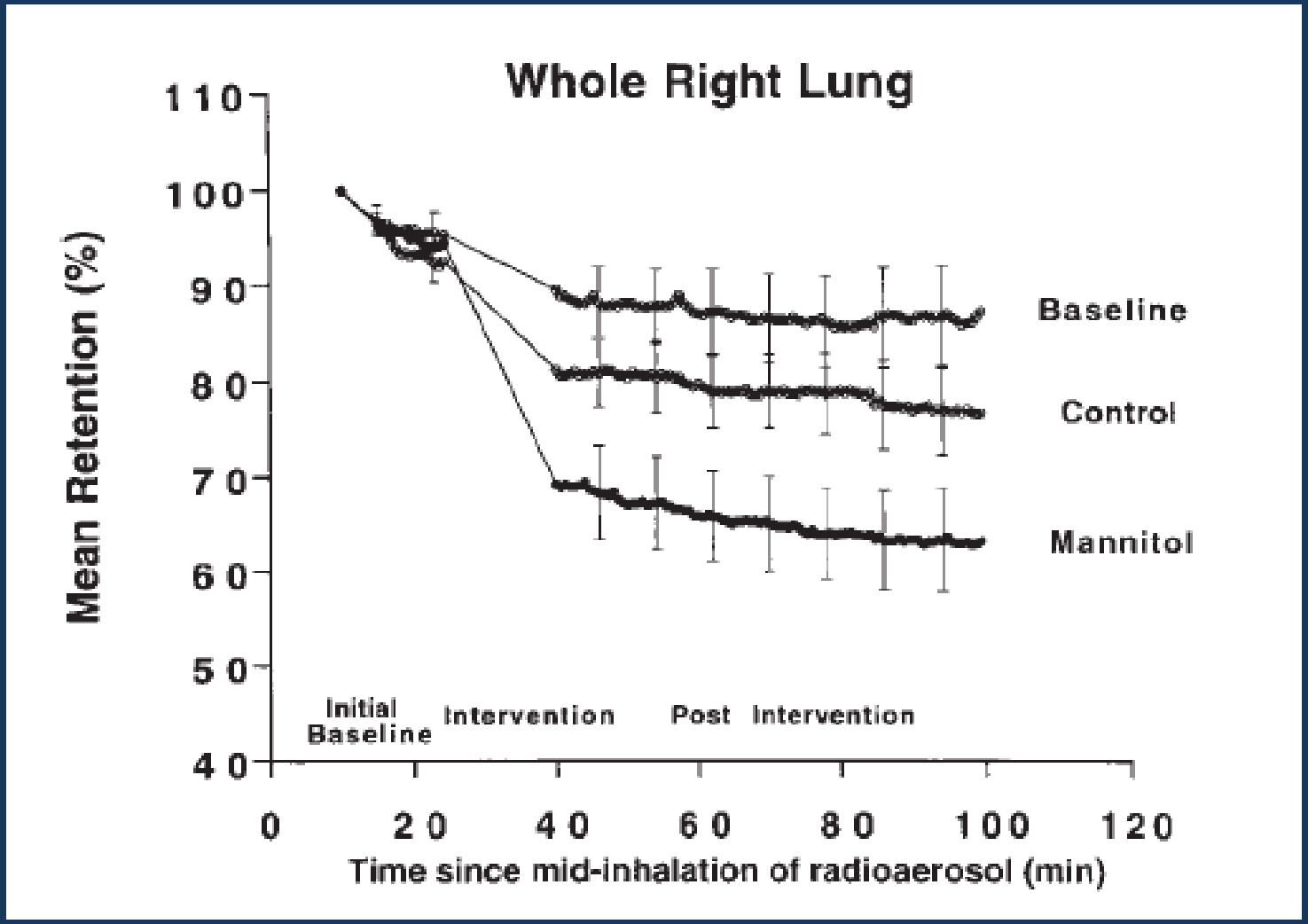
O'Donnell et al. Chest 1998; 113: 1329-1334

Effect of Increasing Doses of Hypertonic Saline on Mucociliary Clearance in Patients with CF



Robinson M et al, Thorax 1997, 52: 900-903

Effect of Mannitol on Mucociliary Clearance in Patients with Bronchiectasis



Daviskas E, et al. Am J Respir Crit Care Med 1999; 159: 1843-1848

Conclusions

- Airway clearance therapies are the most fundamental aspect of management of bronchiectasis
- The ACT of choice should be tailored to the individual patient
  - Which is the most effective?
  - Which is the one they will do?
  - Best if they have options (e.g. for travel)
- Medications may augment effectiveness of airways clearance

Questions?