SAINT-LUC UCL BRUXELLES

UCL Université catholique de Louvain

réanimation 2016 PARIS 13-15 JANVIER

Hypoventilation alvéolaire
« Positionnement et exercice physique »

Montrer l'intérêt de la mobilisation précoce pour prévenir et traiter l'hypoventilation alvéolaire.

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Déclaration de liens

mon intervention
ne présente aucun conflit d'intérêt

réanimation 2016 PARIS 13-15 JANVIER

Plan

- Immobility effects.
- **Positioning and recruitment:**
  - Prone position
  - Lateral position
  - Sitting position
  - Vertical position
- **Early mobilization and recruitment:**
  - Standing and Walking
  - Positioning + early mobilization

Immobility effects.

Review

Bench-to-bedside review: Mobilizing patients in the intensive care unit – from pathophysiology to clinical trials

Alex D Truong[1], Eddy Fan[1], Roy G Brower[1] and Dale M Needham[1,2]

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This article is online at http://ccforum.com/content/13/4/218

Critical Care 2009, 13:218 (doi:10.1186/cc7885)

Table 1

Selected adverse effects of prolonged bed rest

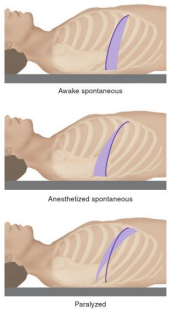
Musculoskeletal
- Decreased muscle protein synthesis [14]
- Muscle atrophy and decrease in lean muscle mass [80]
- Decreased muscle strength [14]
- Decreased exercise capacity [81]
- Connective tissue shortening and joint contractures [82]
- Decreased bone density [80]
- Pressure ulcers [83]

Pulmonary
- Atelectasis [84]
- Pneumonia [85]
- Decreased maximal inspiratory pressure and forced vital capacity [81]

Cardiovascular
- Decreased total cardiac and left ventricular size [86]
- Decreased lower extremity venous compliance [87]
- Orthostatic intolerance [88]
- Decreased cardiac output, stroke volume, and peripheral vascular resistance [86,89,90]
- Impaired microvascular function [91]
- Decreased cardiac response to carotid sinus stimulation [89]

Endocrine and Metabolism
- Decreased insulin sensitivity [91]
- Decreased aldosterone and plasma renin activity [92]
- Increased atrial natriuretic peptide [93]

Immobility effects.



Atelectasis

In many critically ill patients, partial or complete atelectasis of the left lower lobe is apparent on chest radiographs within 48 hrs of recumbency. This may

(39, 40). Atelectasis causes intrapulmonary shunt, increasing requirements for supplemental oxygen. This may increase the risk of oxygen toxicity, especially in patients with acute lung injury.

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Positioning and recruitment:

Body position effects

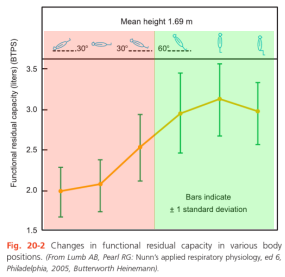


Fig. 20-2 Changes in functional residual capacity in various body positions. *(From Lumb AB, Pearl RG: Nunn's applied respiratory physiology, ed 6, Philadelphia, 2005, Butterworth Heinemann).*

Supine position (0°) is a risk factor for **nosocomial pneumonia in MV** patients when compared with semi-recumbent (45°)

Drakulovic M, et al. Lancet 1999 Alexiou VG, et al. *J of Crit care* 2009

Positioning and recruitment:

Prone position

40 MV early and refractory ARDS

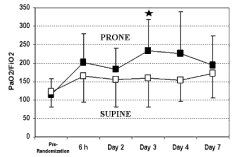


Fig. 1 Mean and SD of PaO_2/FIO_2 in prone and supine groups. The difference did not reach statistical significance until day 3

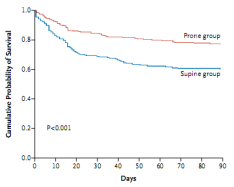


Figure 2. Kaplan–Meier Plot of the Probability of Survival from Randomization to Day 90.

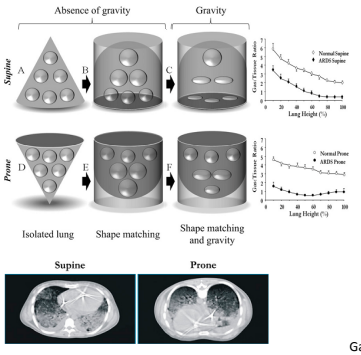
Significant survival benefit in patients with PaO2/FIO2 lower than **150**.

At least 16h/day

Fernandez R. et al *ICM* 2010 Guérin C. et al *NEJM* 2013

Positioning and recruitment:

Prone position



Prone positioning improves **oxygenation** by optimizing lung **recruitment** and **ventilation–perfusion matching**.

Distributing stress and strain more homogeneously through the lung parenchyma. ↓VILI

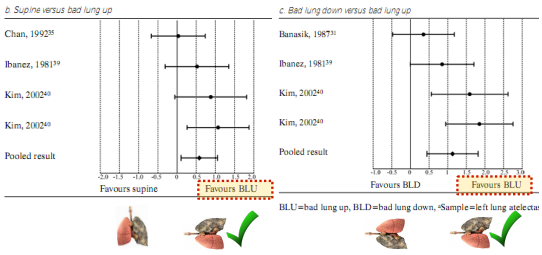
Gattinoni L. et al *AJRCCM* 2013

Positioning and recruitment:

Lateral position

Unilateral lung infiltrates

Improvement of oxygenation PaO_2 by reductions in areas of lung with low ventilation perfusion ratios. 10-30 min… 45° (30-52°)



Thomas PJ et al *anaesth intensive care* 2007

Not improve oxygenation was observed with **lower degree of lung pathology (some patients without lung pathology)!**

Thomas PJ et al *Heart lung* 2007

Positioning and recruitment:

Sitting position

12 patients after laparotomy

Supine 0°, Sitting 70° and standing positions

Arterial oxygen saturation was improved

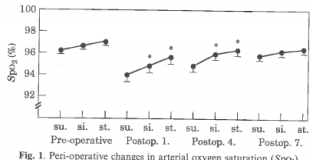


Fig. 1. Peri-operative changes in arterial oxygen saturation (Spo_2) in supine (su.), sitting (si.), and standing (st.) positions in patients undergoing laparotomy. Results are shown as mean (SEM). *p < 0.05 compared with supine position on the same day.

Mynster T, et al *Anaesthesia* 1996

Positioning and recruitment:

Sitting position

n=16 ARDS

Supine (strict horizontal) vs Sitting position
Trunk at 45° with leg down 45°

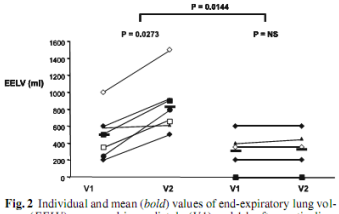


Fig. 2 Individual and mean (*bold*) values of end-expiratory lung volume (*EELV*), measured immediately (*V1*) and 1 h after verticalization (*V2*) in responders (*left*) and nonresponders (*right*)

Responders only (n=11):
increase in PaO_2 higher than 40% of the baseline

↑ end expiratory lung volume (EELV)

Richard JC, et al ICM 2006

Positioning and recruitment:

Sitting position

24 ventilated patients (difficult weaning)

Supine, semi-recumbent (45°) and seated (90°) positions

Table 2 Clinical and hemodynamic parameters during the three study periods

	0°	45°	90°LD	*p*
SBP (mmHg)	116 [104–123]	123 [108–133]*	123 [110–132]*	0.05
DBP (mmHg)	59 [50–65]	57 [49–71]	57 [51–68]	0.58
HR (beats/min)	95 [79–108]‡	98 [79–109]‡	104 [84–114]	0.02
SpO_2 (%)	97 [96–98]	97 [96–97]	97 [95–98]	0.94
$EtCO_2$ (mmHg)	36 [31–41]	36 [32–42]	35 [29–40]	0.51

A 45° position helps to unload the respiratory muscles, moderately reduces PEEPi, and is often considered as comfortable.

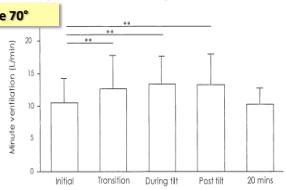
Deye N, et al. *Intensive care med 2012*

Positioning and recruitment:

Vertical position

16 ICU patients, (P/F ratio < 200, n=4).

Tilt table 70°



↑ Minute volume
↑ Tidal volume
↑ Respiratory rate
= PaO2 and PaCO2

PaO2/FIO2 < 200 all showed increased in PaO_2 20 min posttilt.

More severely patients are more beneficed.

Chang AT, et al *Arch Phys Med Rehabil* 2004

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Early mobilization

Early mobilization is the implementation of physical exercise or mobilization within the early phase of illness.

ELSEVIER

Physiotherapy

Physiotherapy 99 (2013) 119–125

Association of postoperative pulmonary complications with delayed mobilisation following major abdominal surgery: an observational cohort study

K.J. Haines [a,*], E.H. Skinner [b], S. Berney [a], The Austin Health POST Study Investigators [1]

[a] Department of Physiotherapy, Austin Hospital, Heidelberg, Victoria, Australia
[b] Departments of Physiotherapy and Intensive Care, Monash Medical Centre, Clayton, Victoria, Australia

Patients were **3.0** (95% confidence interval 1.2 to 8.0) times more likely to develop a **postoperative pulmonary complication** for **each postoperative day** they **did not mobilize away from the bed.**

Early mobilization and recruitment:

Standing and Walking

in 21 mechanically ventilated post-abdominal surgery patients

↑ minute ventilation
↑ tidal volume
↑ respiratory rate
↑ inspiratory flow rates
→ from supine to standing, reversed after 20 min.

↑ rib cage displacement
No changes in abdominal displacement
→ Walking in the spot (1 min)

No changes in arterial blood gases
→ 20 min after sitting following mobilization

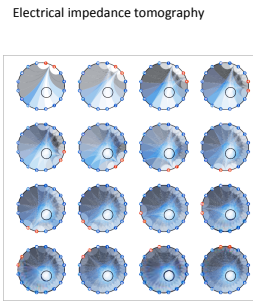
Limited time and intensity because of pain ?

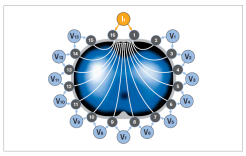
limit further increases in V_T with exercise. Although pain was not rated or controlled during mobilisation in this study, pain may have limited the pace and intensity at which patients could walk on the spot with a resultant effect on ventilatory responses. Other factors such as impairments in preoperative

Zafiropoulus B, et al. *Austr Journ of Physiother* 2004

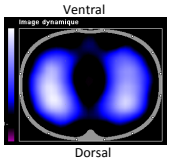
Direct and continuous measurement of regional ventilation distribution.

Electrical impedance tomography





Ventral



Right Left

Dorsal

Electrical impedance tomography

Ventilation data

Impedances difference:

End inspiration

End expiration

Recruitment data

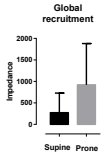
Functional residual capacity impedance [AU]

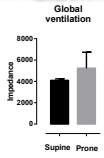
Prone position

72 yr Liver failure / ARDS

PaO2/FiO2: 105

PaO2/FiO2: 108

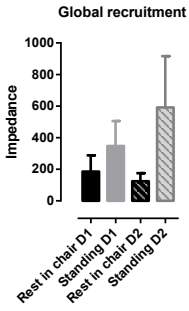




Early mobilization and recruitment:

Standing

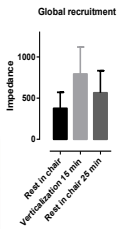
20 yr, Liver transplantation

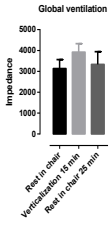


Early mobilization and recruitment:

Vertical position

65 yr, Hepatic Failure / ICUAW



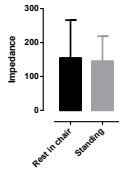


Early mobilization and recruitment:

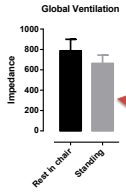
Standing

56 yr, Colon resection

Global recruitment



Global Ventilation



Pain 8/10
PCA
(morphine)

Pain

management is essential for better breathing and moving

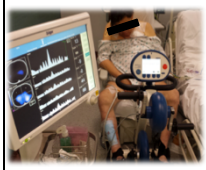
Early mobilization and recruitment:

Early exercise

54 yr, Chronic liver failure

Time 1
Rest in bed 60°

Time 2
Rest in chair

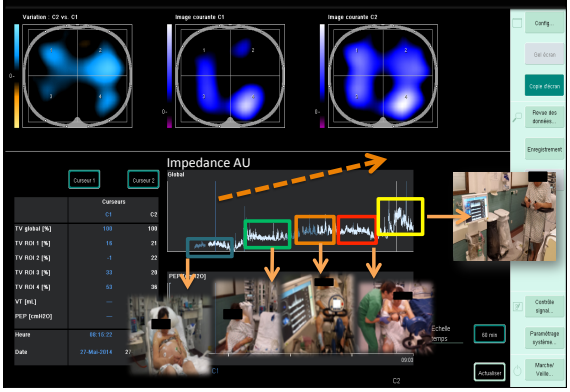


Time 3
Passive leg cycle ergometer

Time 4
Active arm cycle ergometer

Time 5
Static walk

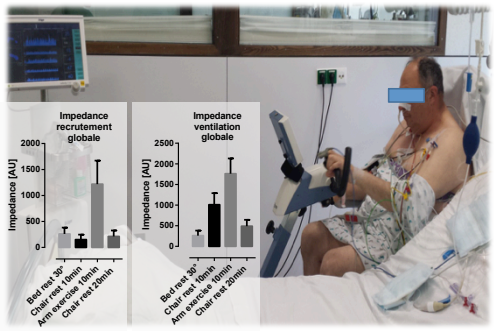
EVOLUTION OF GLOBAL VENTILATION



Early mobilization and recruitment:

Early exercise

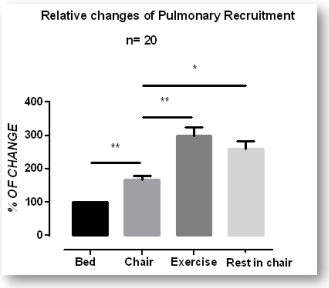
60 yr, 115 kg, Hepatectomy & Obstructive Sleep Apnea



Early mobilization and recruitment:

Active exercise

20 critically ill patients



Conclusion :
Our results show than early active physical exercise **improves alveolar recruitment** and oxygenation in **critically ill patients.**

PaO_2/FiO_2

Arriagada R. et al *Réanimation* (congres abstract) 2014

We need more data…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Merci – Dank U – Thank you - Gracias