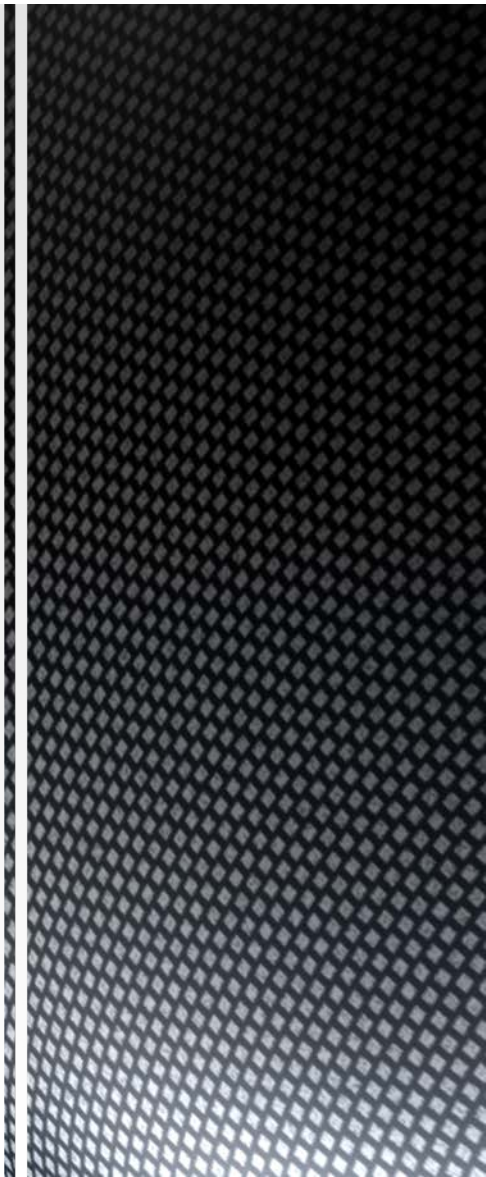
Désencombrement du patient ventilé

Michelle Norrenberg

Soins Intensifs
Hôpital Erasme
ULB, Belgium



Normal subject

- Mucus clearance
- Cough

Toux

- Inspiration rapide à 70% de CV
- Fermeture de la glotte
- Contraction isométrique des muscles expiratoires
  → montée en pression
- contraction diaphragmatique très brève
- Ouverture soudaine de la glotte
- expulsion d'air de l'ordre de 45% de CVF

Mucociliary transport

Mucus = 97% water associated with electrolytes and solid particles (mucins,proteins, phospholipids…)

2 parts: *sol* layer (fluid)

gel layer (gel)

Velocity: 0,4 mm/min peripheral bronchus

20 « central «

Mucus amount: 50-150 ml/day. Controlled by ortho- and para-sympathetic nervous system

Fahy J et al NEJM 2010

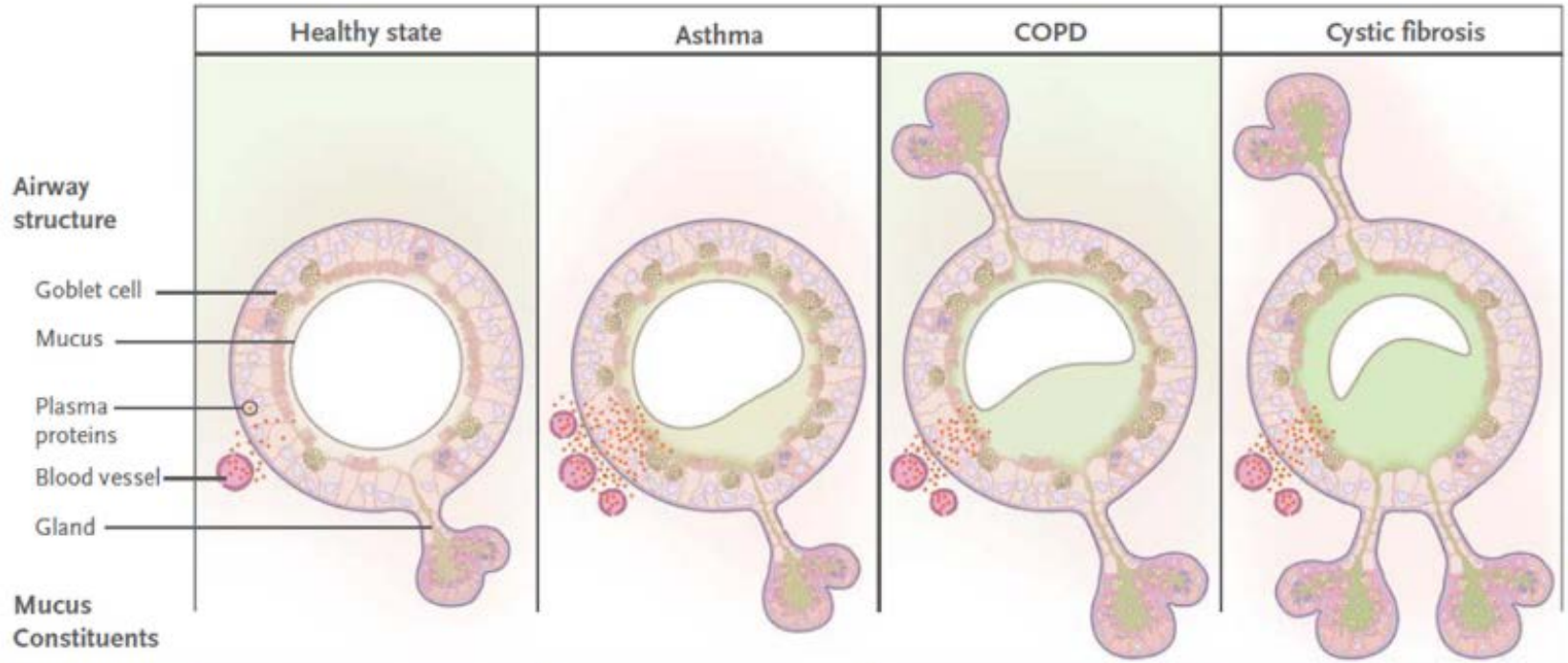
Mucociliary transport

Efficacy:

- Number of active cilia
- Coordination between frequency and beats of cilia
- Depth of *sol* and *gel* layers
- Rheologic properties of mucus

Impaired mucociliary transport

- Primary ciliary dyskinesia
- Bronchial inflammation, edema
- Changes in mucosal rheologic properties
- Morphologic changes of bronchial tree
- Restrictive syndrome
- Decreased expiratory muscle force



Mucus Constituents	Healthy state	Asthma	COPD	Cystic fibrosis
Mucin	X X	X X X X X	X X X X	X X X X
Plasma proteins	X	X X X X	X X	X X
Inflammatory cells	X	X X X	X X X	X X X X X
DNA		X	X X	X X X X X
Actin		X	X X	X X X X X
Bacteria			X X	X X X X X

Figure 4. Airway Mucosal Disease and Mucus Characteristics

Fahy J et al NEJM 2010

Excessive mucus and impaired mucus clearance:

- **Airway plugging (COPD, CF)**
- **Airway trapping**
- **Airway obstruction**
- **Abnormal lung perfusion ratio V/Q**

Marcus A Mall et al Ann Am Thorac Soc 2016

Impaired mucus clearance

- Gas exchange

Mechanisms of worsening gas exchange during acute exacerbations of chronic obstructive pulmonary disease

J.A. Barberà, J. Roca, A. Ferrer, M.A. Félez, O. Díaz*, N. Roger, R. Rodriguez-Roisin

Table 1. – Spirometric and gas exchange data during acute exacerbation and stable clinical conditions

	Acute exacerbation	Stable conditions	p-value
FEV_1 L	0.74±0.17	0.91±0.19	0.01
FVC L	2.17±0.53	2.70±0.55	0.004
FEV_1/FVC %	36±10	35±10	0.77
$P_{a,O_2}/F_{I,O_2}$ kPa	32±7.7	37.6±6.9	0.01
mmHg	245±58	282±52	
P_{a,CO_2} kPa	6.8±1.6	5.9±0.8	0.04
mmHg	51±12	44±6	
V'_E L·min^{-1}	10.5±2.2	9.2±1.8	0.10
$\bar{Q}'$ L·min^{-1}†	6.1±2.4	5.1±1.7	0.05
$V'O_2$ mL·min^{-1}‡	300±49	248±59	0.03
Hb mg·dL^{-1}	13.9±2.1	14.0±2.2	0.97
Shunt $\%\bar{Q}'$	1.8±1.8	1.3±1.7	0.37
Low V'_A/Q' $\%\bar{Q}'$	9.2±12.9	4.1±8.6	0.07
Log SD Q'	1.10±0.29	0.96±0.27	0.04
Log SD V'	1.24±0.38	1.08±0.30	0.22
High V'_A/Q' $\%V'_E$	8.3±8.5	4.0±5.1	0.07
Dead space % V'_E	41±7	43±9	0.48
DISP R-E*	17.8±5.7	13.7±3.8	0.01

Eur Resp J 1997

- Excessive mucus = nutrient rich nidus for bacterial infection, inflammation
- Progressive and irreversible structural lung dammage (brochiectasis)
- Chronic inflammation and infection

⇨ developpment of emphysema (structural damage of distal airways)

➡ **UNPLUGGING = effective treatment**

Marcus A Mall et al Ann Am Thorac Soc 2016
Vestbo J et al AmJ Resp Crit Care Med 2013

Impaired mucus clearance: symptoms

- Cough

  effective or not

- Dyspnea

  mucus obstructs airflow by occupying lumen of numerous airflow

  physical signs-bronchial sounds

  atelectasis-opacities

It is necessary to clear mucus from the airway lumen in order to resolve symptoms and allow effective delivery of aerosol therapies.

Fahy JV et al NEJM 2010

Emerging Concepts and Therapies for Mucoobstructive Lung Disease

Marcus A. Mall[1,2], Henry Danahay[3], and Richard C. Boucher[4]

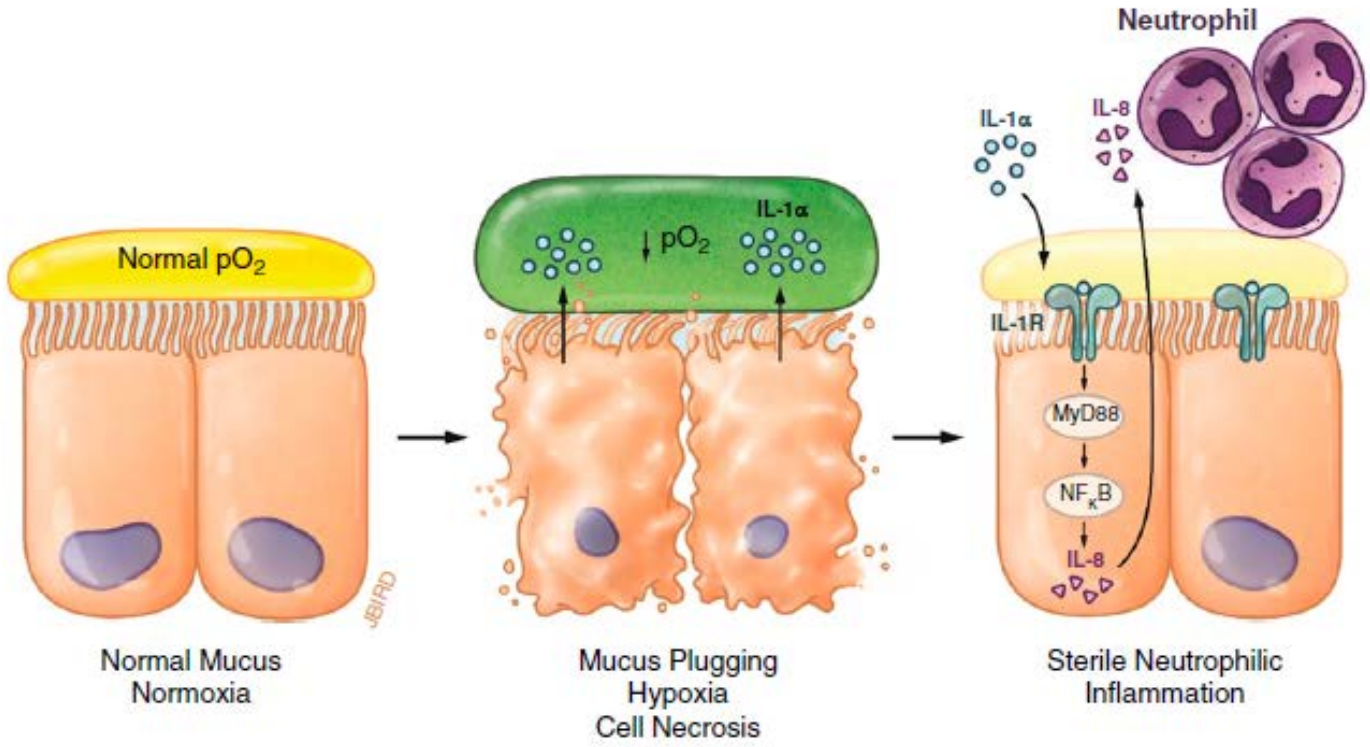


Figure 1. Mucus plugging causes hypoxic epithelial necrosis that triggers sterile inflammation in mucoobstructive lung disease. Mucus plugging produces regional hypoxia and necrosis of a subset of epithelial cells lining the airway surfaces. Dying epithelial cells release the alarmin IL-1α into the airway lumen. Binding of IL-1α to IL-1 receptors (IL-1Rs) on neighboring cells results in activation of the IL-1R/MyD88 signaling pathway, inducing neutrophilic airway inflammation in the absence of bacterial infection. Image courtesy of Joshua Bird. MyD88 = myeloid differentiation primary response 88; NF-κB = nuclear factor-κB; pO_2 = partial pressure of oxygen.

Mall M A et al Ann Am Thorac Soc 2018

- « Mucus plugging per se can trigger airway inflammation in the absence of bacteria infection »

Mucus dysfunction and disease

- **Asthma**

A history of persistent symptoms related to sputum is associated with more severe disease phenotypes in chronic asthma,[91] and mucus hypersecretion is especially problematic in allergic bronchopulmonary aspergillosis.[85]

Fahy JV et al NEJM 2010

Mucus dysfunction and disease

- COPD
- Increased mucin production

⇨ deleterious effects for airway health

(mucus stasis, airway infection

Infection rate increases increasing disease severity)

Fahy JV et al NEJM 2010

Mucus dysfunction and disease

- Cistic fibrosis: poor mucus clearance

  infection

  ⇨ inflammation

  injury

Bronchiectasis

Fibrosis

Cough, purulent sputum, hemoptsisis, dyspnea, rapid loss of lung function

Fahy JV et al NEJM 2010

Mucus dysfunction and disease

- Acute viral and bacterial infection
- Bronchiectasis
- Primary ciliary dyskinesia
- Immunodeficiency status (organ transplantation….)
- Intubated patient
- Paralysis
- Immobilization
- Surgery….

Fahy JV et al NEJM 2010

Intubation : technique, indication, surveillance, complications

L. Vazel *, G. Potard, C. Martins-Carvalho, M. LeGuyader, N. Marchadour, R. Marianowski

Indications

Les indications sont :

- la protection des voies aériennes inférieures et du parenchyme pulmonaire contre le risque d'inhalation ;
- le traitement de l'obstruction des voies aériennes supérieures ;
- les aspirations trachéobronchiques chez des patients ne pouvant pas assurer le drainage correct de leur arbre trachéobronchique (sécrétions abondantes, toux inefficace) avec risque d'atellectasie ;
- la ventilation mécanique chez le patient en insuffisance respiratoire aiguë, ou en situation de détresse vitale.

EMC-Oto-rhino-laryngologie 1 (2004) 22-34

Intubation and Mechanical ventilation

- Bypass of normal barriers
- => lower airways are opened for intrusion of bacterias, viruses….
- => lower-airway infection => impaired mucociliary transport
- Impaired mucociliary transport due to loss of cilia (suctioning) rather than structural abnormalities

Konrad F et al Int Care Med 1995

Intubation and Mechanical ventilation

- Incidence of lower respiratory tract colonization (LRTC): 22-95% of intubated patients => major risk of VAP
- Risk of colonization of oral cavity, nasopharynx, aspiration gastric content, position, sedation
- ↘ cough reflex and effectiveness
- => altered mucus clearance, hypersecretion, retention……

Konrad F et al Int Care Med 1995

Intubation and Mechanical ventilation

- Cough:
- Ineffective (closure of glottis)
- Muscle weakness, neuromuscular disorders, ICUAW

⇨ secretions pooling, atelectasis, respiratory tract infections

⇨ weaning failure

⇨ reintubation

Fahy JV et al NEJM 2010

Detrimental role of the airway mucin Muc5ac during ventilator-induced lung injury

M Koeppen[1,2], EN McNamee[1], KS Brodsky[1], CM Aherne[1], M Faigle[3], GP Downey[4,5], SP Colgan[6], CM Evans[5], DA Schwartz[5], and HK Eltzschig[1]

MUC5AC transcript and protein levels are induced with cyclic mechanical stretch *in vitro*

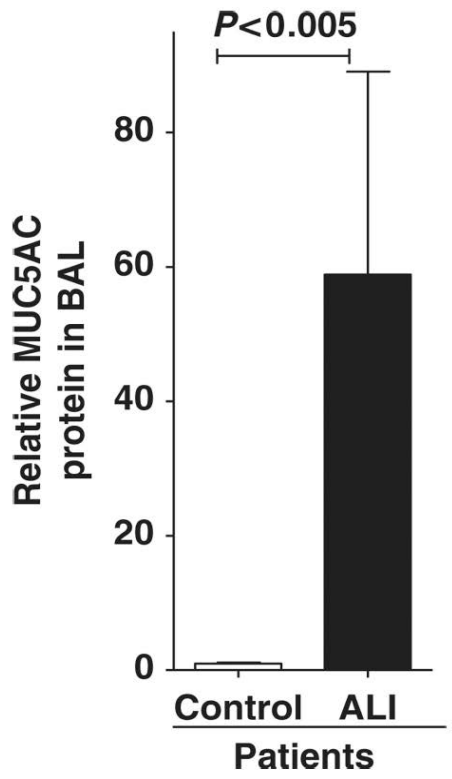


Figure 3.
MUC5AC content in the bronchoalveolar lavage (BAL) of patients with acute lung injury (ALI). Human BAL fluid was obtained from patients with ALI and MUC5AC protein content was assessed using enzyme-linked immunosorbent assay. Results were compared with samples collected from unventilated subjects without lung injury, who were otherwise healthy. Results are presented as mean±s.d.(n= 5 per group).

MUC5AC expression is increased in mice exposed to VILI

Mucosal Immunol. 2013 July ; 6(4): 762–775. doi:10.1038/mi.2012.114.

Independent Effects of Etiology of Failure and Time to Reintubation on Outcome for Patients Failing Extubation

SCOTT K. EPSTEIN and RONALD L. CIUBOTARU

TABLE 3

CAUSES OF EXTUBATION FAILURE

Cause of Extubation Failure	Patients* (n)	Patients* (%)	Deaths† (n)	Deaths† (%)
Respiratory failure	21	28	12	57
Congestive heart failure	17	23	8	47
Aspiration/excess secretions	12	16	2	17
Upper airway obstruction	11	15	2	18
Encephalopathy	7	9	3	43
Other	6	8	4	67

* Percentage of all patients (n = 74) requiring reintubation.

† Percentage of patients dying compared with all patients reintubated secondary to that cause for extubation failure.

AJRCCM 1998

TREATMENT

- « …. Mucus clearance is aided by any maneuver that promotes cough and increased minute ventilation including exercices. »
- Airflow generates shear stress on airway cell surfaces

⇒ effects on mucus hydratation

⇒ both mechanical and biochemical beneficial effects from non pharmacological approaches

Fahy JV et al NEJM 2010
Flume PA et al Resp Care 2009
Tarran R et al Annu Rev Physiol 2006

Intensive Care Med
DOI 10.1007/s00134-008-1026-7

ESICM STATEMENT

R. Gosselink
J. Bott
M. Johnson
E. Dean
S. Nava
M. Norrenberg
B. Schönhofer
K. Stiller
H. van de Leur
J. L. Vincent

Physiotherapy for adult patients with critical illness: recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients

Aims of respiratory physiotherapy

- To clear airways secretions
- To improve ventilation and lung compliance
- To reduce airway resistance and work of breathing

Intensive Care Med (2008) 34:1188–1199
DOI 10.1007/s00134-008-1026-7

Multimodality respiratory physiotherapy reduces mortality but may not prevent ventilator-associated pneumonia or reduce length of stay in the intensive care unit: a systematic review

Pozuelo-Carrascosa DP et al 2018 Journal of Physiotherapy

Box 1. Inclusion criteria.

Design
- Randomised controlled trials

Participants
- Intubated patients in an ICU
- Mechanically ventilated for more than 48 hours

Intervention
- More than two chest physiotherapy techniques
  - positioning or postural drainage
  - manual hyperinflation
  - vibration or rib springing
  - suctioning

Comparisons
- Control group that did not receive more than two chest physiotherapy techniques
- Any other co-interventions (eg, usual care) were equivalent

Outcome measures
- Incidence of VAP
- Length of ICU stay
- Mortality

ICU = intensive care unit, VAP = ventilator-associated pneumonia

Multimodality respiratory physiotherapy reduces mortality but may not prevent ventilator-associated pneumonia or reduce length of stay in the intensive care unit: a systematic review

Pozuelo-Carrascosa DP et al 2018 Journal of Physiotherapy

Table 1
Characteristics of the studies included in the meta-analysis.

Study	Country	Participants	Intervention		Outcome measures
			Exp	Con	
Zeng et al[20]	China	Exp = 37 (22 male) Age (yr) = 63 (SD 15) APACHE II = 19 (SD 6) Con = 31 (25 male) Age (yr) = 66 (SD 14) APACHE II = 18 (SD 5)	Positioning, MH, vibrations, early functional exercise, and mobilisation	Positioning and mobilisation	• incidence of VAP • length of ICU stay
Pattanshetty et al[21]	India	Exp = 87 (64 male) Age (yr) = 49 (SD 16) APACHE II = N/A Con = 86 (67 male) Age (yr) = 50 (SD 16) APACHE II = N/A	Positioning, MH, vibrations and suctioning Two sessions per day	MH and suctioning Two sessions per day	• incidence of VAP • length of ICU stay • mortality
Patman et al[22]	Australia	Exp = 72 (51 male) Age (yr) = 46 (SD 19) APACHE II = 20 (SD 6) Con = 72 (36 male) Age (yr) = 41 (SD 20) APACHE II = 21 (SD 6)	Positioning, MH and suctioning Six sessions per day	No chest physiotherapy	• incidence of VAP • length of ICU stay • mortality
Templeton et al[23]	UK	Exp = 87 (53 male) Age (yr) = 58 (SD 17) APACHE II = N/A Con = 85 (58 male) Age (yr) = 58 (SD 18) APACHE II = N/A	Positioning, MH, vibration, rib springing, suctioning and general mobilisation Intensity and frequency that physiotherapist felt appropriate	Decubitus care[a], suctioning and general mobilisation Two sessions per day	• incidence of VAP • length of ICU stay • mortality
Ntoumenopoulos et al[24]	Australia	Exp = 22 (gender N/A) Age (yr) = 39 (SD 17) APACHE II = 12 (SD 4) Con = 24 (gender N/A) Age (yr) = 41 (SD 20) APACHE II = 14 (SD 7)	Positioning, MH and suctioning Two sessions per day	No chest physiotherapy	• incidence of VAP • length of ICU stay • mortality

APACHE II = Acute Physiology and Chronic Health Evaluation II, Con = control group, Exp = experimental group, MH = manual hyperinflation, VAP = ventilator-associated pneumonia, ICU = intensive care unit, N/A = not available.

[a] Decubitus care was mentioned only in the control group but might also be considered to have been covered by the experimental group because it included positioning and general mobilisation.

Multimodality respiratory physiotherapy reduces mortality but may not prevent ventilator-associated pneumonia or reduce length of stay in the intensive care unit: a systematic review

Pozuelo-Carrascosa DP et al 2018 Journal of Physiotherapy

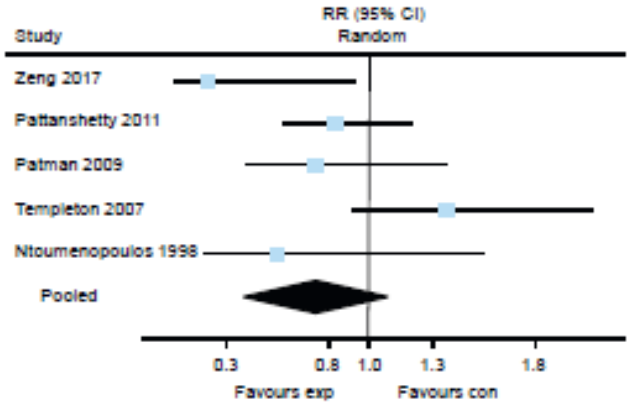


Figure 3. RR (95% CI) of the preventive effect of multimodality respiratory physiotherapy on ventilator-associated pneumonia by pooling data from five studies.

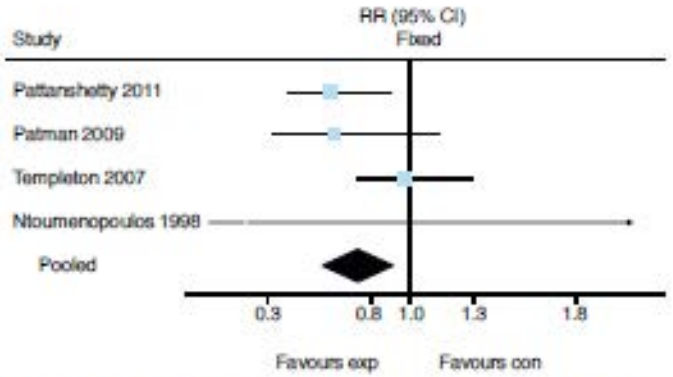


Figure 7. RR (95% CI) of the effect of multimodality respiratory physiotherapy on mortality by pooling data from four studies.

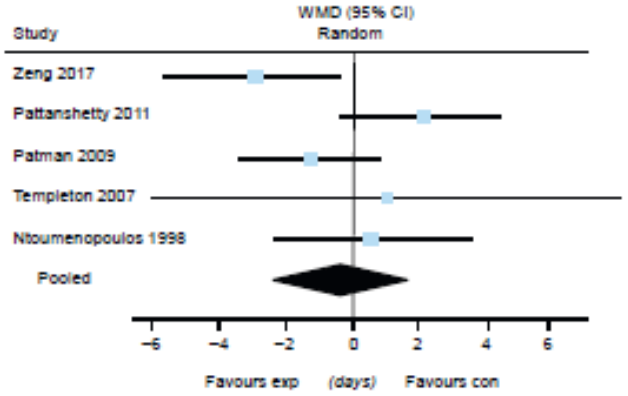


Figure 5. WMD (95% CI) in the effect of multimodality respiratory physiotherapy on length of intensive care unit stay by pooling data from five studies.

Chest physiotherapy in mechanically ventilated patients without pneumonia—a narrative review

Herbert D. Spapen, Jouke De Regt, Patrick M. Honoré

Table 1 Prospective randomized controlled studies of chest physiotherapy in mechanically ventilated patients without pneumonia

Author (reference)	Patients	CPT intervention	Result
Ntoumenopoulos (4)	22 CPT, 24 controls	MLH, postural drainage; bid	No difference in VAP incidence and duration of ventilation between groups
Ntoumenopoulos (5)	24 CPT, 36 controls	Body positioning, expiratory chest wall vibrations, suction; bid	Less VAP in CPT group
Templeton & Palazzo (6)	87 CPT, 85 controls	Body positioning, MLH, rib springing, chest wall vibration, suction; bid	Tendency for more VAP and prolonged ventilation in CPT group
Pattanshetty & Gaude (7)	87 CPT, 86 controls	Body positioning, MLH, chest wall vibrations, suction; bid (controls: MLH and suction)	No difference in VAP incidence between groups; prolonged hospitalization in CPT group
Patman (8)	72 CPT, 72 controls	Body positioning, MLH, suction; 6 times/day	No significant difference between groups for any outcome
Spapen (9)	15 CPT	Body positioning, chest wall vibrations, suction; bid	Tendency for less Gram-negative IVACs in IPV-AADP-treated patients
	15 no CPT	Mobilisation, suction; bid	
	15 IPV-AADP	20 min IPV-AADP sessions, suction; bid	

CPT, chest physiotherapy; MLH, manual lung hyperinflation; VAP, ventilator-associated pneumonia; IPV-AADP, intrapulmonary percussive ventilation-assisted autogenic drainage physiotherapy; IVACs, infection-related ventilator-associated complications; bid, twice daily.

J Thorac Dis 2017, 9

Chest physiotherapy in mechanically ventilated patients without pneumonia—a narrative review

Herbert D. Spapen, Jouke De Regt, Patrick M. Honoré

Conclusions: meilleure clearance

effets sur oxygénation et ventilation: éphémère

le plus utilisé: MHI mais nécessité de déconnection

CPT plus intense: bénéfice?

position et compressions thoraciques manuelles? (études préliminaires et expérimentales)

J Thorac Dis 2017, 9

Chest physiotherapy for the prevention of ventilator-associated pneumonia: A meta-analysis.

Wang MY, Pan L, Hu XJ. 2019 Am J infect control

- **RESULTS:**

A total of 6 randomized (n = 704) controlled trials were identified. CPT did not significantly reduce the incidence of VAP (risk ratio = 1.02; 95% confidence interval, 0.82-1.26; P = .87), but reduced hospital mortality (risk ratio = 0.68; 95% confidence interval, 0.48-0.95; P = .02). No significant differences were observed regarding length of intensive care unit stay and duration of mechanical ventilation.

- **CONCLUSIONS:**

CPT may not significantly reduce the incidence of VAP.

However, the results should be interpreted cautiously owing to the heterogeneity and the limited trials.

RESEARCH Open Access

Benefits and risks of manual hyperinflation in intubated and mechanically ventilated intensive care unit patients: a systematic review

Fr. Paulus, Jan M Binnekade, M. B Vroom and M J Schultz

Crit Care 2012;16

Results: 50 articles (19 relevant). Trials differed too much to permit meta-analysis.

Short-term improvements in lung compliance, oxygenation, and secretion clearance, no changes in outcomes.

!!! decreases in CO, alterations of HR, and increased CVP.

Conclusions: Studies have failed to show that MH benefits intubated and mechanically ventilated patients.

!!! short-term side effects.

Lung hyperinflation by mechanical ventilation versus isolated tracheal aspiration in the bronchial hygiene of patients undergoing mechanical ventilation

50 patients were included.

Compared to the Control Group, the MVH Group showed greater aspirated secretion amount (3.9g versus 6.4g, p = 0.0001)

C Assmann et al Rev Bras Ter Intensiva 2016;1

Experimental study on the efficiency and safety of the manual hyperinflation maneuver as a secretion clearance technique

8 respiratory therapists

CONCLUSIONS:

MHI produced safe P_{alv} levels. However, the MH maneuver was often performed in a way that did not favor secretion removal (PIF exceeding PEF), even after instruction. The unfavorable PIF/PEF ratio was attributable to overly rapid inflations and low V_T.

de Arruda Ortiz T et al J 2013 Bras Pneumol

RESEARCH ARTICLE

Effects of manual hyperinflation, clinical practice versus expert recommendation, on displacement of mucus simulant: A laboratory study

Marcia S. Volpe[1]*, Juliane M. Naves[2], Gabriel G. Ribeiro[2], Gualberto Ruas[2], Mauro R. Tucci[3]

PlosOne 2018

Table 1. Mean (SD) for outcomes during MH for each study phase.

Variables	Pre-instruction *Clinical Practice*	Post-instruction *Expert recommendation*	*P value*
V_T (mL)	711.4 ± 76.1	643.1 ± 57.8	0.005
T_{INSP} (s)	0.62 ± 0.15	1.84 ± 0.54	< 0.001
PIF (L/min)	129.6 ± 28.8	38.0 ± 9.6	< 0.001
PIP (cmH_2O)	39.1 ± 11.1	15.0 ± 1.5	< 0.001
PEF (L/min)	75.0 ± 5.2	65.4 ± 6.7	0.001
PIF/PEF	1.73 ± 0.38	0.58 ± 0.16	< 0.001
PEF-PIF (L/min)	-54.6 ± 28.3	27.5 ± 11.0	< 0.001
CMD[a] (cm)	- 2.35 ± 0.63	0.52 ± 0.33	< 0.001

[a]A negative displacement indicates mucus movement towards the test-lung.

Abbreviations: CMD, center-of-mass displacement; PEF, peak expiratory flow; PIF, peak inspiratory flow; PIP, peak inspiratory pressure; T_{INSP}, inspiratory time; V_T, tidal volume.

Conclusions

Performance of MH during clinical practice with PIF higher than PEF was ineffective to clear secretion in a lung model simulating a mechanically ventilated patient. In order to remove secretion, MH should result in an adequate expiratory flow bias.

Effects of duty cycle and positive end-expiratory pressure on mucus clearance during mechanical ventilation

Li Bassi G et al Crit Care 2012; 40

In the semirecumbent position, mucus clearance is improved with prolongation of the duty cycle.

Effects of manual rib cage compressions on expiratory flow and mucus clearance during mechanical ventilation.

Marti D et al Crit Care 2013; 41

Hard manual rib cage compression improved mucus clearance in the semirecumbent position. The technique appeared to be safe. Conversely, soft manual rib cage compression was not effective and potentially unsafe.
Predominant role of peak expiratory flow on mucus clearance.

Comparison of changes in tidal volume associated with expiratory rib cage compression and expiratory abdominal compression in patients on prolonged mechanical ventilation.

Morino A J et al 2015 Phys Ther Sci

18 patients: Vt at rest: 7.2 ± 1.7 mL/kg

Vt chest compression: 8.3 ± 2.1 mL/kg

Vt abdominal « :9.1 ± 2.2 mL/kg *

* Vt rest# abdo p < 0,05

Expiratory abdominal compression may be an effective alternative to the manual breathing assist procedure.

December 2016 : online expert panel as part of a Delphi Process, to determine expert consensus regarding **physiotherapy management of intensive care patients with community acquired pneumonia (CAP) during the acute, intubated period.**

Lisa van der Lee

PhD Candidate, School of Physiotherapy

University of Notre Dame Australia

- **Systematic review protocol**
- **JBI Database System Rev Implement Rep. 2017 Jun;15(6):1508-1511.**

Clinical validation of expert consensus statements for respiratory physiotherapy management of invasively ventilated adults with community-acquired pneumonia: A qualitative study

Lisa van der Lee [a,c,*], Anne-Marie Hill [b], Shane Patman [a]

Intensive & Critical Care Nursing 60 (2020) 102854

The aim of this study was to conduct a peer-review of the expert consensus statements for respiratory physiotherapy management of CAP to determine their acceptability to Australian multidisciplinary ICU staff and to explore what adaptations might be required to enable them to be developed into a relevant and useful guideline for clinical practice

Clinical validation of expert consensus statements for respiratory physiotherapy management of invasively ventilated adults with community-acquired pneumonia: A qualitative study

Lisa van der Lee [a,c,*], Anne-Marie Hill [b], Shane Patman [a]

Intensive & Critical Care Nursing 60 (2020) 102854

Conclusion: Multidisciplinary peer-review established clinical validity of expert consensus statements for implementation with invasively ventilated adults with community acquired pneumonia

CONCLUSIONS

Mechanical ventilation

Impaired mucus clearance

Ineffective cough

Bypass of N barriers → **risk of pulmonary infection**

CONCLUSIONS

Mechanical ventilation

Impaired mucus clearance

Ineffective cough

Bypass of N barriers → risk of pulmonary infection

UNPLUGGING = EFECTIVE TREATMENT

Conclusions

- **Intubated patients:**

- **CPT recommended to avoid mucus plugging**
- **Chest wall or abdominal compression can be recommended but P exp flow > Pinsp flow**

- **Pneumonia : some evidence for recommendations**

MERCI

Chest physiotherapy for pneumonia in adults.

Yang M, Yan Y, Yin X, Wang BY, Wu T, Liu GJ, Dong BR.

- **SELECTION CRITERIA:**
- **6 Randomised controlled trials (RCTs) assessing the efficacy of chest physiotherapy for treating pneumonia (conventional CPT, active cycle breathing tech, osteopathic manipulative treat, PEEP) in adults.**
- **No effect on mortality, improvement chest X-ray, length of stay**
- **AUTHORS' CONCLUSIONS:**
- **Based on current limited evidence, chest physiotherapy might not be recommended as routine additional treatment for pneumonia in adults.**

Cochrane Data base syst rev 2013