MANŒUVRES D'HYPERINSUFLATION MANUELLE:

CONTRE (COMME D'HABITUDE)

Roberto Martinez Alejos
RPT, Msc, PhD candidate

IFMK Montpellier
Université de Barcelona
Philips France

@Rober_Mtnez

Presenter Disclosure Information

Roberto Martínez Alejos, RPT, Msc, PhD candidate

Partial employee Philips France

Presenter will deliver content that is evidence-based and conforms to the generally accepted formats of scientific data presentations. Any and all clinical recommendations made relating to patient care will be based on the best available scientific evidence and not biased by any commercial entity's interest.

Presenter will use scientific or generic names in referring to products in their lectures or enduring materials. *For any product that will be mention, both the benefits and limitations of that product will be discussed and those of the products in that class of drugs.* Presenters will not stress one product over another without scientific evidence for recommendations.

¡Hola!

Avant de commencer, rappelez-vous:

Qu’est-ce que c’est une manouvre d’hyperinflation manuelle (MHI)?

Inspiration lente avec une aide externe, puis une pause inspiratoire et une expiration rapide

Simulation d’une expiration forcée

Idéalement il faut delivrer un Vt de 150% par rapport au Vt normal sans dépasser 40 cmH_2O

Pourquoi j'ai raison et pas Guillaume?

Déconnexion du patient de la VM
+ application pression élevée

Sécurité?

Débits générés

Efficacité:
- Sécrétions?
- Mécanique pulmonaire?
- Critères cliniques?

Commençons par les choses importantes: la sécurité

Anaesthesia, 1999, 54, pages 936–940

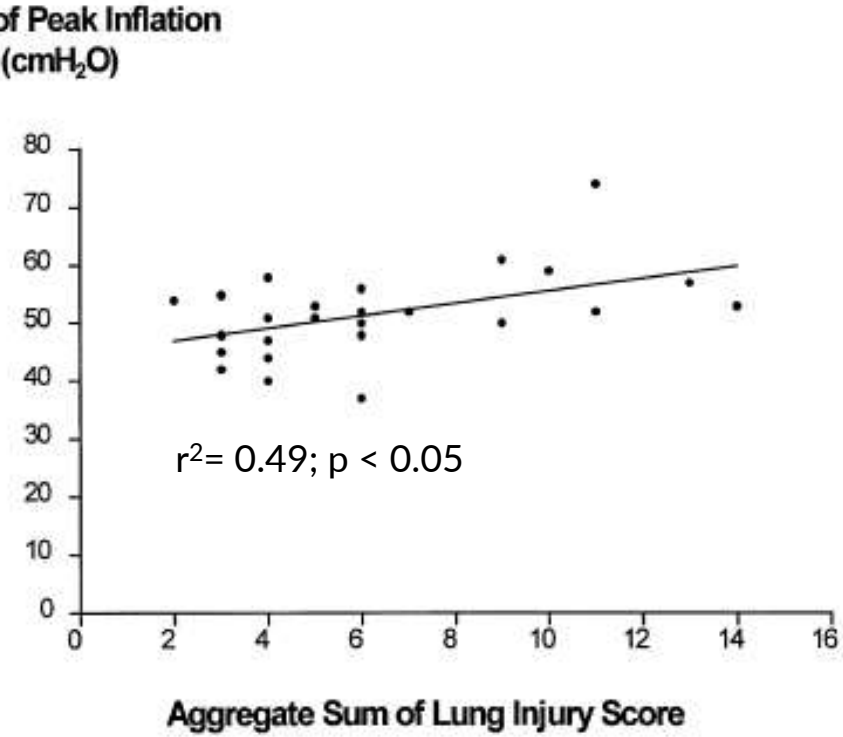
Ventilatory characteristics in mechanically ventilated patients during manual hyperventilation for chest physiotherapy

R. C. N. Clarke,[1] B. E. Kelly,[2] P. N. Convery[1] and J. P. H. Fee[3]

n = 26

10 insufflations avec Ambú

Pmax: [37-74]; 51±7.6 cmH_2O
Pambú: [48-78]; 59±6.9 cmH_2O



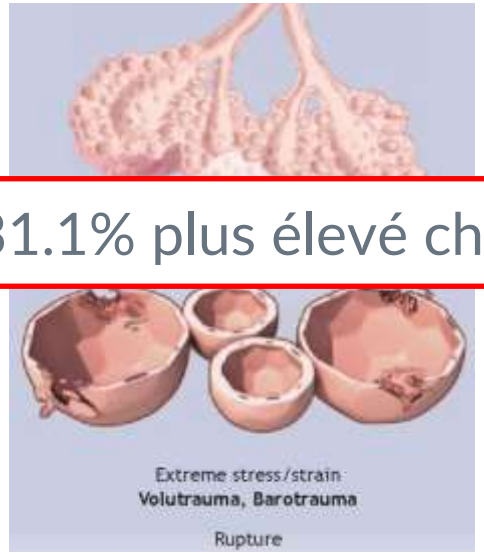
Our findings suggest an increased potential for barotrauma or volutrauma in susceptible lungs. Would it be possible to use lower inflation pressures? Or, would lower pressures decrease the effectiveness of chest physiotherapy?

Commençons par les choses importantes: la sécurité

Incidence, risk factors and outcome of barotrauma in mechanically ventilated patients

Intensive Care Med (2004) 30:612–619
DOI 10.1007/s00134-004-2187-7

Barotraumatisme: surdistension des voies aériennes
Rupture bronchique ou alvéolaire par fuite d'air sous l'effet de la surpression générée par la VM



Mortalité 31.1% plus élevé chez les patients présentant un barotraumatisme

Short-Term Appraisal of the Effects and Safety of Manual Versus Ventilator Hyperinflation in an Animal Model of Severe Pneumonia

Gianluigi Li Bassi, Joan Daniel Martí, Talitha Comaru, Eli Aguilera-Xiol, Montserrat Rigol, George Ntoumenopoulos, Silvia Terraneo, Francesca De Rosa, Mariano Rinaudo, Laia Fernandez-Barat, Denise Battaglini, Andrea Meli, Miguel Ferrer, Paolo Pelosi, Davide Chiumello, and Antoni Torres

RESPIRATORY CARE • JULY 2019 VOL 64 NO 7

n = 6

Inspiration avec Ambú jusqu'à PIP 40 cmH_2O, 4 s insufflation
Pause inspiratoire
Passage rapide en expiration
12 insufflations

Table 1. Pulmonary Mechanics, Gas Exchange, and Hemodynamics

	Manual Hyperinflation		Ventilator Hyperinflation		*P*	
	Before Intervention	After Intervention	Before Intervention	After Intervention	Effect of Interventions	Effect Time of Assessment
Lung elastance, cm H_2O/L	23.3 (20.5–31.8)	31.2 (22.6–35.5)	26.1 (23.4–26.4)	26.0 (22.9–26.4)	.46	.38
Chest wall elastance, cm H_2O/L	9.4 (6.4–11.6)	7.3 (5.2–9.3)	9.5 (6.5–9.8)	8.1 (6.4–8.8)	.35	.17
Inspiratory resistance, cm H_2O/L/s	8.9 (7.9–9.1)	8.8 (8.7–9.6)	8.8 (7.7–9.3)	8.9 (8.4–9.1)	.59	.68
Pulmonary tissue resistance, cm H_2O/L/s	6.6 (6.3–6.7)	7.3 (5.5–12.2)	4.9 (4.1–5.4)	4.7 (3.7–7.2)	.52	.41
P_{aO_2}/F_{IO_2}, mm Hg	294 (235–375)	237 (137–328)	321 (302–379)	278 (246–355)	.77	.02
P_{aCO_2}, mm Hg	48.4 (38.2–60.4)*	61.1 (57.6–71.5)	53.6 (52.7–54.9)	54.3 (52.4–55.9)	.81	.01
Pulmonary shunt, %	8.6 (6.1–11.7)	11.5 (8.8–30.9)	10.4 (8.8–11.7)	15.8 (11.4–17.1)	.64	.03
Heart rate, beats/min	61 (54–73)*	73 (67–119)	67 (51–79)	83 (64–101)	.93	< .01
Mean arterial pressure, mm Hg	76.5 (76–87)	87.5 (80–96)	85.5 (80–86)	90.5 (81–96)	.54	.17
Mean pulmonary artery pressure, mm Hg	21.5 (20–28)	25 (21–28)	22 (21–24)	24.5 (22–26)	.69	.03
Systemic vascular resistance, dyne/s/L	2269 (1518–3329)	1973 (1324–1986)	2037 (1866–2412)	1980 (1829–2089)	.85	.07
Pulmonary vascular resistance, dyne/s/L	347 (324–369)	338 (321–376)	334 (219–417)	269 (268–278)	.60	.80
Central venous pressure, mm Hg	8 (7–10)	6.5 (5–9)	9 (8–10)	7 (5–9)	.34	.01
Wedge pressure, mm Hg	11 (10–12)	9 (11–12)	9 (10–12)	10 (10–11)	.83	.37
Cardiac output, L/min	2.5 (1.9–3.5)	3.7 (2.9–5.4)	2.8 (2.6–3.2)	3.4 (3.2–4.2)	.98	.01
Delivery of O_2, mL	29.3 (21.4–43.7)	47.4 (31.9–64.3)	32.4 (29.5–36.0)	42.3 (34.4–46.5)	.81	.03
Extraction ratio, %	45 (37–60)	32 (30–47)	38 (35–42)	33 (27–37)	.20	.01
Mixed venous saturation, %	56.7 (40.9–61.5)	68.2 (53.9–69.3)	64.0 (59.7–68.9)	68.4 (62.3–73.9)	.14	.02

Données cliniquement non significatifs

Physiotherapy

Effects of ventilator vs manual hyperinflation in adults receiving mechanical ventilation: a systematic review of randomised clinical trials

Anderson et al. Physiotherapy 2015

4 RCT

Completed risk of bias tool summary.

Study	Random sequence generation	Allocation concealment	Blinding: partici-pants/personnel	Blinding: outcome assessment	Incomplete outcome data	Selective reporting	Other bias	Risque de biais
Berney and Denehy (2002) [7]	Low	Low	Low	High	Low	High	High	43%
Savian *et al.* (2006) [14]	Low	Unclear	High	Low	Unclear	Unclear	High	71%
Ahmed *et al.* (2010) [15]	Unclear	Unclear	Unclear	Unclear	Low	Unclear	Low	71%
Dennis *et al.* (2012) [3]	Low	Low	Unclear	Unclear	Low	Unclear	High	57%

Aucune des deux techniques a des effets majeurs sur la stabilité hémodynamique

Risque de biais des études élevé
Hétérogénéité entre les études
Pas d'analyse des résultats à longue terme

Et si on se fixe sur l'efficacité?

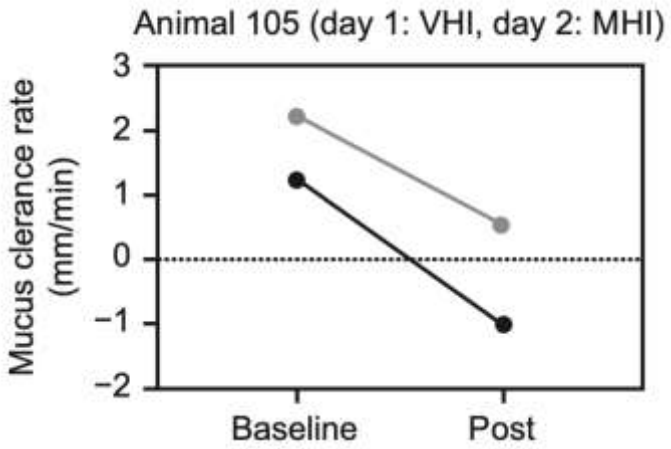
Short-Term Appraisal of the Effects and Safety of Manual Versus Ventilator Hyperinflation in an Animal Model of Severe Pneumonia

Gianluigi Li Bassi, Joan Daniel Martí, Talitha Comaru, Eli Aguilera-Xiol, Montserrat Rigol, George Ntoumenopoulos, Silvia Terraneo, Francesca De Rosa, Mariano Rinaudo, Laia Fernandez-Barat, Denise Battaglini, Andrea Meli, Miguel Ferrer, Paolo Pelosi, Davide Chiumello, and Antoni Torres

RESPIRATORY CARE • JULY 2019 VOL 64 NO 7

n = 6

Inspiration avec Ambú jusqu'à PIP 40 cmH_2O, 4 s insufflation
Pause inspiratoire
Passage rapide en expiration
12 insufflations



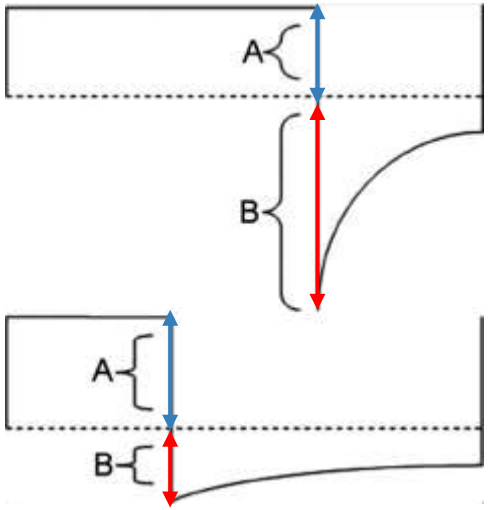
MHI diminue le déplacement des secrétions vs aucune intervention

Avant de continuer faisons un point:
Comment favoriser le déplacement des sécrétions?

Générer des PEFs élevés?

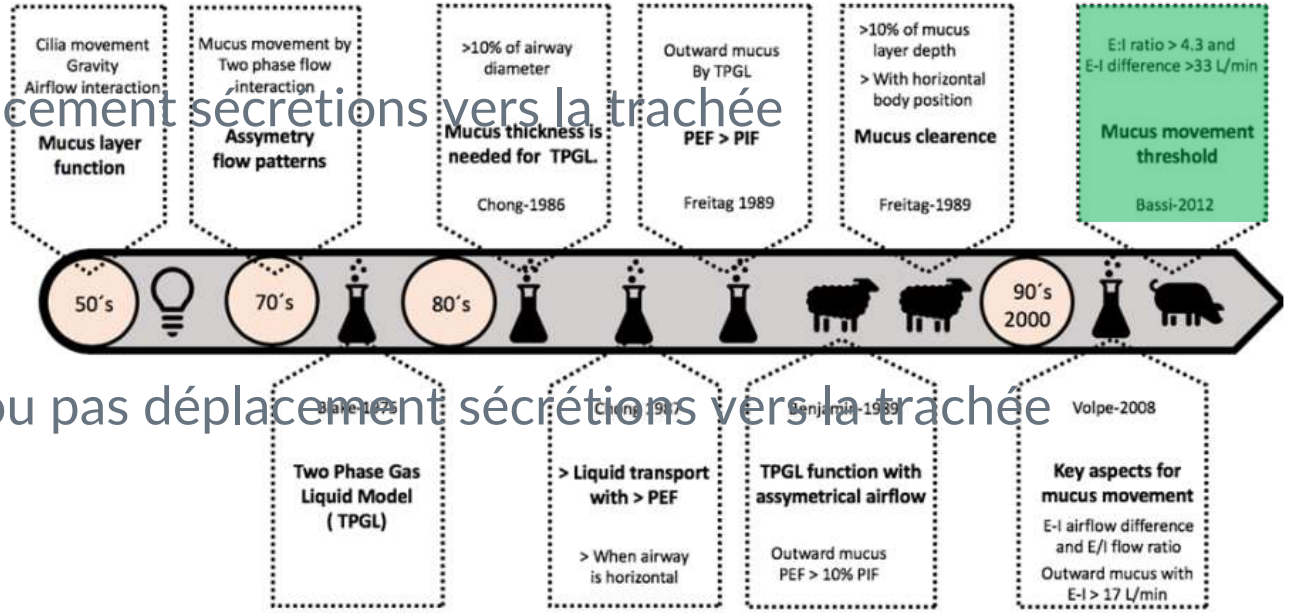
- PEFs > 160 l/min = toux efficace (Bach et al. 1993 / Guerin et al. 2011)
- PEFs 35-114 l/min suffisant pour extuber les patients (Jiang et al. 2017)

Augmenter la différence entre les débits (***flow bias***)



PEF > PIF: déplacement sécrétions vers la trachée

PEF ≤ PIF: peu ou pas déplacement sécrétions vers la trachée



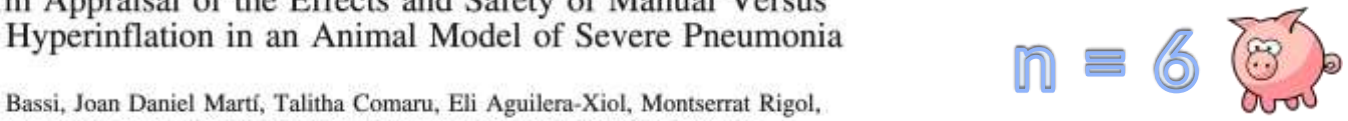
Et si on se fixe sur l'efficacité?

Short-Term Appraisal of the Effects and Safety of Manual Versus Ventilator Hyperinflation in an Animal Model of Severe Pneumonia

Gianluigi Li Bassi, Joan Daniel Martí, Talitha Comaru, Eli Aguilera-Xiol, Montserrat Rigol, George Ntoumenopoulos, Silvia Terraneo, Francesca De Rosa, Mariano Rinaudo, Laia Fernandez-Barat, Denise Battaglini, Andrea Meli, Miguel Ferrer, Paolo Pelosi, Davide Chiumello, and Antoni Torres

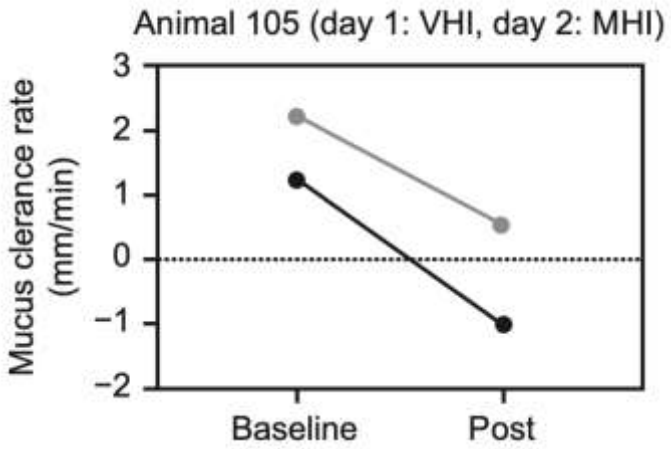
RESPIRATORY CARE • JULY 2019 VOL 64 NO 7

n = 6



Inspiration avec Ambú jusqu'à PIP 40 cmH_2O, 4 s insufflation
Pause inspiratoire
Passage rapide en expiration
12 insufflations

Ti trop longue?



Flow bias 60 l/min

Effect of Inspiratory Time and Lung Compliance on Flow Bias Generated During Manual Hyperinflation: A Bench Study

Bradley G Bennett, Peter Thomas PhD, and George Ntoumenopoulos PhD

RESPIRATORY CARE • OCTOBER 2015 VOL 60 NO 10

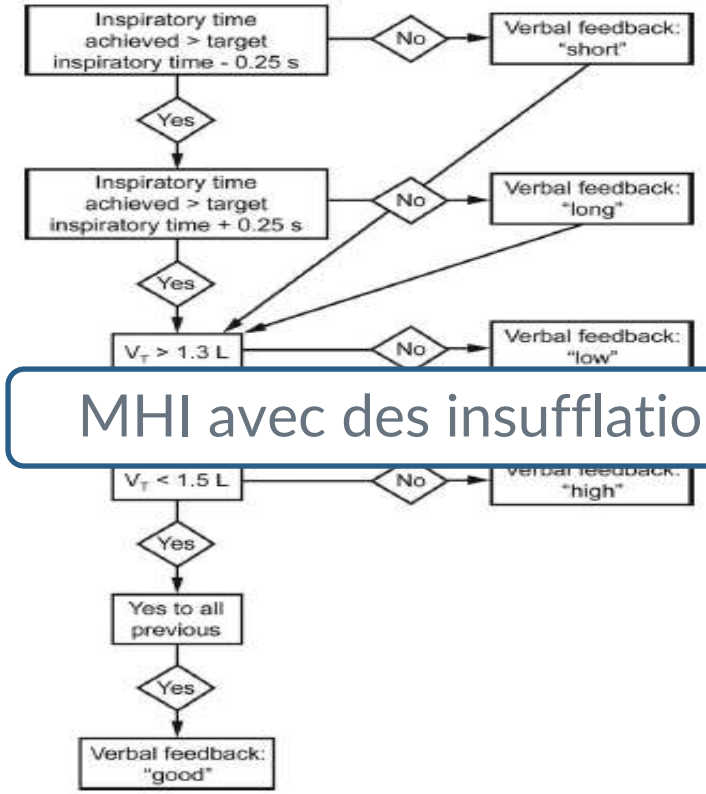


Table 1. Pairwise Comparisons of Inspiratory Time (1, 2, and 3 s) for the Normal Compliance Setting Experiments

Variable	T_I Target = 1 s	T_I Target = 2 s	T_I Target = 3 s	Mean Difference (1 s vs 2 s)	*P*	Mean Difference (1 s vs 3 s)	*P*	Mean Difference (2 s vs 3 s)	*P*
V_T, mL	1,357.00 ± 13.64	1,344.30 ± 9.50	1,370.63 ± 18.05	−12.7	.02	13.63	.009	26.33	<.001
T_I experiment, s	0.93 ± 0.06	2.03 ± 0.09	2.98 ± 0.12	1.10	<.001	2.05	<.001	0.95	<.001
T_{IH}, s	0.06 ± 0.03	0.58 ± 0.09	0.72 ± 0.15	0.51	<.001	.65	<.001	0.14	<.001
T_E, s	2.21 ± 0.12	2.86 ± 0.22	2.80 ± 0.23	0.65	<.001	.59	<.001	−0.06	.27
PIP, cm H_2O	47.42 ± 5.67	27.33 ± 1.61	17.51 ± 1.50	−20.09	<.001	−29.91	0.005	9.82	<.001
MIF, L/min	43.31 ± 2.60	19.65 ± 0.91	13.60 ± 0.63	−23.66	<.001	−29.71	<.001	−6.05	<.001
PIF, L/min	134.87 ± 9.94	94.22 ± 14.70	65.40 ± 4.52	−40.65	<.001	−69.47	<.001	−28.82	<.001
MEF, L/min	−18.11 ± 0.99	−13.90 ± 1.00	−14.48 ± 1.18	4.21	<.001	3.78	<.001	−0.58	.11
PEF, L/min	−92.16 ± 1.64	−81.02 ± 31.89	−85.20 ± 2.42	11.14	.001	6.96	.042	−4.18	.22
PIF/PEF	1.46 ± 0.11	1.08 ± 0.17	0.77 ± 0.06	−0.38	<.001	−0.70	<.001	−0.32	<.001
PIF − PEF, L/min	42.70 ± 10.11	7.35 ± 14.67	−19.81 ± 5.39	−35.35	<.001	−62.510	<.001	−27.16	<.001
MIF − MEF, L/min	25.20 ± 2.85	5.75 ± 1.28	−0.88 ± 1.28	−19.45	<.001	−26.08	<.001	−6.63	<.001

MHI avec des insufflations à 3 secondes peut être efficace si technique bien appliquée

Variable	T_I Target = 1 s	T_I Target = 2 s	T_I Target = 3 s	Mean Difference (1 s vs 2 s)	*P*	Mean Difference (1 vs 3 s)	*P*	Mean Difference (2 s vs 3 s)	*P*
VT, mL	1,420.13 ± 27.16	1,414.43 ± 23.49	1,434.67 ± 22.63	−5.7	.27	14.53	.005	20.23	<.001
T_I experiment, s	1.05 ± 0.08	1.91 ± 0.12	2.94 ± 0.11	0.865	<.001	1.90	<.001	1.03	<.001
TIH, s	0.11 ± 0.04	0.56 ± 0.10	0.86 ± 0.17	0.46	<.001	0.76	<.001	0.30	<.001
TE, s	1.79 ± 0.10	2.46 ± 0.23	2.18 ± 0.29	0.67	<.001	0.38	<.001	−0.29	<.001
PIP, cm H_2O	56.25 ± 7.48	40.02 ± 2.33	37.05 ± 0.45	−16.23	<.001	−19.20	<.001	−2.98	.005
MIF, L/min	40.59 ± 3.66	21.98 ± 1.55	14.44 ± 0.64	−18.61	<.001	−26.15	<.001	−7.54	<.001
PIF, L/min	133.21 ± 15.23	102.66 ± 6.05	77.21 ± 4.61	−30.56	<.001	−56.007	<.001	−25.45	<.001
MEF, L/min	−23.44 ± 1.18	−17.00 ± 1.53	−19.66 ± 2.08	6.44	<.001	3.63	<.001	−2.66	<.001
PEF, L/min	−124.29 ± 1.22	−120.35 ± 1.53	−126.20 ± 2.16	3.94	.25	−1.90	.58	−5.84	.09
PIF/PEF	1.07 ± 0.12	0.85 ± 0.05	0.61 ± 0.04	−0.22	<.001	−0.46	<.001	−0.24	<.001
PIF − PEF, L/min	8.92 ± 14.68	−17.70 ± 6.32	−48.99 ± 5.56	−26.62	<.001	−57.91	<.001	−31.29	<.001
MIF − MEF, L/min	17.15 ± 4.02	4.98 ± 2.20	−5.22 ± 2.51	−12.17	<.001	−22.37	<.001	−10.20	<.001

Et si on se fixe sur l'efficacité?

Manual hyperinflation combined with expiratory rib cage compression for reduction of length of ICU stay in critically ill patients on mechanical ventilation*,**

Juliana Savini Wey Berti, Elisiane Tonon, Carlos Fernando Ronchi, Heloisa Wey Berti, Laércio Martins de Stefano, Ana Lúcia Gut, Carlos Roberto Padovani, Ana Lucia Anjos Ferreira

J Bras Pneumol. 2012;38(4):477-486

n = 49

Insufflation Ambú jusqu'à PIP 40 cmH_2O
3 sec de pause inspiratoire
Passage rapide en expiration + compression de la cage thoracique

Max 4 instillations NaCl/j

Control

6 instillations NaCl/j

Table 3 – Effect of the 5-day respiratory physiotherapy on weaning from mechanical ventilation, ICU discharge, and disease severity scores.

Variable	Day 1		2		3		4		5	
	RP (n = 16)	C (n = 19)	RP (n = 16)	C (n = 19)	RP (n = 16)	C (n = 19)	RP (n = 16)	C (n = 19)	RP (n = 16)	C (n = 19)
Weaning[a]	0 (0.0)	0 (0.0)	6 (37.5)	0 (0.0)**	6 (37.5)	0 (0.0)**	6 (37.5)	1 (5.3)*	6 (37.5)	3 (15.9)*
Discharge[a]	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (25.0)	0 (0.0)*	5 (31.0)	0 (0.0)**	5 (31.0)	0 (0.0)**
Murray score[b]	1.00 [0.75-1.25]***	1.25 [1.00-1.50]*							0.00 [0.00-0.00]	1.00 [1.00-1.00]****
APACHE II score[b]	17 [14-18]	16 [12-20]							16 [8-21]	16 [11-21]

* p<0.05 **p<0.01

Intensive Care Med (2007) 33:1938–1945
DOI 10.1007/s00134-007-0762-4

ORIGINAL

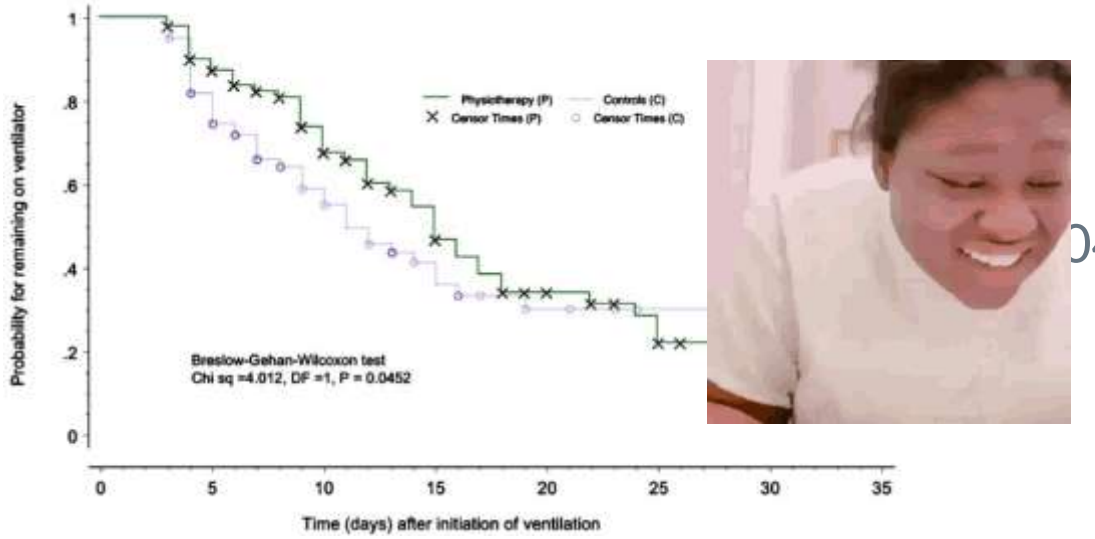
Maie Templeton
Mark G. A. Palazzo

Chest physiotherapy prolongs duration of ventilation in the critically ill ventilated for more than 48 hours

n = 179

Compression thoraco-abdominales + MHI
(no info MHI)

Control IDE



Guillaume pendant que je parle

04 ± 10.7 jours vs. 8.56 ± 4.7 jours; p=0.04

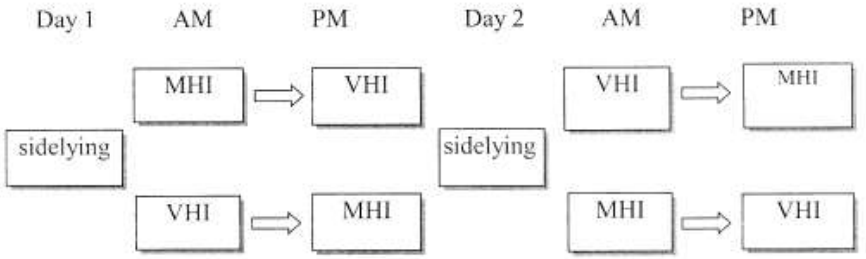
Kiné respi + MHI augmente le temps passé sous ventilation mécanique

Et si on se fixe sur l'efficacité?

A comparison of the effects of manual and ventilator hyperinflation on static lung compliance and sputum production in intubated and ventilated intensive care patients

Berney et al. Phys Res Int 2002

n = 20



MHI: 6 sets de 6 HI: 3 séc inspiration à max 40 cmH_20, 2 sec de pause, expiration
VHI: 6 sets de 6 HI: VC, FR: 6, débit: 20 l/min, Vt augmenté jusqu'à PIP 40cmH_2O

TABLE 2: Mean sputum production (95% confidence interval) for the two days of physiotherapy and the mean total sputum wet weight (95% confidence interval)

Day	*Mean hyperinflation*	*Ventilator hyperinflation*
1		
2	6.18 (4.83–7.53)	6.62 (5.38–7.86)
Mean (CI)	6.53 95.86–7.20)	6.01 (4.83–7.19)

NS

TABLE 3: Means (mean percentage improvement) (95% confidence interval)in static pulmonary compliance before and after physiotherapy

Hyperinflation	*Pre-treatment*	*Post-treatment*	*30 min post-treatment*
	(41.5–50.9)	(46.6–56.4)	(46.3–54.9)
Ventilator	44.9 (40.5–49.3)	49.3 (9.8%) (45.7–52.9)	50.1 (11.6%) (45.5–54.7)

NS

Hyperinsufflations manuelles ou mécaniques semblent similaires en termes d'efficacité

Information sur flow bias?

Et si on se fixe sur l'efficacité?

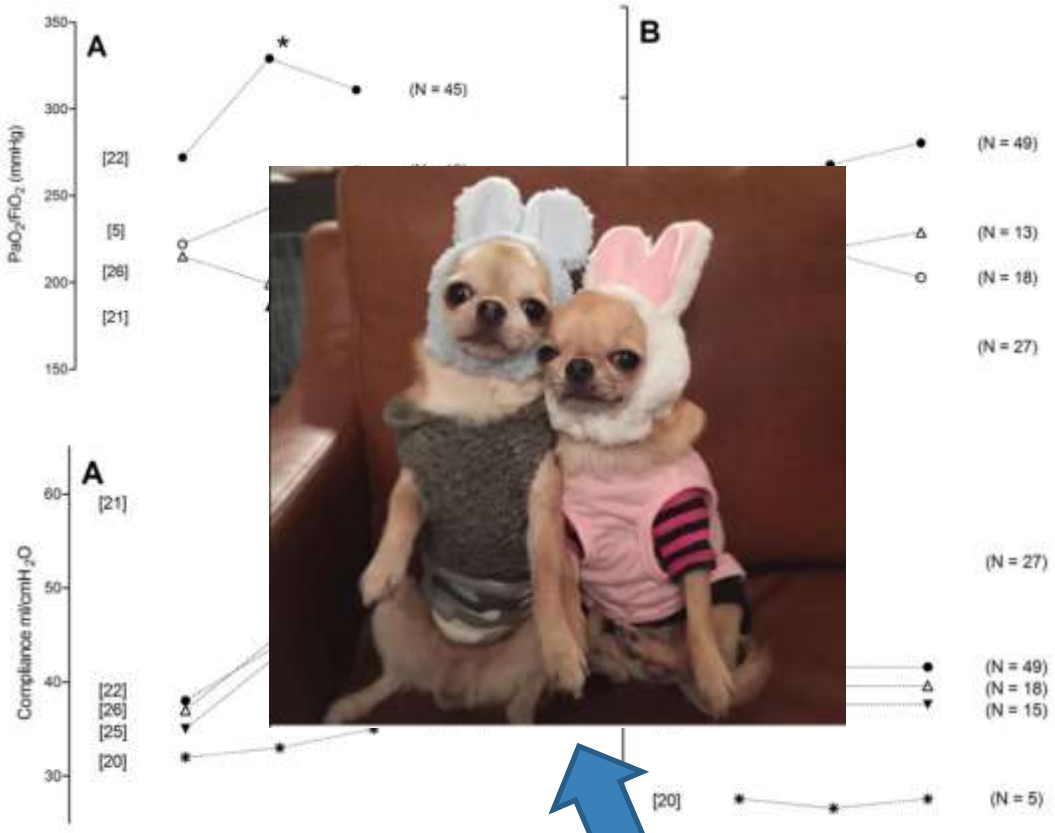
10 RCT
3 RCOT

Paulus et al. Critical Care 2012, 16:R145
http://ccforum.com/content/16/4/R145

CRITICAL CARE

RESEARCH Open Access

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



Données mixtes sur l'oxygenation chez des patients post-chirurgie cardiaque, avec PAV, ALI ou atélectasiés.

Amélioration possible mécanique pulmonaire chez des patients post-chirurgie cardiaque, avec PAV ou atélectasiés.
Aucun effet patients ALI

Hyperinsufflation manuelle

Guillaume et moi après présentation des résultats de cette revue systématique

EN RÉSUMÉ:

Les manœuvres d'hyperinsufflation manuelle semblent **peu probables** d'avoir un **effet physiologique** sur les patients **hors** sur la **mécanique pulmonaire**

L'effet du **flow bias** est **rarement étudié**

Les **effets cliniques** sont **questionnables**

Peu des articles récentes

Mon avis « **100% objectif »** est que **Guillaume Maercx n'a pas raison**

Merci!

Des questions?