PHYSIOTHÉRAPIE DE DÉSENCOMBREMENT BRONCHIQUE

Gregory Reychler
Physiotherapist, PhD
Pneumology Unit
Cliniques universitaires Saint-Luc

Joint BTS/ACPRC guideline

Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient

J Bott, S Blumenthal, M Buxton, S Ellum, C Falconer, R Garrod, A Harvey, T Hughes, M Lincoln, C Mikelsons, C Potter, J Pryor, L Rimington, F Sinfield, C Thompson, P Vaughn, J White, on behalf of the British Thoracic Society Physiotherapy Guideline Development Group

- COPD, CF, bronchiectasis, neuromuscular and restrictive lung diseases, chest wall disorders

Pulmonary rehabilitation

Recommendations

- Pulmonary rehabilitation should include exercise training of the muscles of ambulation. (Grade A)
- Pulmonary rehabilitation should incorporate strength training of both upper and lower limbs. (Grade A)
- Information, advice and education should be integral to pulmonary rehabilitation. (Grade A)
- Pulmonary rehabilitation should be made available to all appropriate patients with COPD. (Grade A)

Airway clearance techniques

Recommendations

- Consider the active cycle of breathing techniques (which includes the forced expiration technique), autogenic drainage and plain or oscillating positive expiratory pressure for patients with stable COPD who need an airway clearance technique to assist in the removal of secretions. (Grade C)
- Incorporate postural drainage only if it further aids clearance and has no detrimental effects. (Grade D)

Thorax 2009;64(Suppl I):i1–i51

Joint BTS/ACPRC guideline

Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient

J Bott, S Blumenthal, M Buxton, S Ellum, C Falconer, R Garrod, A Harvey, T Hughes, M Lincoln, C Mikelsons, C Potter, J Pryor, L Rimington, F Sinfield, C Thompson, P Vaughn, J White, on behalf of the British Thoracic Society Physiotherapy Guideline Development Group

- COPD, CF, bronchiectasis, neuromuscular and restrictive lung diseases, chest wall disorders

Airway clearance

Recommendations

- ► Teach patients with cystic fibrosis an airway clearance technique to increase mucus transport in the short term. (Grade A)
- ► Self-administered techniques should be the first-line airway clearance techniques offered in order to improve adherence to treatment. (Grade B)

Thorax 2009;64(Suppl I):i1–i51

Joint BTS/ACPRC guideline

Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient

J Bott, S Blumenthal, M Buxton, S Ellum, C Falconer, R Garrod, A Harvey, T Hughes, M Lincoln, C Mikelsons, C Potter, J Pryor, L Rimington, F Sinfield, C Thompson, P Vaughn, J White, on behalf of the British Thoracic Society Physiotherapy Guideline Development Group

- COPD, CF, bronchiectasis, neuromuscular and restrictive lung diseases, chest wall disorders

Assisted coughing

Recommendations

- Try manually assisted coughing for patients with an ineffective cough. (Grade D)
- The upright seated position should be considered initially. (Grade D)
- The abdominal thrust (Heimlich-style manoeuvre) should be considered initially. (Grade D)

Mechanical insufflation–exsufflation

Recommendations

- Mechanical insufflation–exsufflation should be considered for individuals with upper spinal cord injury, if simpler techniques fail to produce an adequate effect. (Grade D)
- Where cough effectiveness remains inadequate with mechanical insufflation–exsufflation alone, combine it with manually assisted coughing. (Grade D)

Thorax 2009;64(Suppl I):i1–i51

Chest physiotherapy techniques

Autogenic drainage

Slow expiration

Forced expiration technique

Flutter

Cornet

Cough Assist

PEP mask

Acappella

Clapping

Active cycle of breathing technique

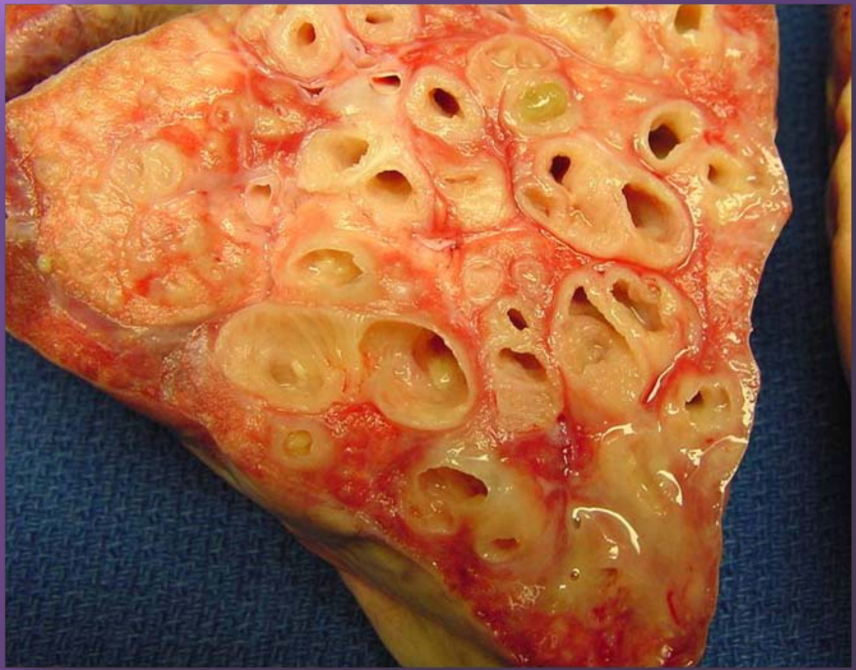
IPV

Cough

The Vest

Goals of chest physiotherapy

- Two main goals
  - Increasing airway clearance and decreasing viscosity of secretions
    - Airway clearance techniques
  - Improving global and local ventilation
    - *Mechanical ventilation*
    - Chest physiotherapy manoeuver

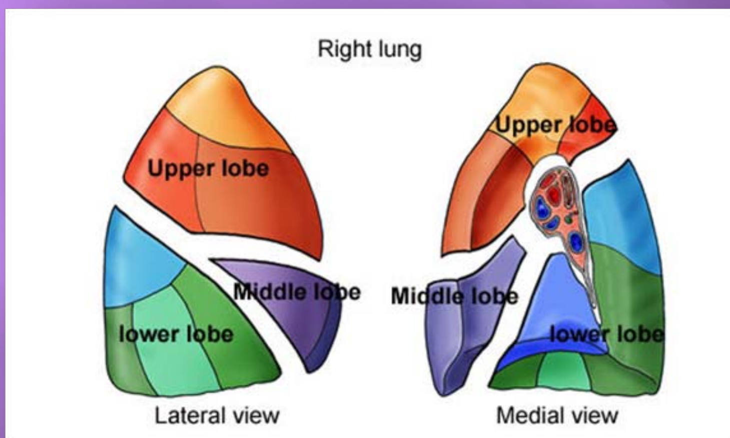


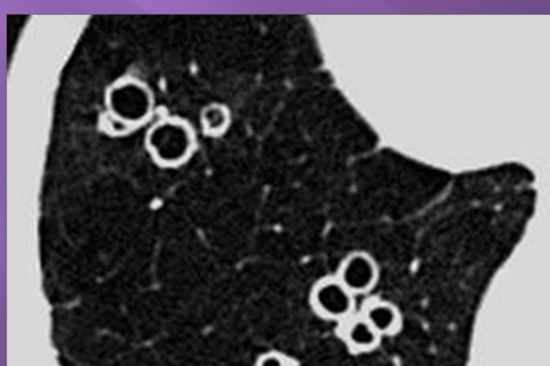
Increasing airway clearance

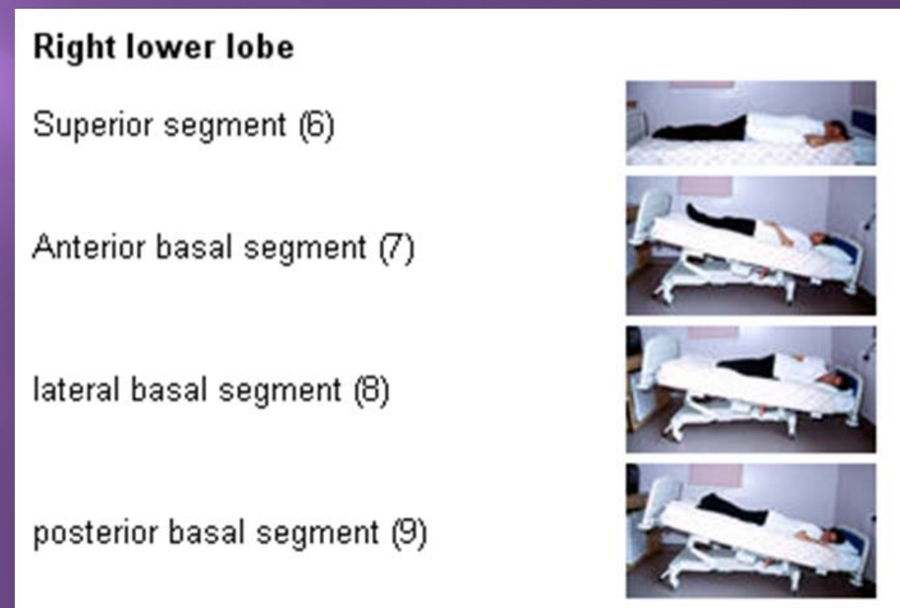
- Elements of this field of action
  - Avoiding secretions stagnation
    - Various modalities to mobilize secretions
  - Helping to sputum evacuation
    - Cough

Mobilization of secretions

- Two possibilies
  - Gravity



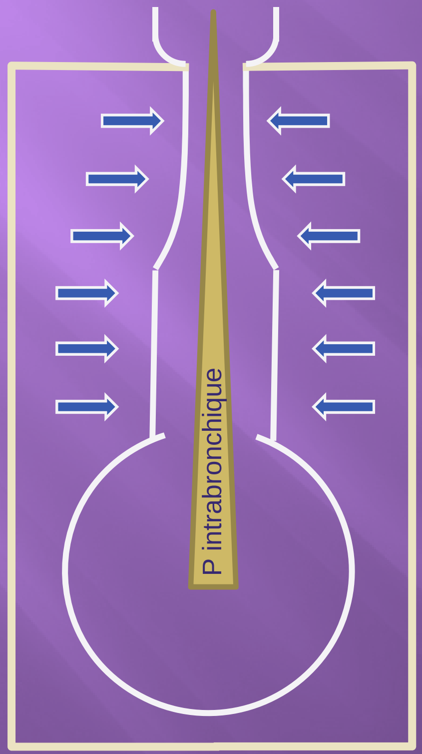


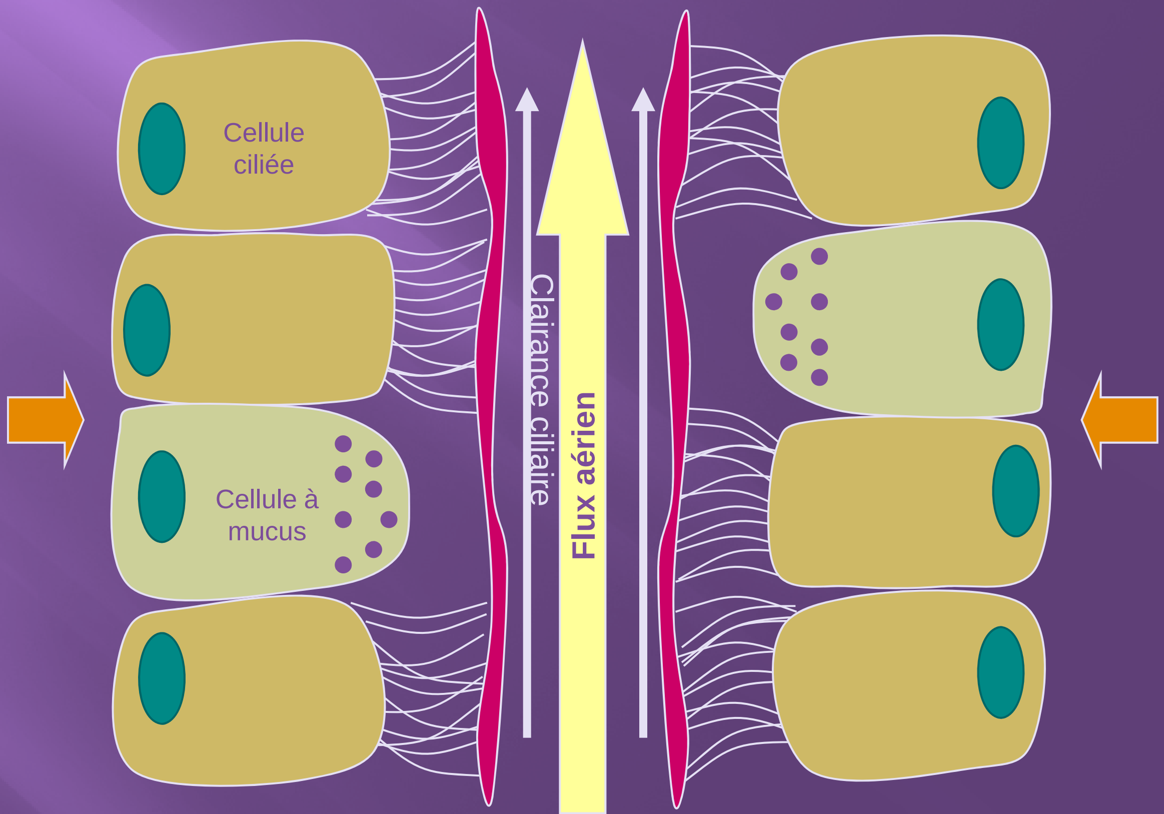


Be careful with patients with GOR or severe obstruction!

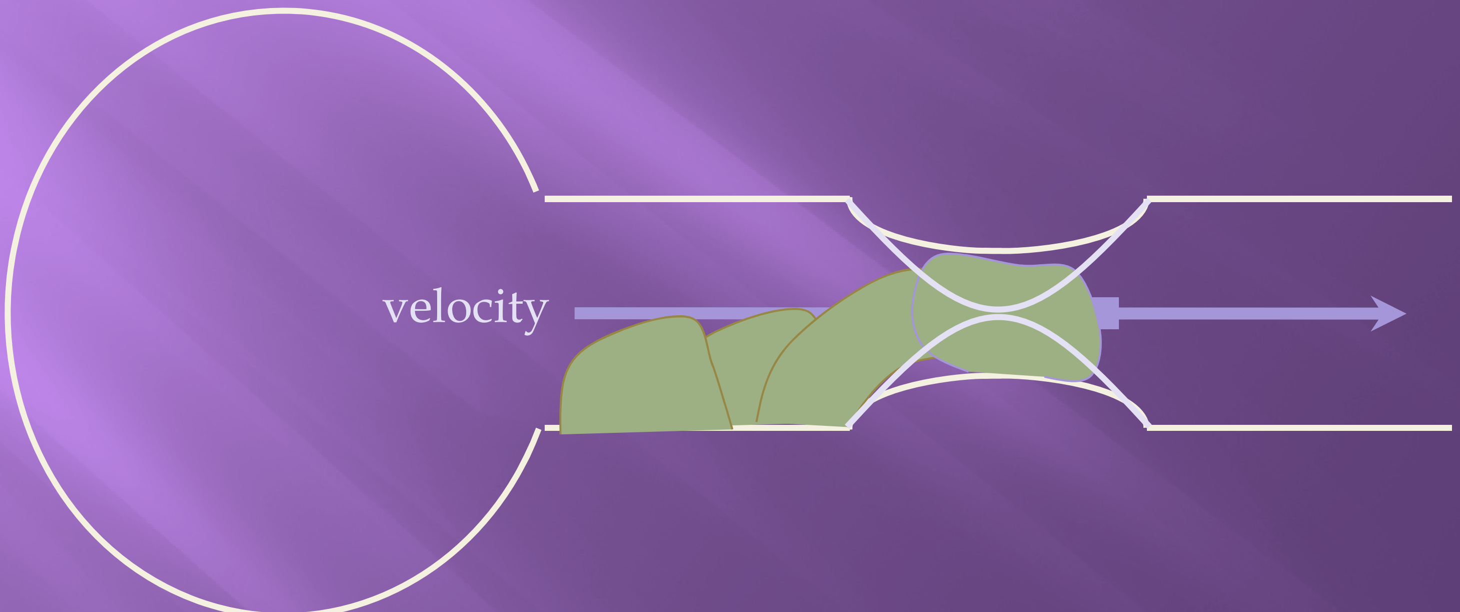
Mobilization of secretions

- Two possibilies
  - Modulation of expiratory air velocity





Improving mucociliary clearance



$v = Q / S$

Mechanism of action

Mucus clearance by two-phase gas-liquid flow mechanism: asymmetric periodic flow model

CHONG S. KIM, ANTONIO J. IGLESIAS, AND MARVIN A. SACKNER
Pulmonary Division, University of Miami School of Medicine at Mount Sinai Medical Center, Miami Beach, Florida 33140

TABLE 5. *Critical mucus layer thickness required for mucus transport in horizontal tube*

PEIFR: / $\dot{V}E_p$:	3.0 / 60	2.0 / 40	1.5 / 30
Mucus simulants			
A1	0.47±0.01 (89)	0.70±0.02 (92)	0.87±0.02 (86)
A2	0.66±0.02 (76)	0.91±0.02 (76)	1.08±0.03 (77)
A3	0.52±0.01 (60)	0.74±0.03 (69)	0.94±0.02 (71)
B1	0.71±0.01 (87)	1.02±0.03 (94)	1.23±0.04 (93)
B2	0.80±0.02 (64)	0.97±0.03 (64)	1.14±0.02 (64)
B3	0.58±0.01 (51)	0.81±0.02 (61)	0.99±0.07 (62)
C1	1.08±0.03 (92)	1.24±0.04 (90)	1.38±0.04 (88)
C2	1.05±0.04 (65)	1.25±0.04 (69)	1.33±0.05 (68)
C3	0.72±0.03 (48)	0.88±0.03 (53)	1.07±0.04 (55)

Values are means ± SD given in mm for 1.0-cm-ID horizontal tube. PEIFR, peak expiratory to inspiratory flow rate; $\dot{V}E_p$, peak expiratory ... indicate percent of steady-state ... 4. For details of mucus simulants,

two phases. The greater the difference in airflow velocity, the faster the liquid movement. However, our results indicate that LLTS is mainly governed by the absolute value of the higher airflow, not by the difference between the expiratory and inspiratory flow rate. Our results further show that when the expiratory flow rate is kept constant above the inspiratory flow rate, LLTS remains unaffected regardless of the magnitude of the inspiratory flow rate until the inspiratory flow rate approaches within 10% difference from the expiratory flow rate.

...he square of mean airflow ... liquid layer is expected to ...flow velocity and vice versa. ...eriodic airflow, the unequal ...unequal shear forces in op... liquid layer may move ac... ...irflow velocity between the ...

Although this seems to be in variance with the theoretical prediction, the reason becomes obvious when the flow characteristics in the two-phase flow model are closely analyzed.

In two-phase gas-liquid flow models, particularly in annular or stratified flow situation, the interfacial shear

DISCUSSION

Liquid layer transport speed. Theoretically, the shear stress on the liquid layer is directly proportional to the inertia force of airflow which is represented by the prod-

J. Appl. Physiol. 62(3):959-971,1987

CPT efficacy: flow

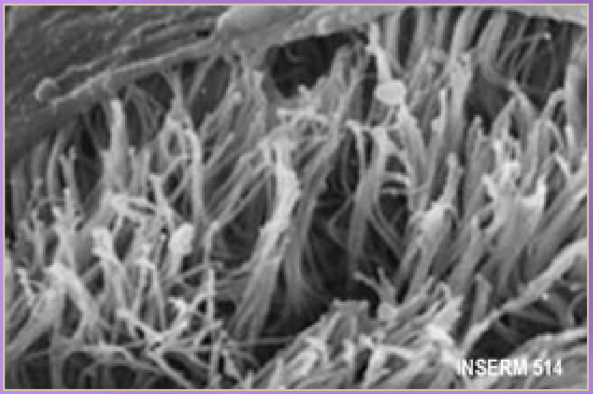
TABLE 1 Effects of physiotherapy interventions on peak flow rate respiratory volumes and stimulation of cough

Intervention	Subjects n	PEFR $L \cdot s^{-1}$	PIFR $L \cdot s^{-1}$	PEFR/PIFR	V_I L	V_E L	Coughs stimulated
Vibration	17[¶]	1.58±0.73	1.06±0.27	1.51	1.78±0.87	2.44±1.06	0.7±1.0
Percussion	18	0.83±0.14***	0.84±0.10	0.99	0.91±0.37***	1.03±0.50	0.5±0.9
PEP	18	0.44±0.15***	0.96±0.20	0.47	1.64±0.40	1.96±0.57	0.5±0.6
Flutter®	17[¶]	1.13±0.30[#]	1.05±0.27	1.15	1.62±0.52	1.81±0.57	0.4±0.7
Acapella®	18	0.59±0.08***	0.98±0.27	0.64	1.55±0.46	1.68±0.50	0.8±1.0
TLCrelax	15[+]	0.66±0.16	1.01±0.40	0.73	1.79±0.66	2.24±0.79	0

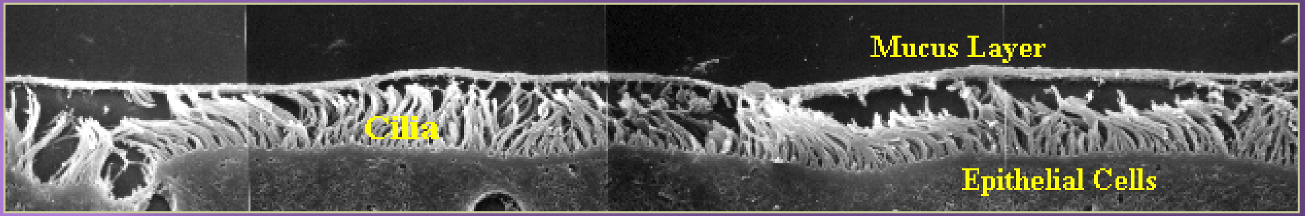
Data are presented as mean±SD of means of each subject, unless otherwise stated. PEFR: peak expiratory flow rate; PIFR: peak inspiratory flow rate; V_I: inspiratory volume; V_E: expiratory volume; PEP: peak expiratory pressure; TLCrelax: total lung capacity positive expiration. [¶]: data lost due to technical difficulties (data from different interventions lost in different subjects); [+]: data only collected from stated number of subjects. p-values are significantly different from vibration. ***: $p<0.001$; [#]: $p=0.002$.

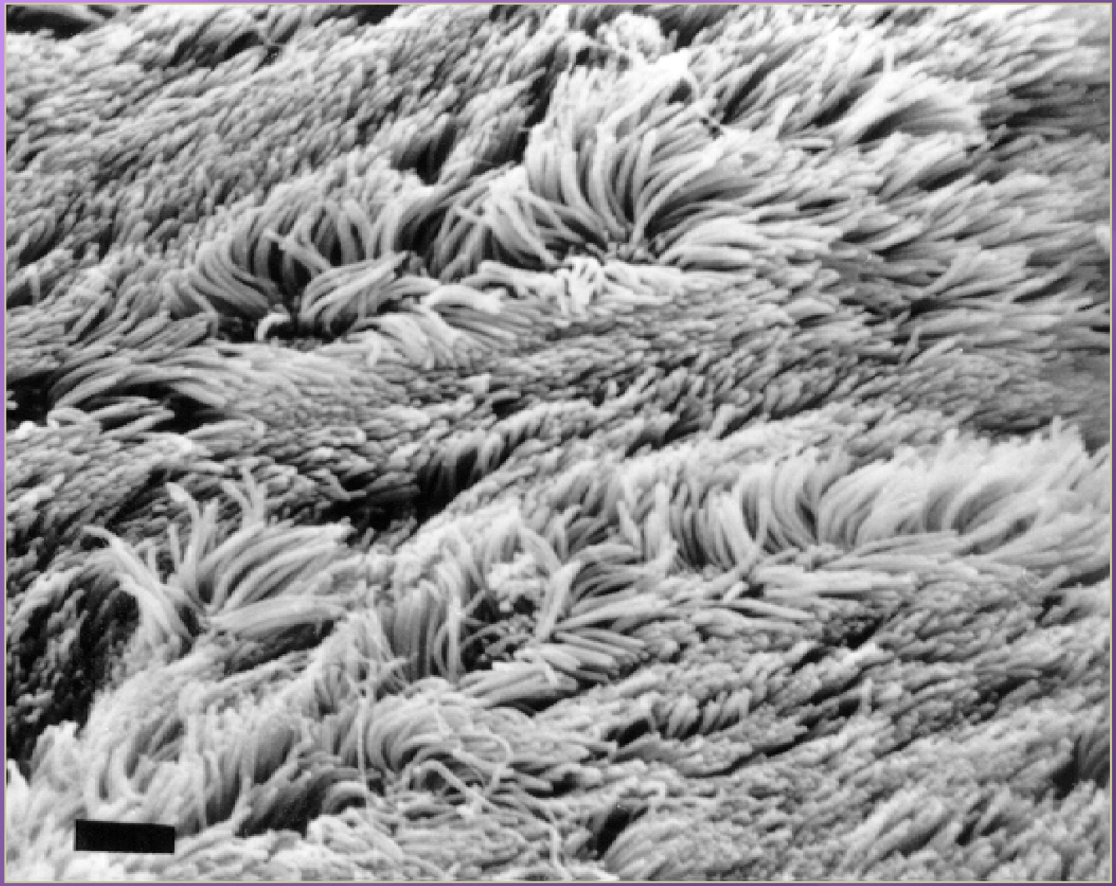
McCarren B., Eur Respir J 2006; 27: 1204–1209

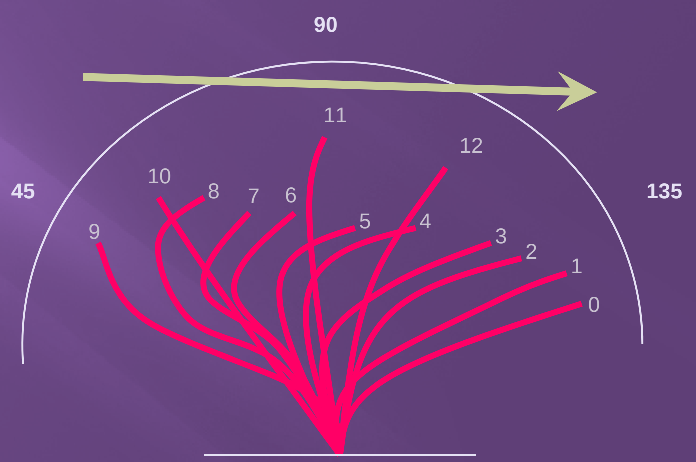
Cilia



Source : Puchelle E, INSERM 514







8-15Hz

CPT efficacy: frequency

TABLE 2 The frequency of oscillation of the physiotherapy interventions as determined by frequency spectral analysis

Intervention	Frequency Hz
Vibration	8.4 ± 0.4 (7.3–10.0)
Percussion	7.3 ± 0.3 (6.5–8.0)
Flutter®	11.3 ± 1.5 (7.5–13.7)***
Acapella®	13.5 ± 1.7 (10.0–18.3)***

Data are presented as mean ± SD of means of each subject. p-value is significantly different from vibration. ***: $p<0.001$.

McCarren B., Eur Respir J 2006; 27: 1204–1209

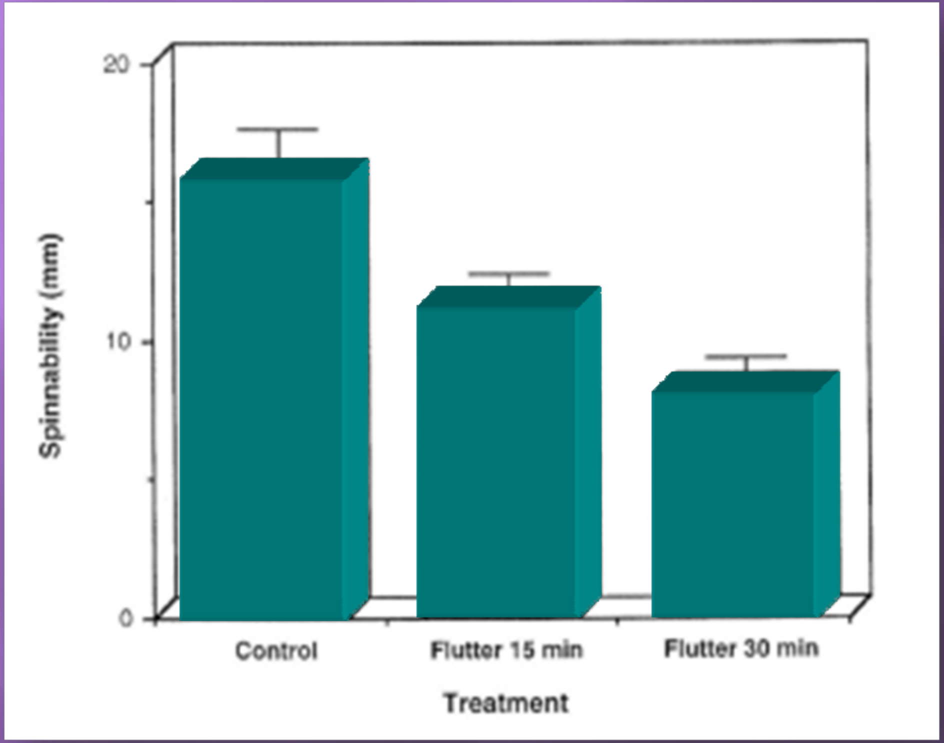
Challenges for the physiotherapist…

Decreasing viscosity of secretions

- Drug delivery
- Airway clearance techniques
  - Oscillations
  - Percussions

Effect of oscillatory positive expiratory pressure

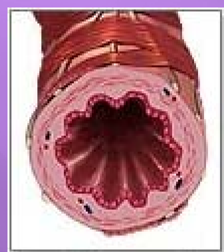
In vitro

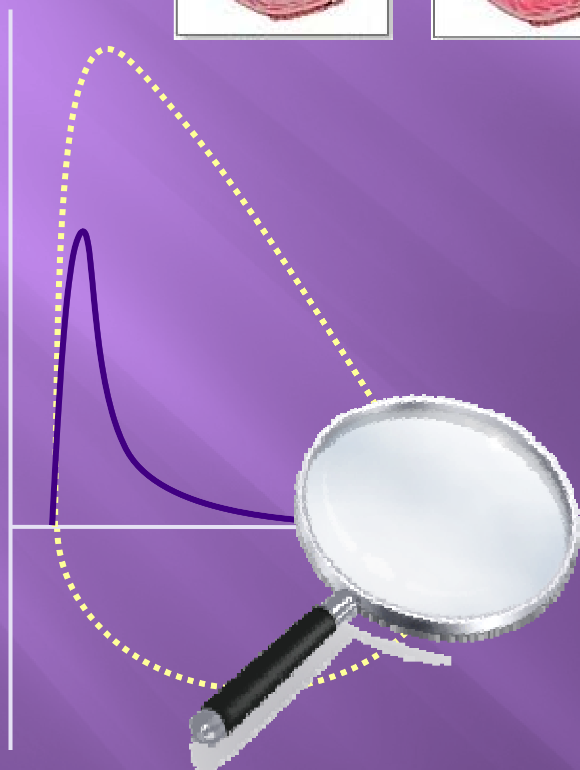


In vitro properties of mucus (spinnability) before,15’ and 30’ minutes after a Flutter session

App E, Chest 1998;114:171 –177

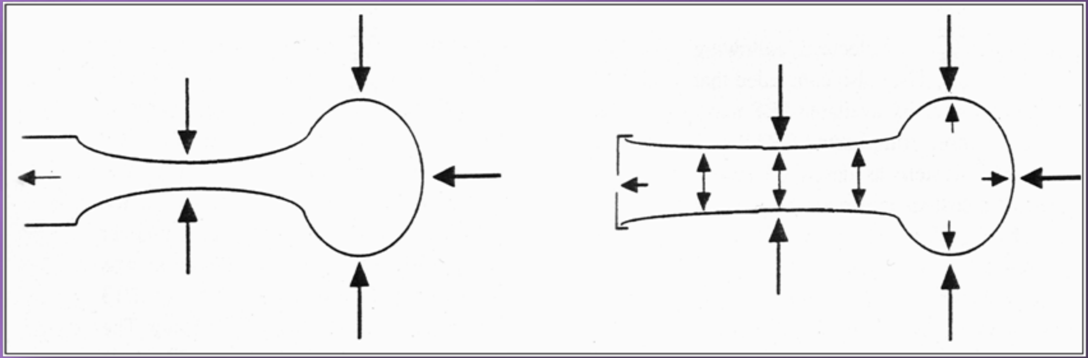
Obstruction and flow limitation



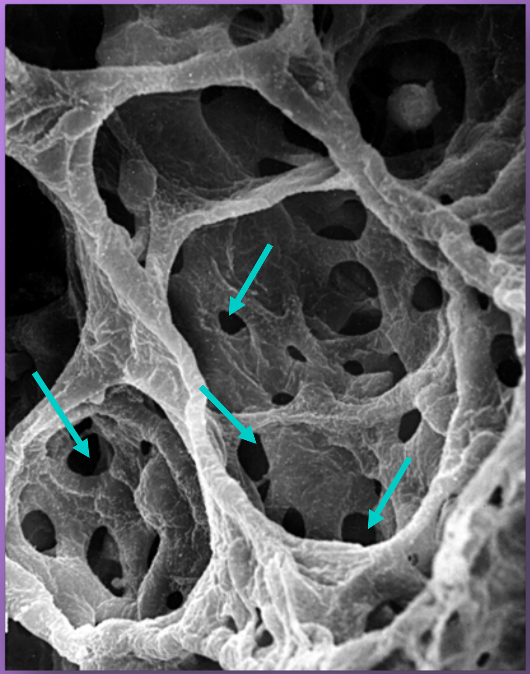


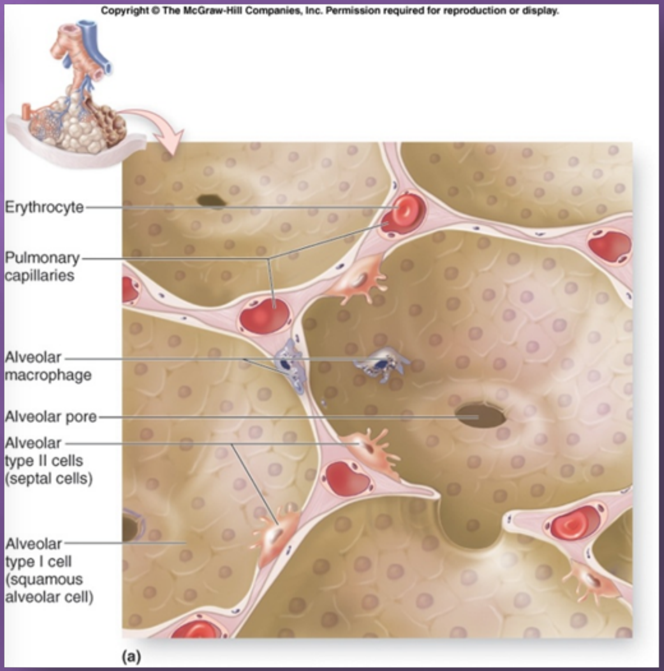
Positive expiratory pressure (PEP)

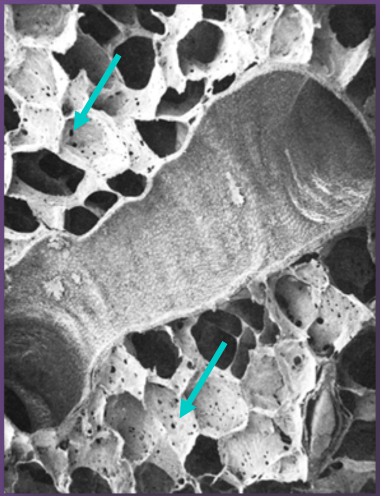
- Expiration through a resistance
- Decreasing airway colapse

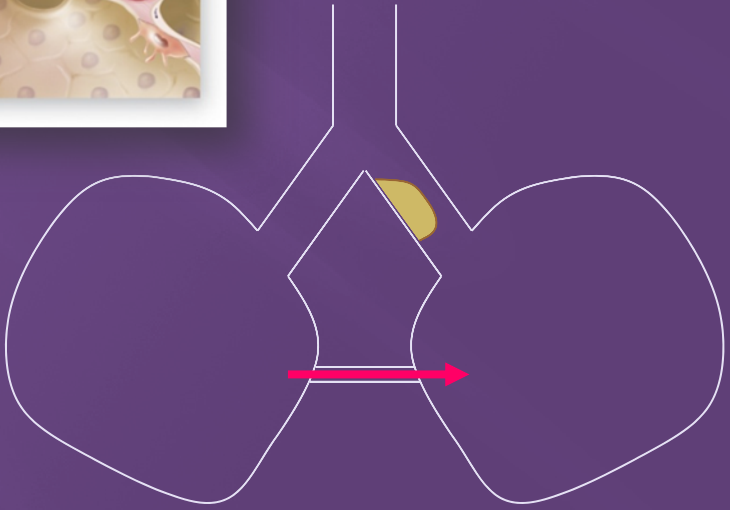


Effect of PEP



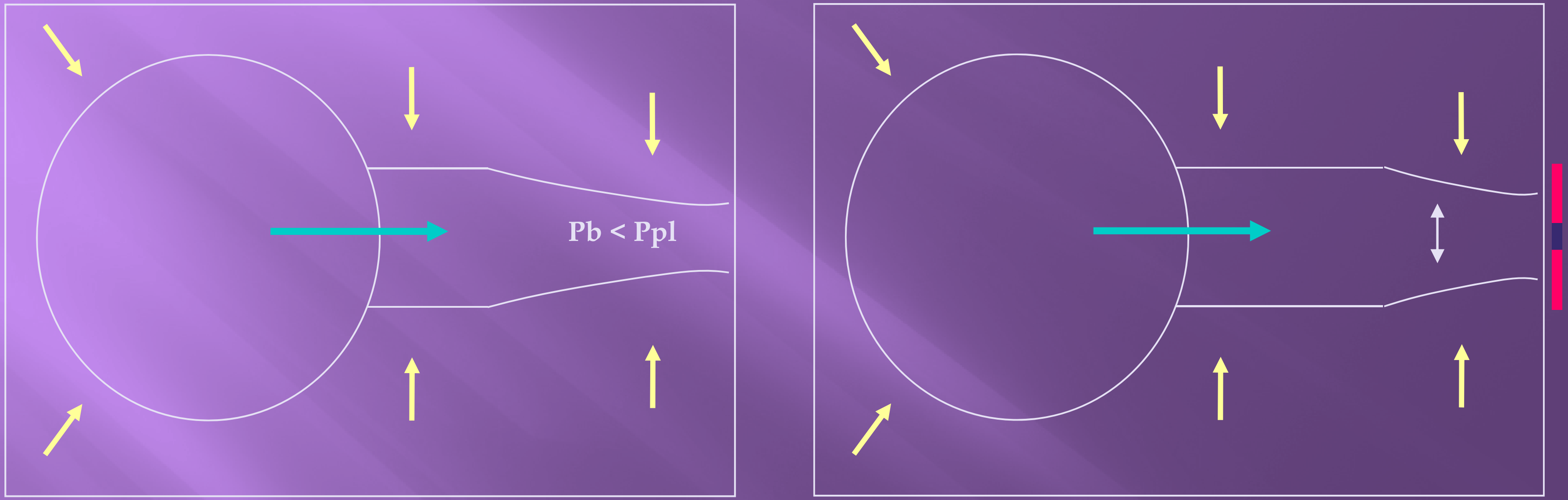






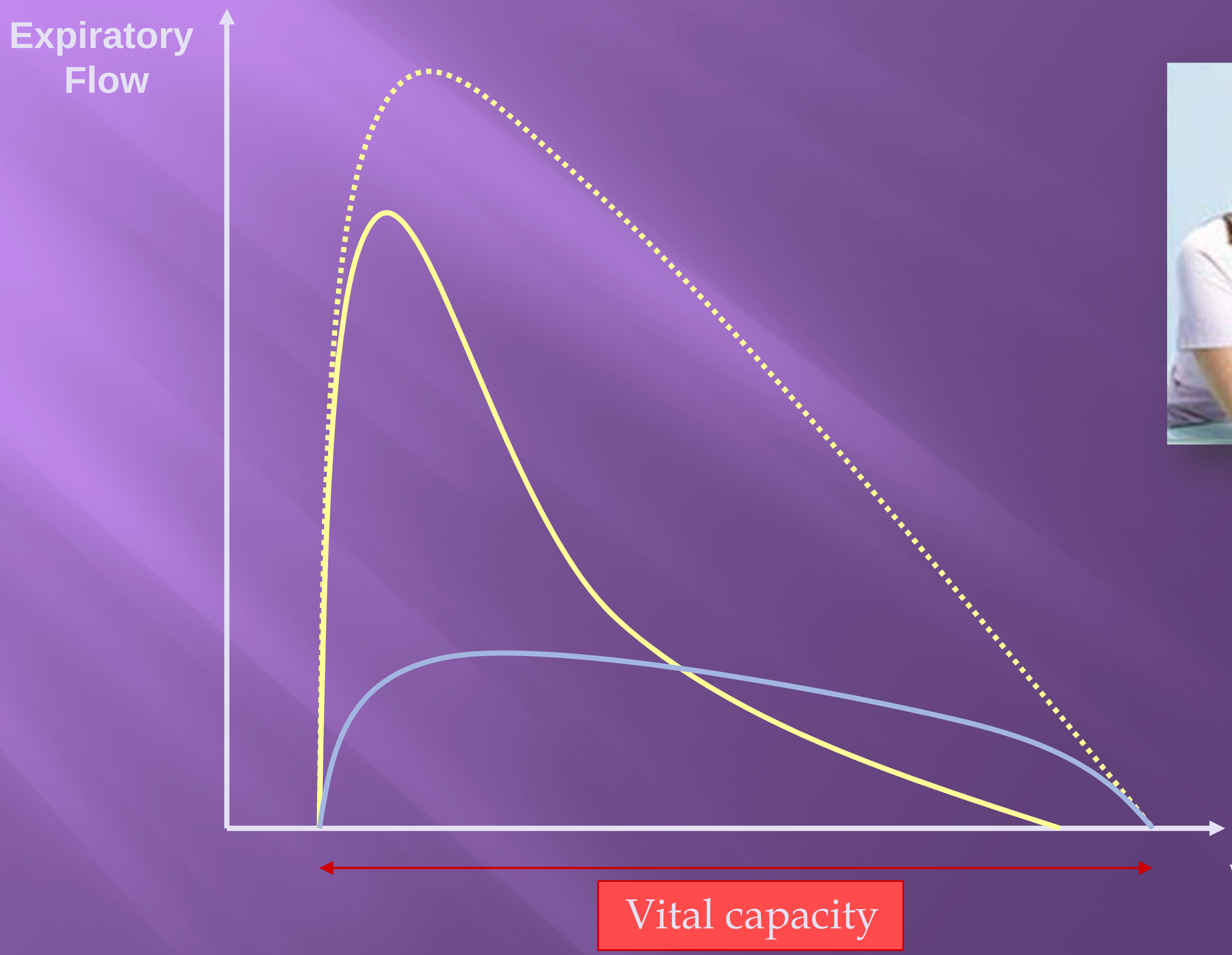
Collateral ventilation improvement

Effect of PEP

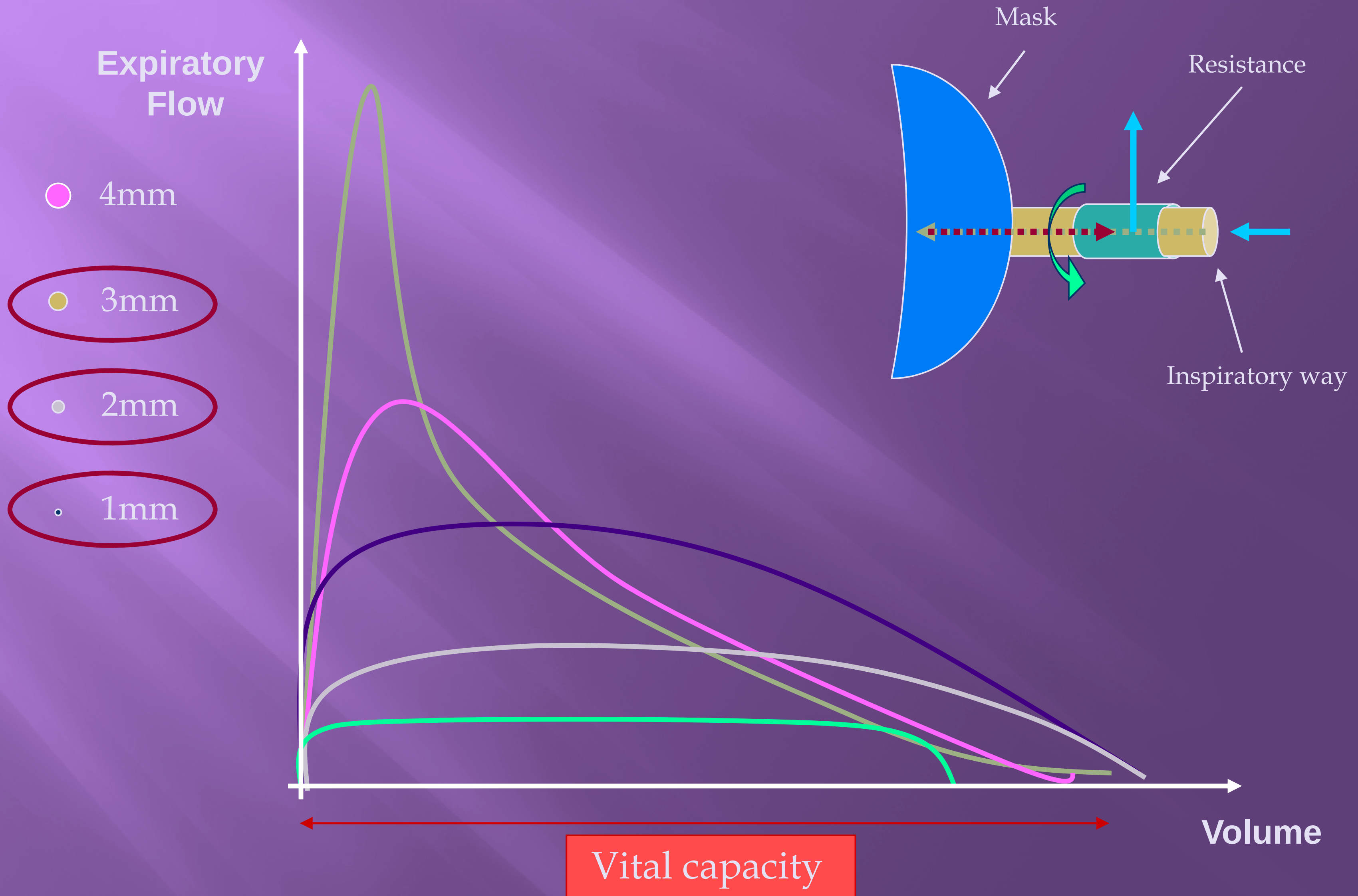


Decrease of dynamic compression

Positive expiratory pressure



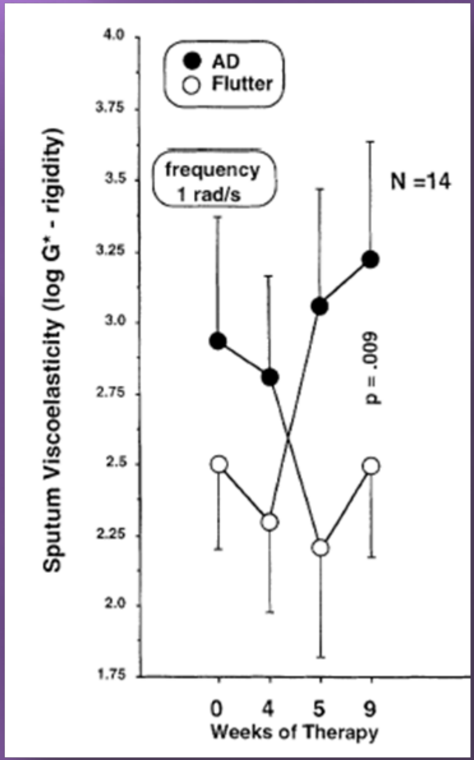
Influence of resistance



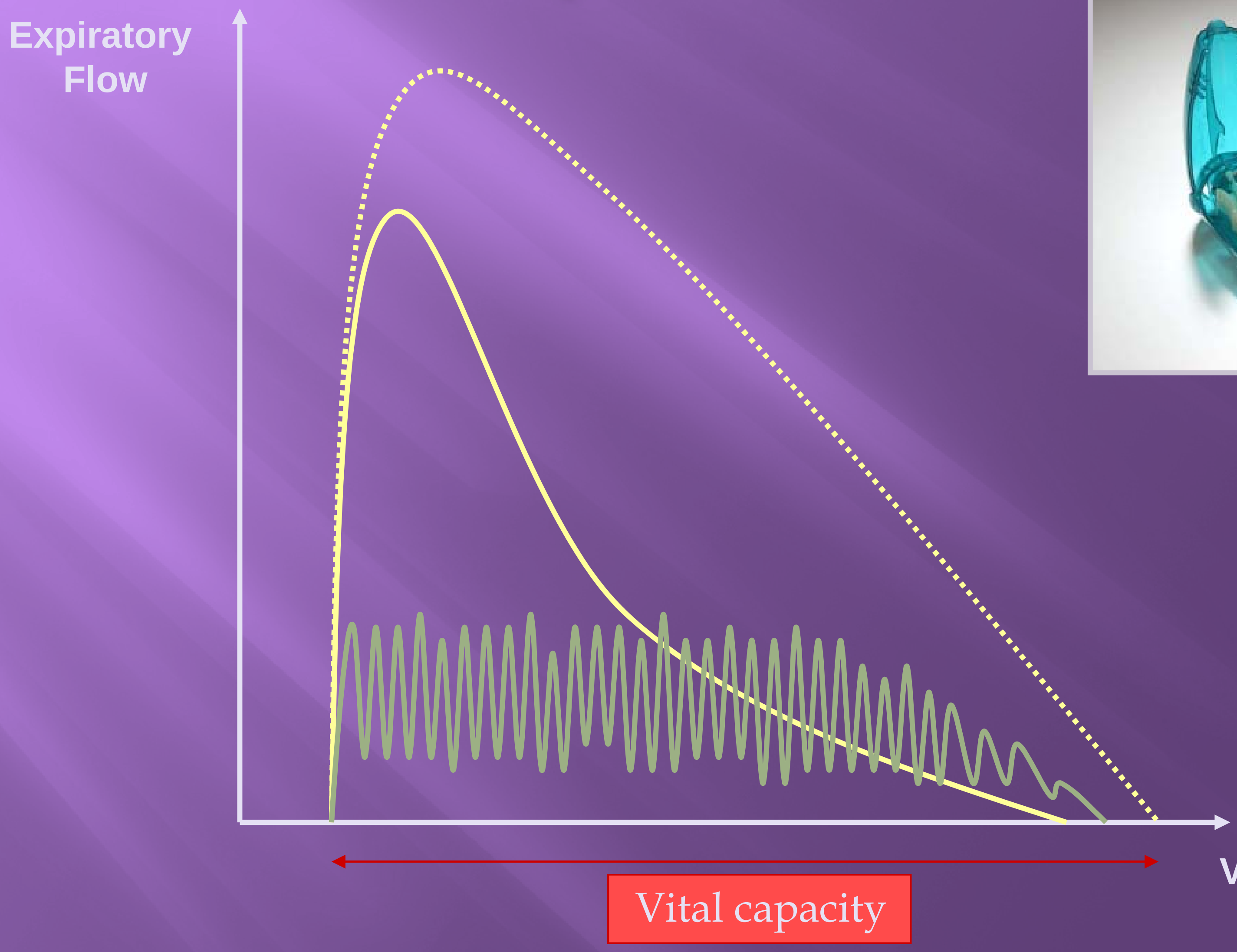
Wagener JS, Respir Care 2003;48(3):234 –245

Oscillatory positive expiratory pressure

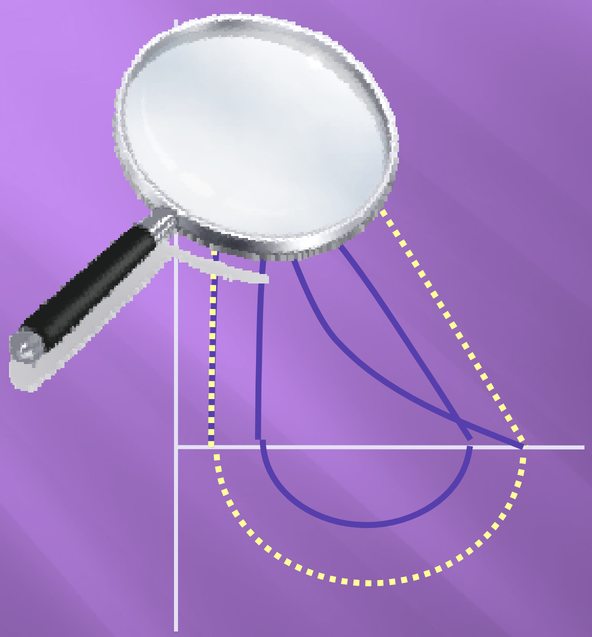
- Oscillatory resistance
- Decrease secretions viscosity

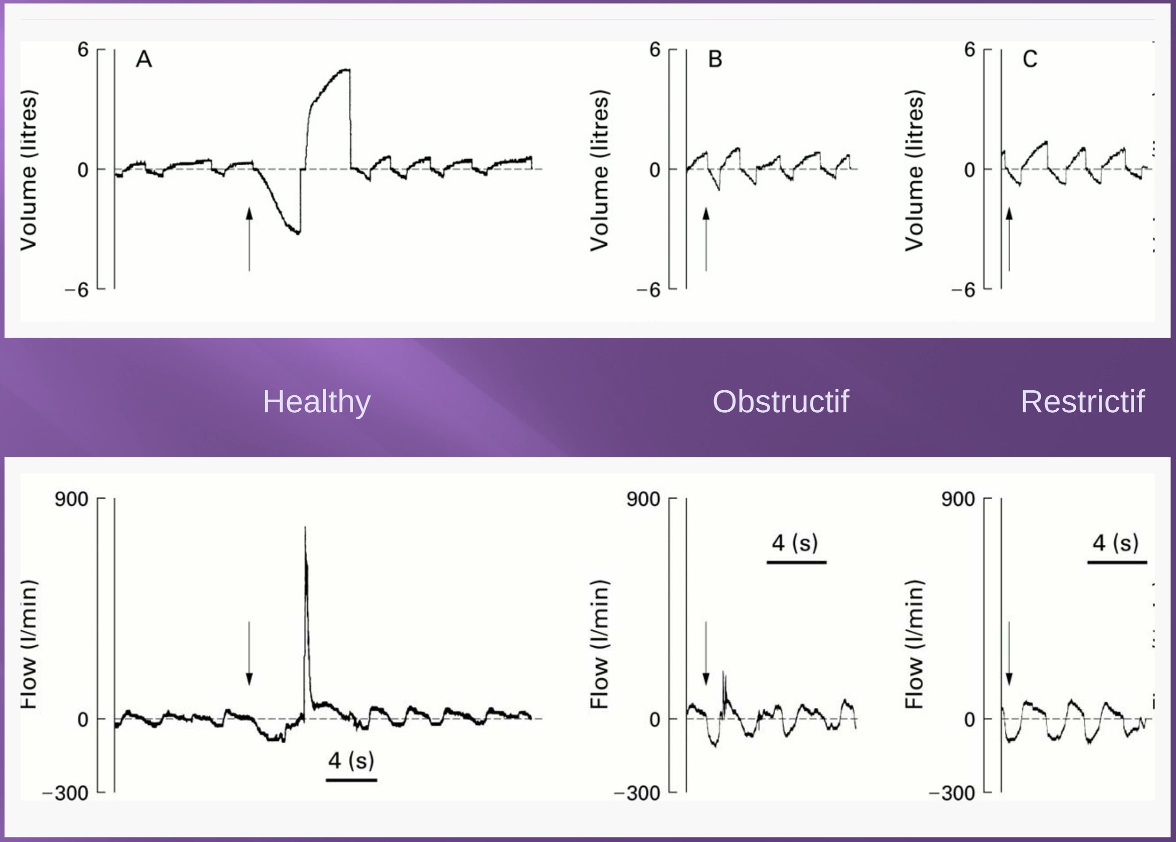


Oscillatory positive expiratory pressure



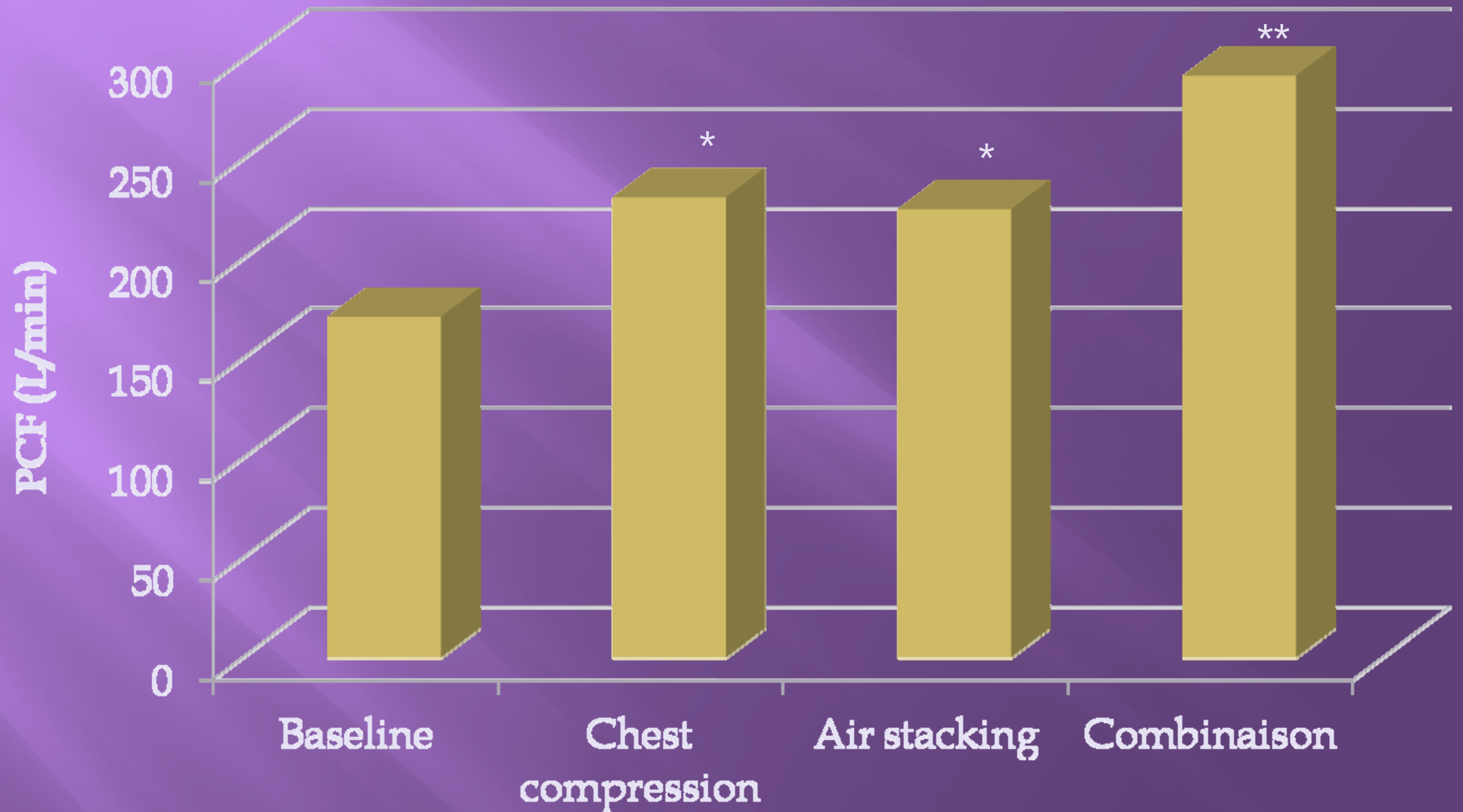
Cough





Sivasothy et al. Thorax 2001;56:438-444

Helping to cough



28 DMD patients (20 4 years, FVC of 29 12%, weight of 56 17 kg)

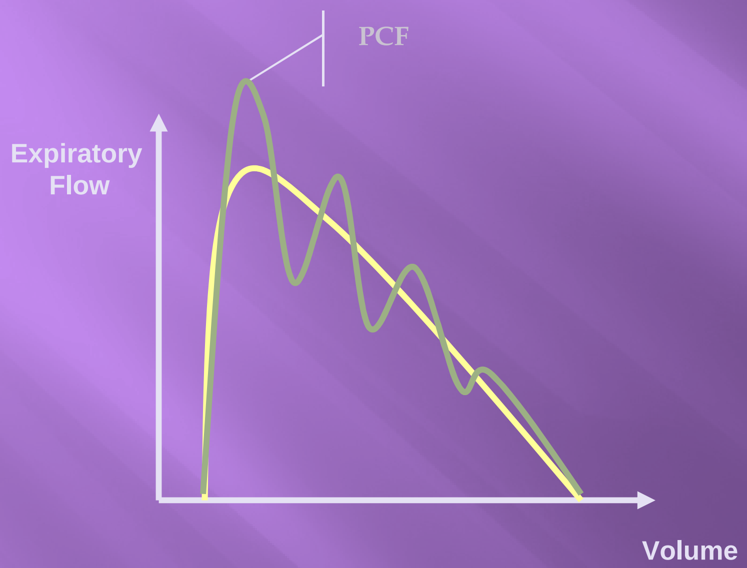
Brito M et al. J Bras Pneumol. 2009;35(10):973-979

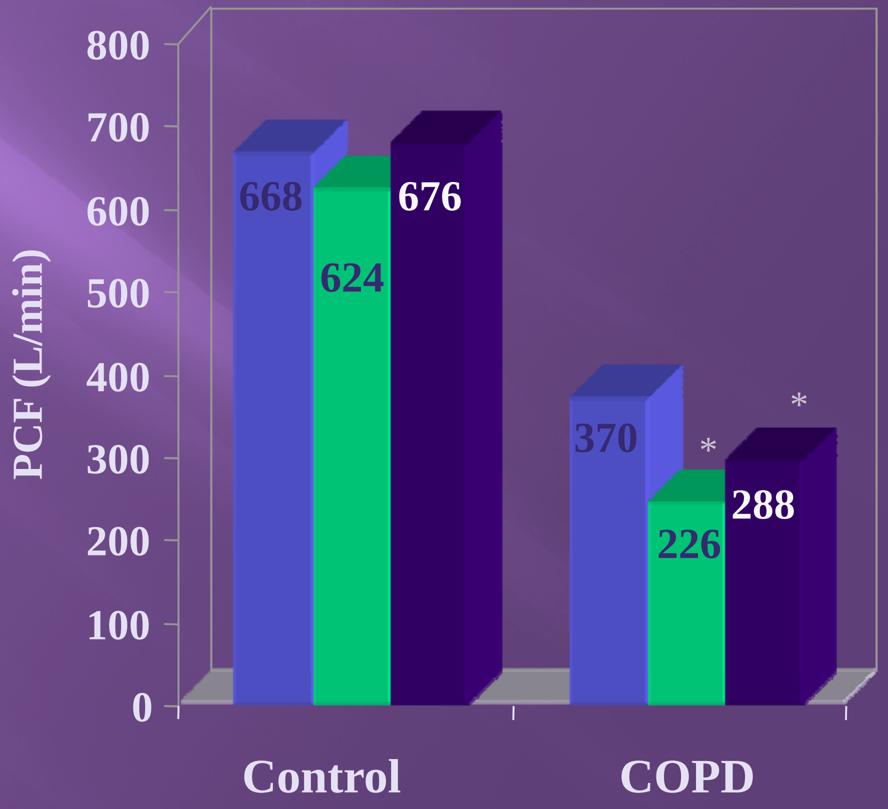
In-Exsufflator or Cough assist

- Positive pressure followed by negative pressure

Effect of manually assisted cough and mechanical insufflation on cough flow of normal subjects, patients with chronic obstructive pulmonary disease (COPD), and patients with respiratory muscle weakness

- 8 COPD vs 9 healthy control





Cough manually assisted

Cough mechanically assisted

Adapted from Michel Toussaint

Sivasothy et al. Thorax 2001

Breathing different lung volume

Breathing at low lung volumes and chest strapping: a comparison of lung mechanics

N. J. DOUGLAS, G. B. DRUMMOND, AND M. F. SUDLOW
Departments of Medicine, Anaesthetics, and Respiratory Medicine, University of Edinburgh, Edinburgh EH3 9YW, Scotland

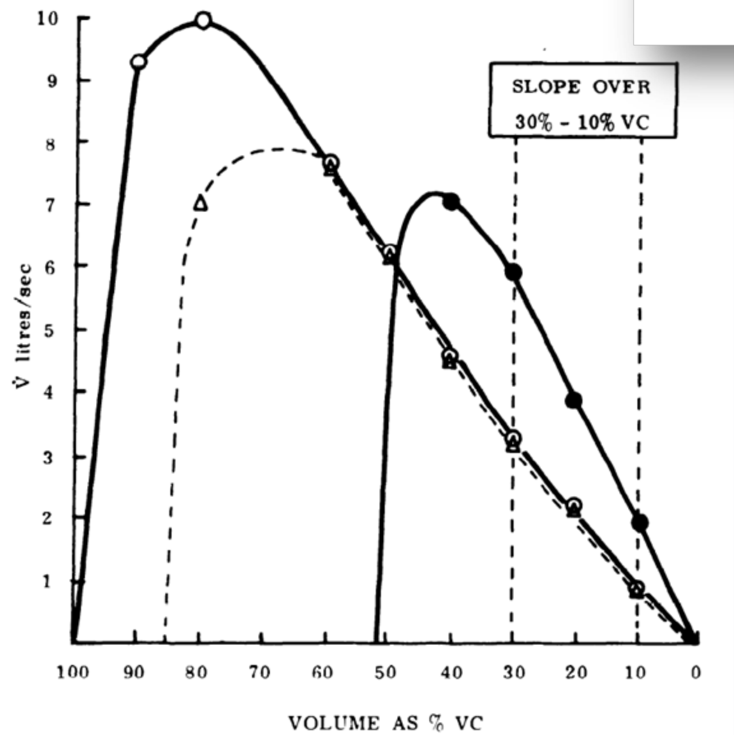


FIG. 2. Effect on forced expiratory flow rates of mild (△) and severe (●) chest strapping compared with maximal flow-volume curve (○) in *subject 2.*

- Decrease of peak expiratory flow
- If there is an important restriction, flow in the small airways is improved

J Appl Physiol 1981;50(3):650-657


Thank you for your attention!