

Spécificités De La Ventilation Chez L'obèse Agressé

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**Service de Réanimation Médicale CHU
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Introduction

- | Selon l'Organisation mondiale de la santé (OMS), l'obésité est considérée comme **la première épidémie non infectieuse** de l'histoire.
- | La **mortalité** qui lui est imputée peut aller jusqu'à **22 %** de réduction de l'espérance de vie chez les hommes
- | Pathologie fréquente

Dans les unités de Réanimation:

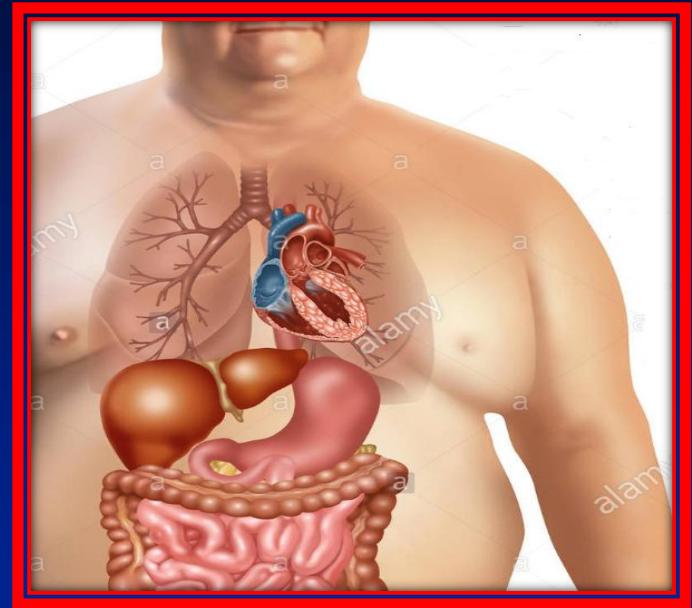
❖ **un tiers (30%)** des patients ont un IMC ≥ 30 kg/m² et,

❖ **7 %** des patients ont un IMC ≥ 40 kg/m²

Sujet obèse en Réanimation

* Difficultés multiples :

- Co-morbidités
- Diagnostic (clinique, ultrasons, radiologie)
- Accès veineux
- Soins d'hygiène, mobilisation
- Thérapeutiques médicamenteuses
- Equipements adaptés (lit, fauteuil)



Modifications physiologiques liées à l'obésité

- ✓ **Fonction cardiovasculaire**
 - ✓ Système vasculaire
 - ✓ Fonction cardiaque
- ✓ **Distribution et métabolisme des drogues**
- ✓ **Fonction respiratoire**
 - ✓ Poumons
 - ✓ Centre de la respiration

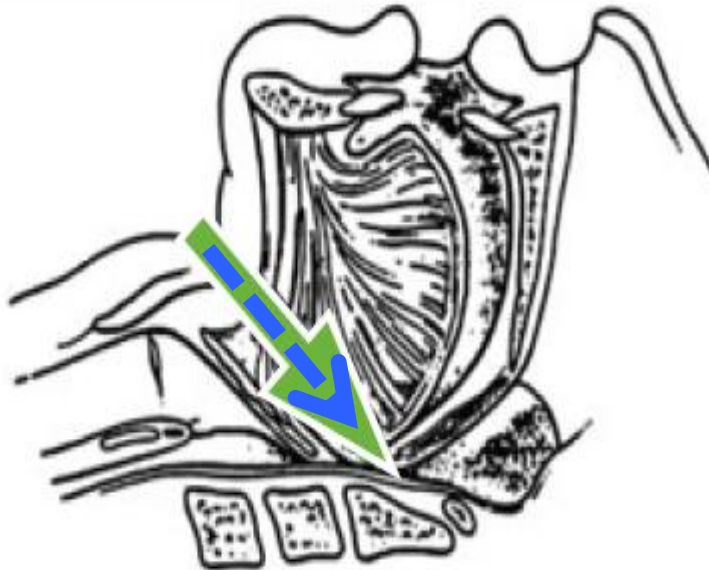
Obésité et Problèmes respiratoires

Mais...

Physiologie pulmonaire du sujet obèse



Upper airway collapse



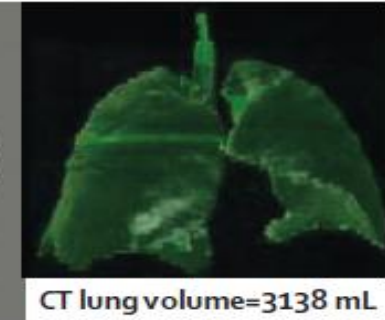
A

Obese

Sex: female
Age: 53 years
Height: 155 cm
Weight: 125 kg
BMI=52 kg/m²



B



CT lung volume=3138 mL

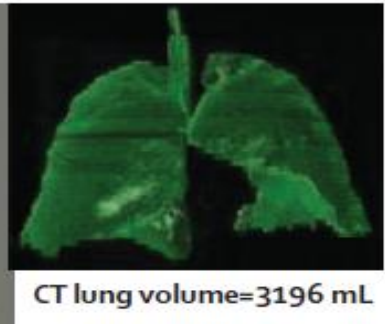
C

Non-obese

Sex: female
Age: 65 years
Height: 164 cm
Weight: 57 kg
BMI=21 kg/m²

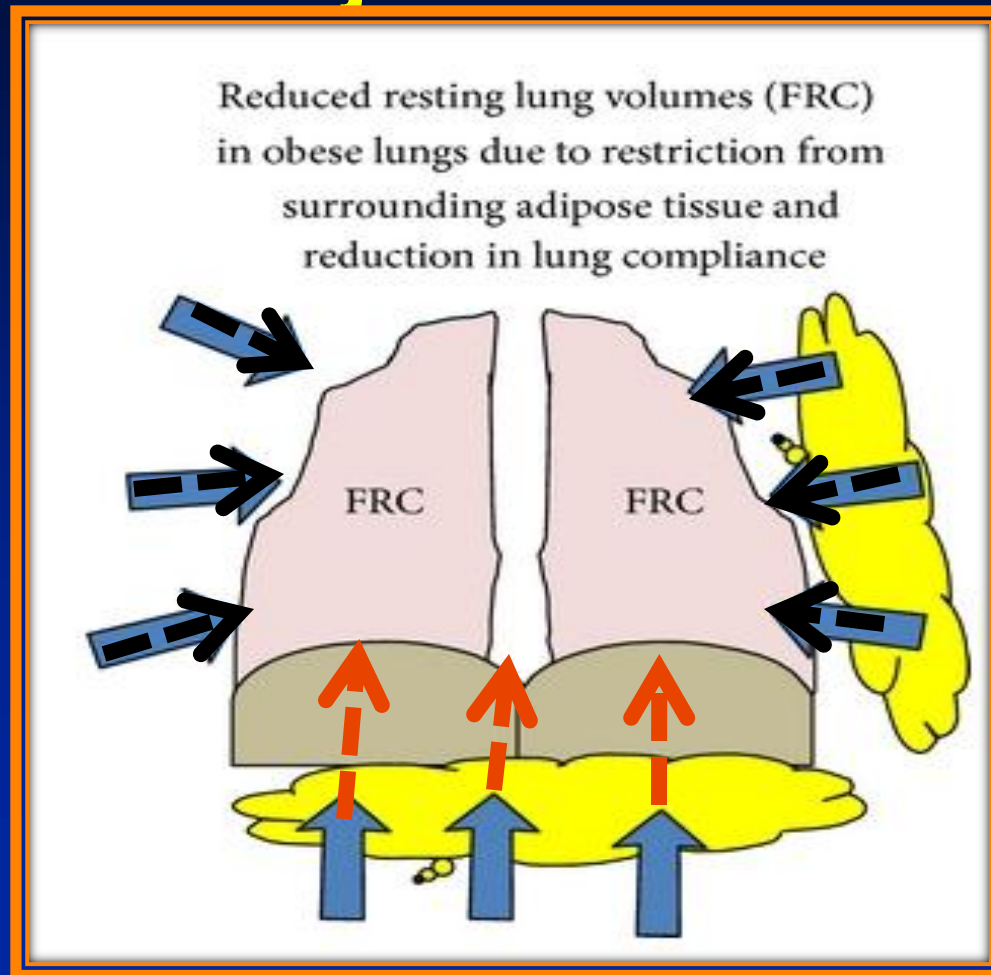


D



CT lung volume=3196 mL

Physiologie pulmonaire du sujet obèse

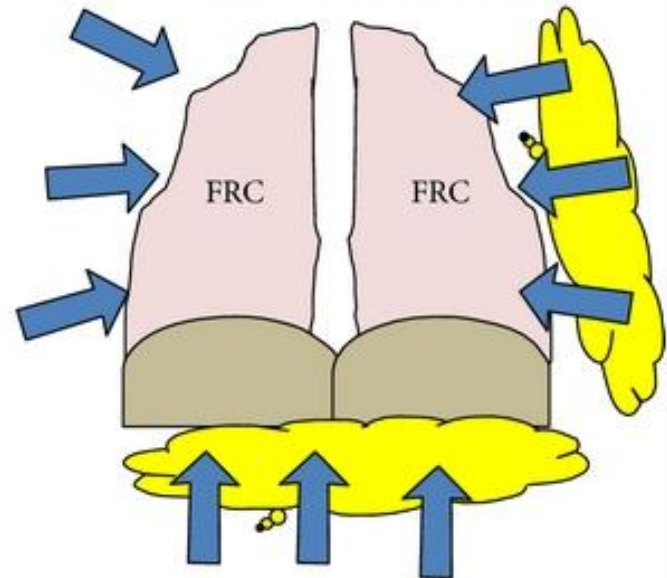


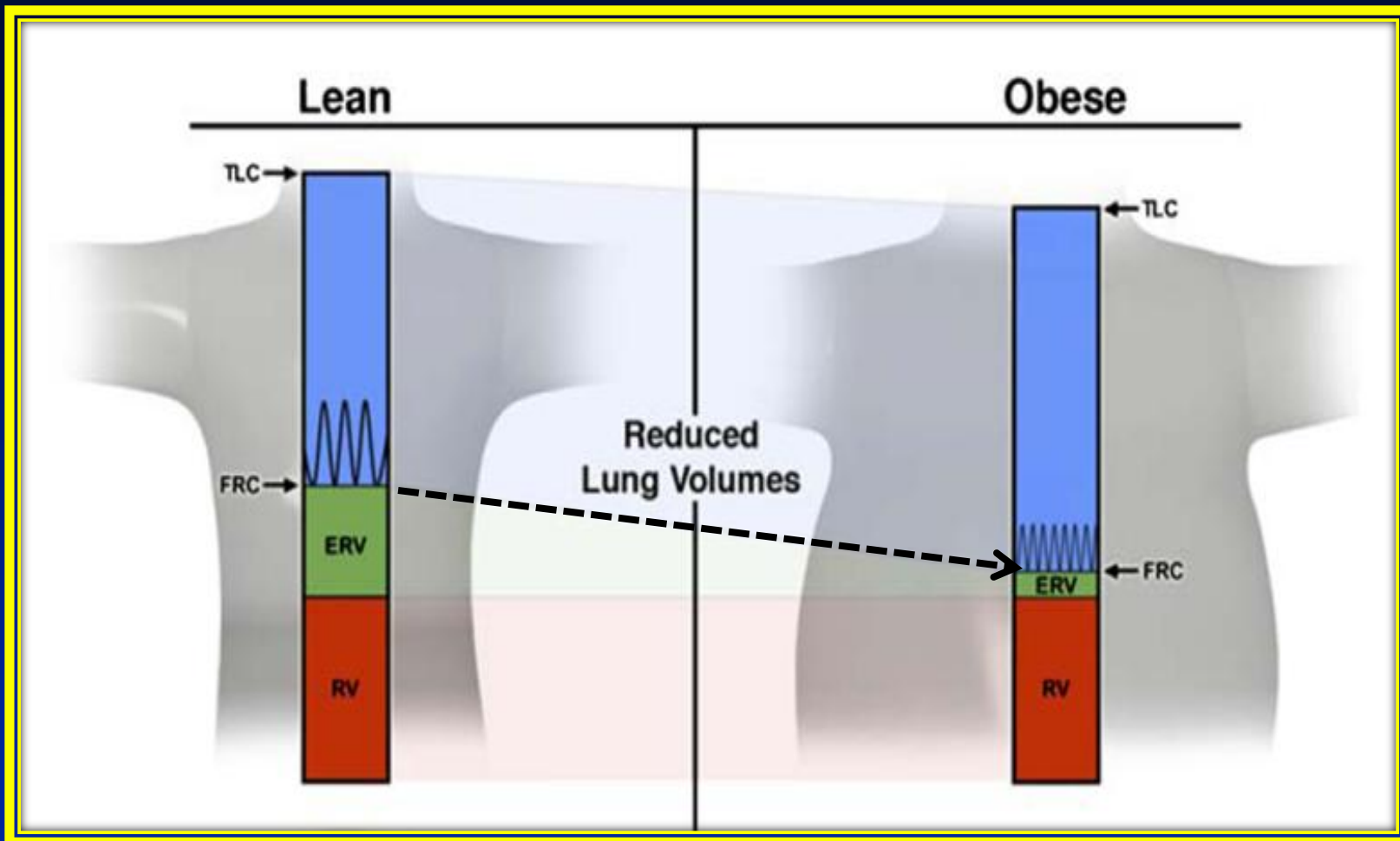
Physiologie pulmonaire du sujet obèse

Upper airway collapse



Reduced resting lung volumes (FRC) in obese lungs due to restriction from surrounding adipose tissue and reduction in lung compliance



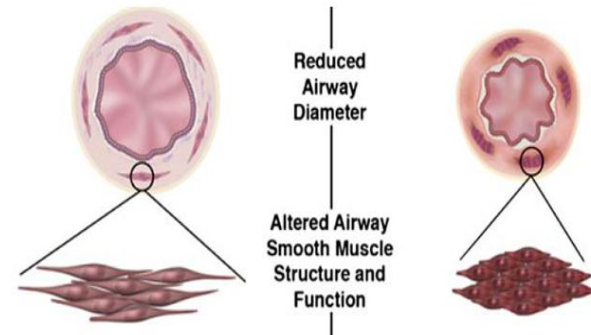


DA Beutler et al; AJRCCM 2006

Adipose tissue in the abdomen
and surrounding chest walls



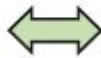
Ventilation-perfusion mismatching
Low PaO_2



Hyperréactivité bronchique

Obesity hypoventilation syndrome

Respiratory
drive

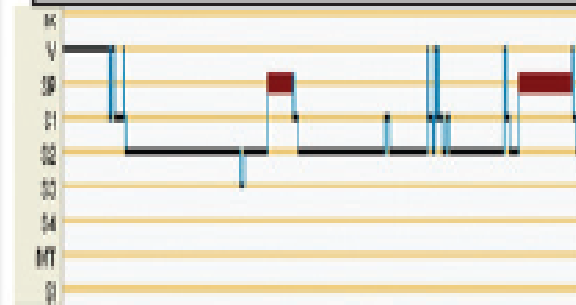


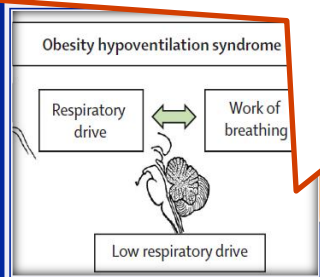
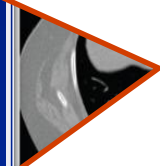
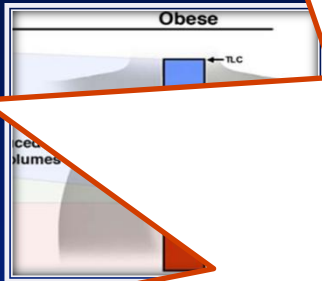
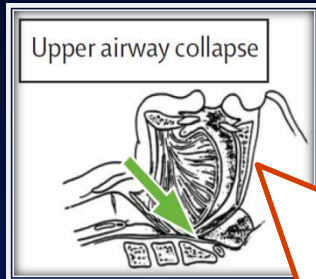
Work of
breathing



**Altération de la commande
respiratoire**

REM sleep





Anesthésie G

Décubitus Dorsal

Une altération, apparemment réversible, de la commande ou drive respiratoire

AS

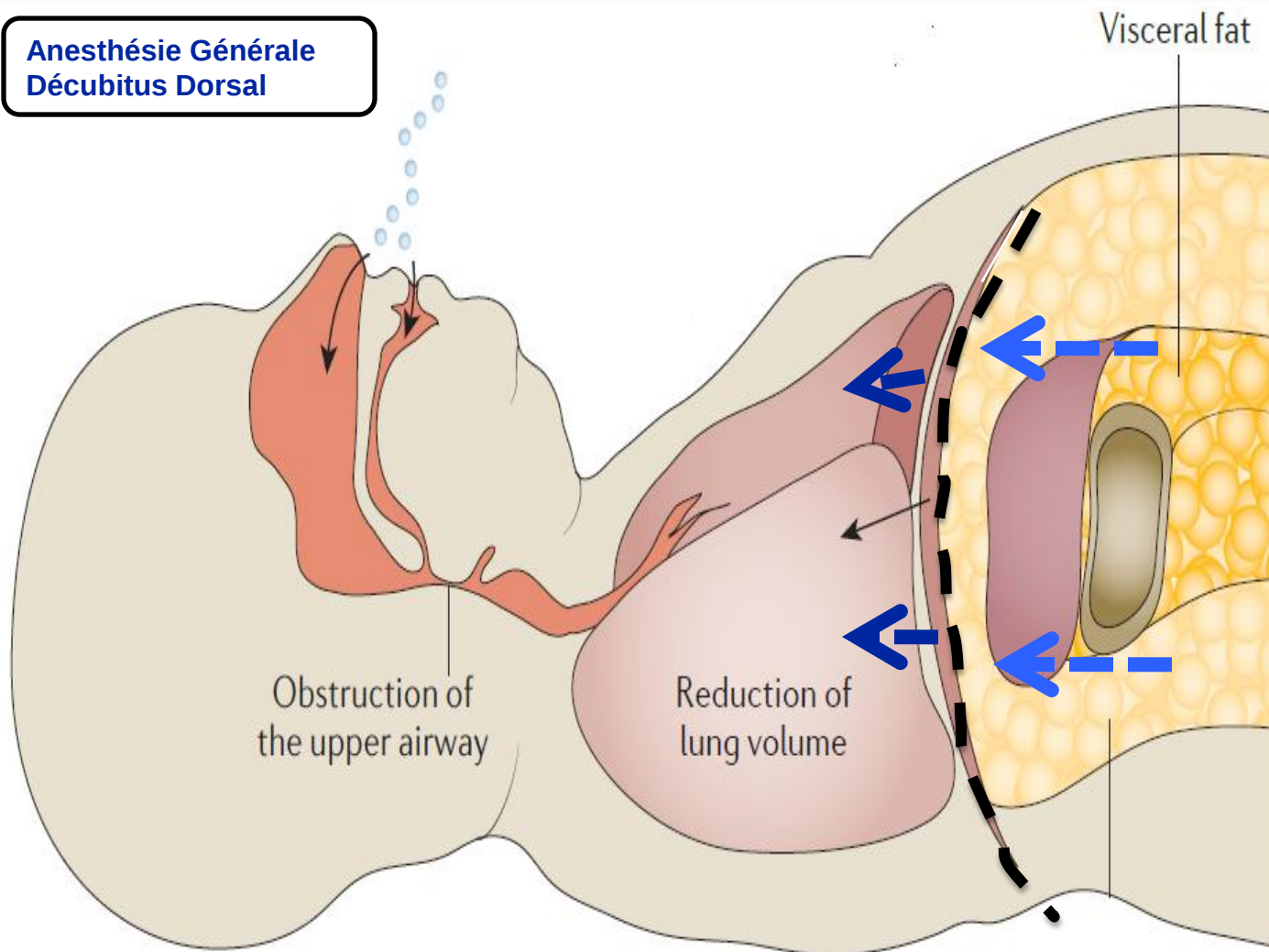
matique

monaires

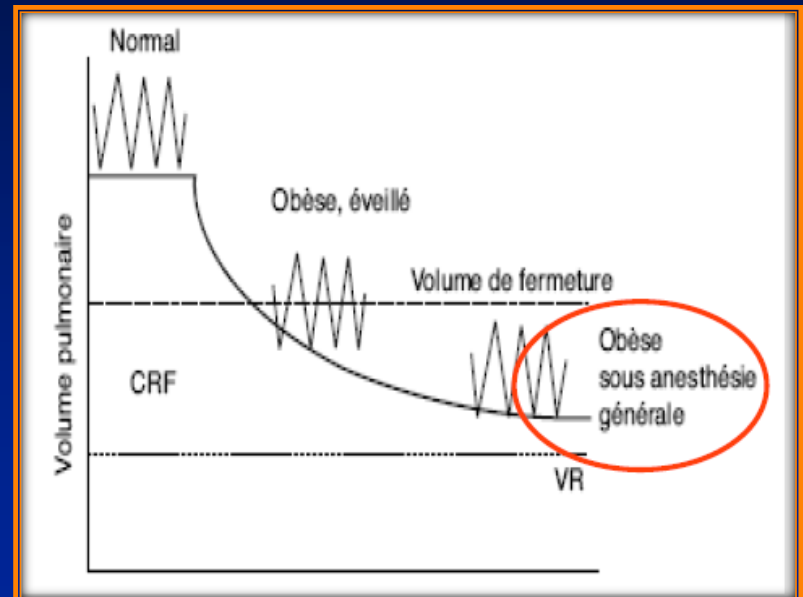
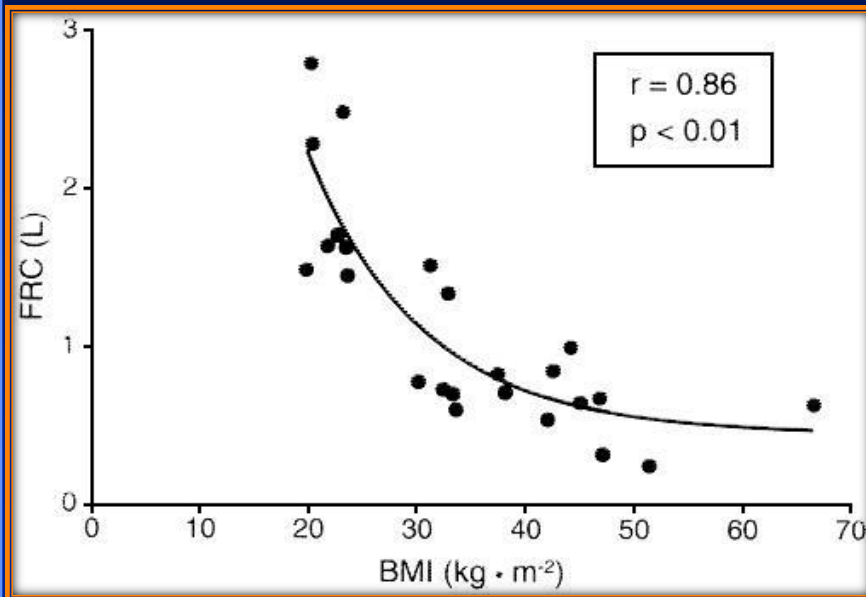
, Shunt to-PEEP



Anesthésie Générale
Décubitus Dorsal



Effet de l'Anesthésie Générale sur la CRF



Sous AG: CRF < volumes de fermeture = **risque d'atélectasies**

Anesth Analg. 1996 Sep;83(3):578-83.

Normal

Avant VM



Après VM



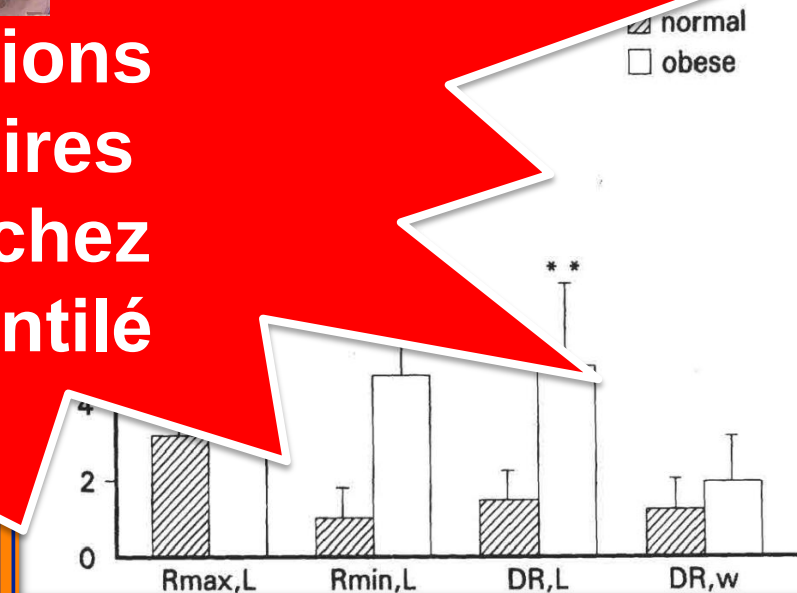
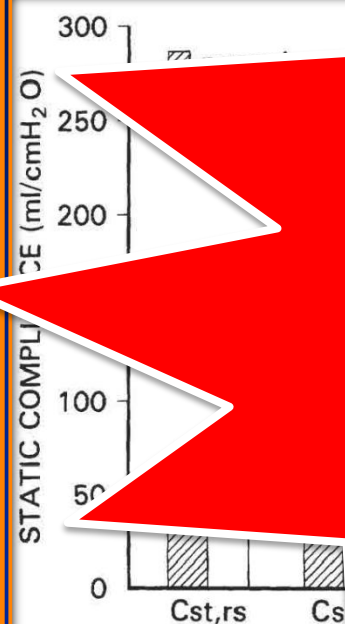
Obese



Total respiratory system, lung, and chest wall mechanics
in sedated-paralyzed postoperative morbidly obese
patients.

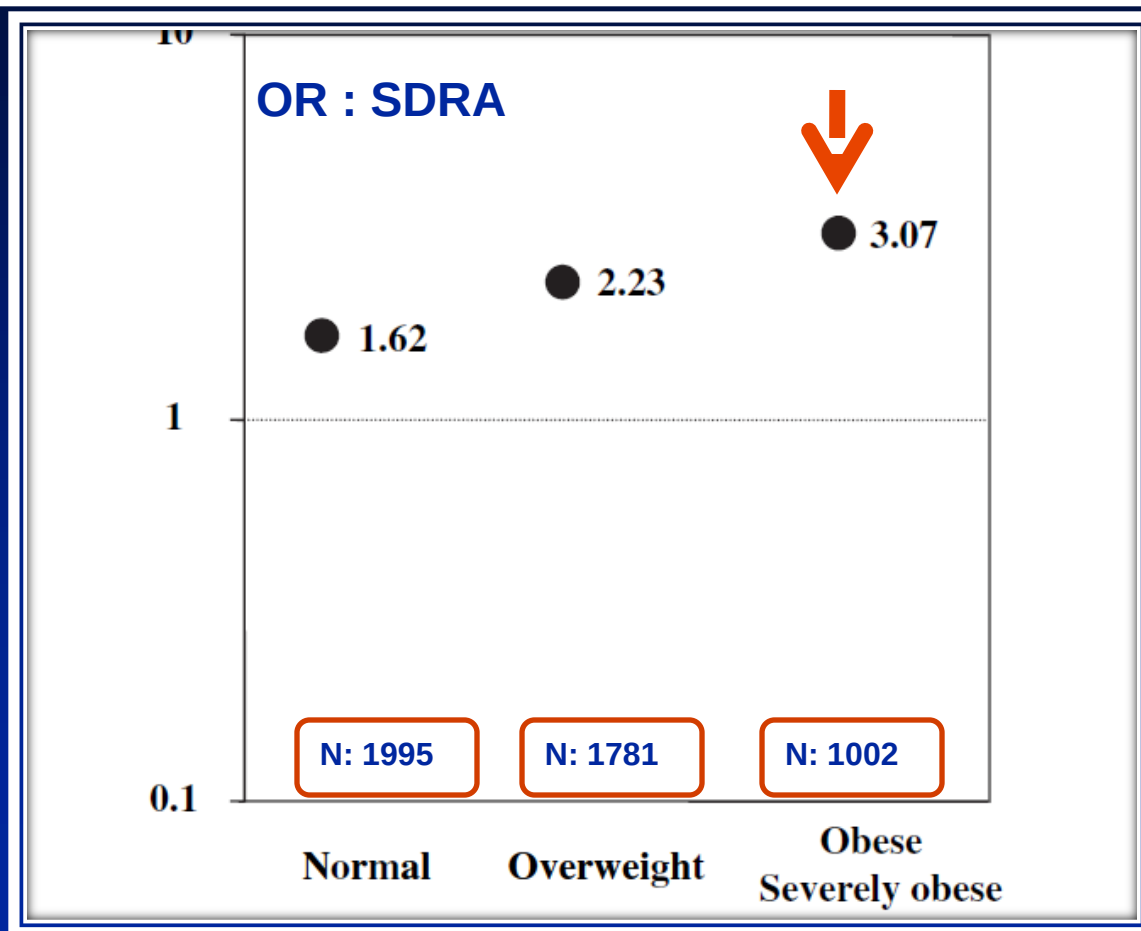


Complications Respiratoires Majeures chez l'obèse ventilé



Chest. 1996 Jan;109(1):144-51.

Influence of body mass index on outcome of the mechanically ventilated patients



Anzueto A et al. Thorax. 2011 Jan;66(1):66-73

Patient Obèse

Spécificité Ventilatoire

La Ventilation Mécanique

- Doit prendre en considération les particularités physiopathologiques du patient obèse
- **Buts:**
 1. Assurer La ventilation avec une bonne oxygénation
 2. Eviter les complications Barotraumatiques
 3. Limiter les atélectasies et l'hypoxémie dues au syndrome restrictif (**Utilisation de la PEP + MR**)

Intubation

- Obésité : Temps de désaturation réduit +++

**Une Pré-oxygénation
adéquate est
nécessaire**

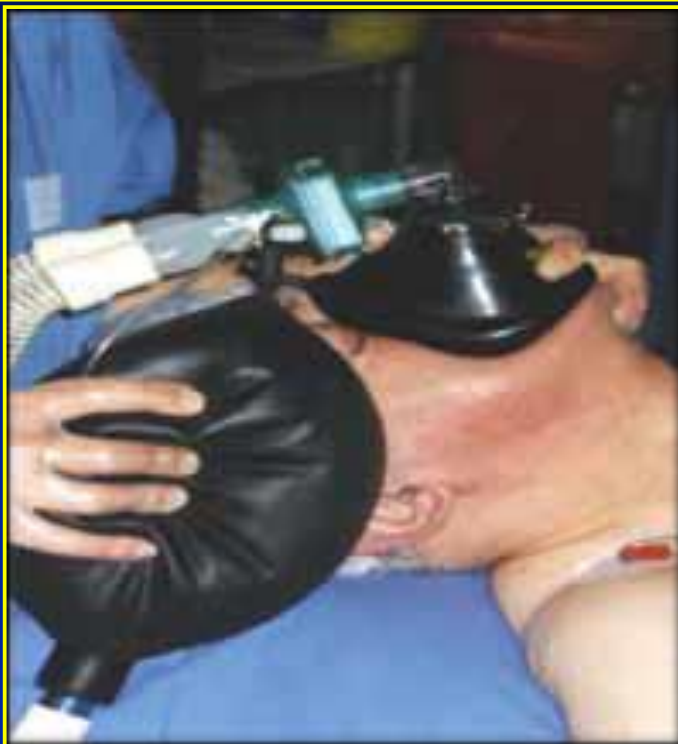
Pre-oxygenation in the obese patient: effects of position on tolerance to apnoea



British Journal of Anaesthesia 95 (5): 706–9 (2005)
doi:10.1093/bja/aei231 Advance Access publication September 2, 2005

Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients

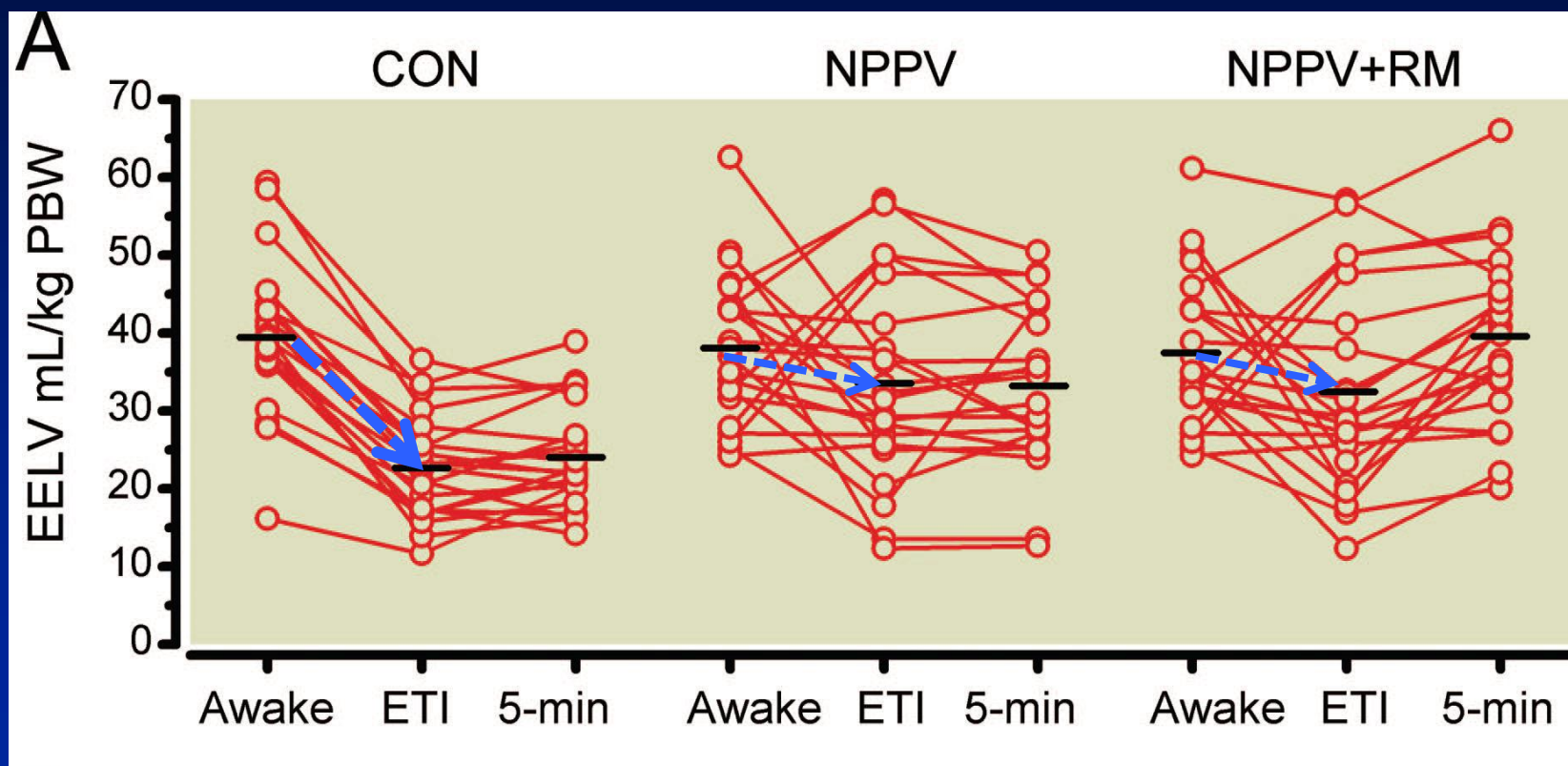
Standard (balloon)



CPAP-preOxy
NIV (PSV+PEEP)-preOxy



Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients



Anesthesiology 2011 114: 1354-1363

Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients

What This Article Tells Us That Is New

In 66 morbidly obese patients, a combination of preoxygenation with noninvasive positive pressure ventilation and a recruitment maneuver immediately after tracheal intubation more effectively maintains both lung volume and oxygenation during anesthesia induction

Anesthesiology 2011 114: 1354-1363

RESPIRATION AND THE AIRWAY

Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units

A. De Jong¹, N. Molinari², Y. Pouzeratte¹, D. Verzilli¹, G. Chanques¹, B. Jung^{1,3}, E. Futier¹, P.-F. Perrigault⁶, P. Colson⁴, X. Capdevila⁵ and S. Jaber^{1,3*}

- Multicentre prospective observational cohort study in ICU and OT in obese (BMI ≥ 30 kg m²) patients

- In cohorts of 1400 and 11 035 consecutive patients intubated in ICU and in the OT, 282 (20%) and 2103 (19%) were obese

British Journal of Anaesthesia 114 (2): 297–306 (2015)

Advance Access publication 27 November 2014 · doi:10.1093/bja/aeu373

Service Réanimation

Bloc Opératoire

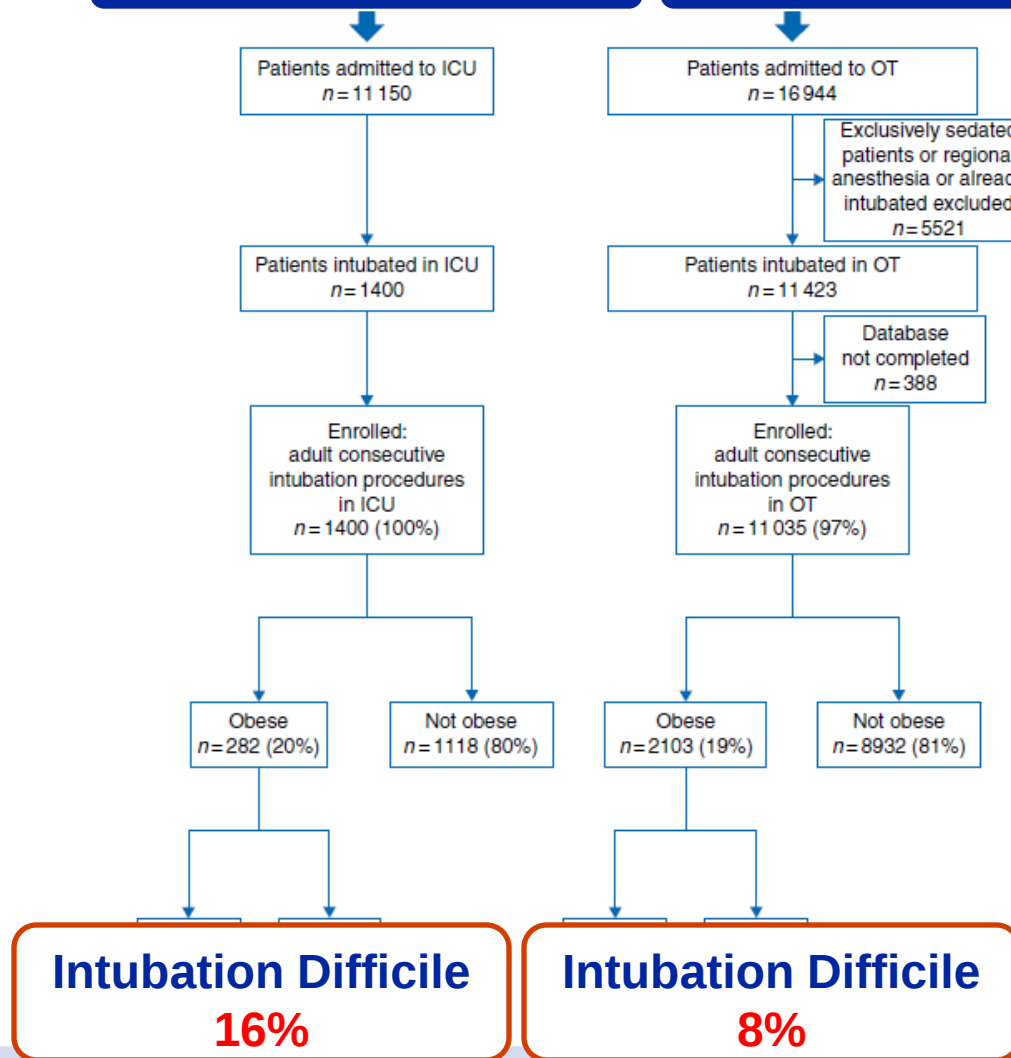


Fig 1 Flow chart of the study.

RESPIRATION AND THE AIRWAY

Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units

A. De Jong¹, N. Molinari², Y. Pouzeratte¹, D. Verzilli¹, G. Chanques¹, B. Jung^{1,3}, E. Futier¹, P.-F. Perrigault⁶, P. Colson⁴, X. Capdevila⁵ and S. Jaber^{1,3*}

- **Specific difficult airway management techniques were used in 66 (36%) cases of difficult intubation in obese patients in the OT and in 10 (22%) cases in ICU (P : 0.04).**
- **Severe life-threatening complications were significantly more frequent in ICU than in the OT (41.1% vs 1.9%, relative risk 21.6, 95% confidence interval 15.4 – 30.3; P: 0.01).**

Intubation de l'obèse

1. Considérer comme Toujours Difficile +++
2. Préparation Adéquate: Intubation vidéo-guidée +++



Stratégie Ventilatoire

Chez le patient obèse il ya:

1. Baisse de 35% de la compliance du système respiratoire
2. Modification des volumes pulmonaires (CRF) avec effet shunt
3. L'anesthésie et la VM majorent ces phénomènes avec diminution de plus de 50% de la CRF (<20% chez le patient non obèse)

Réglages du ventilateur

Volume 2014, 14(1), 1-14

British Journal
doi:10.1093

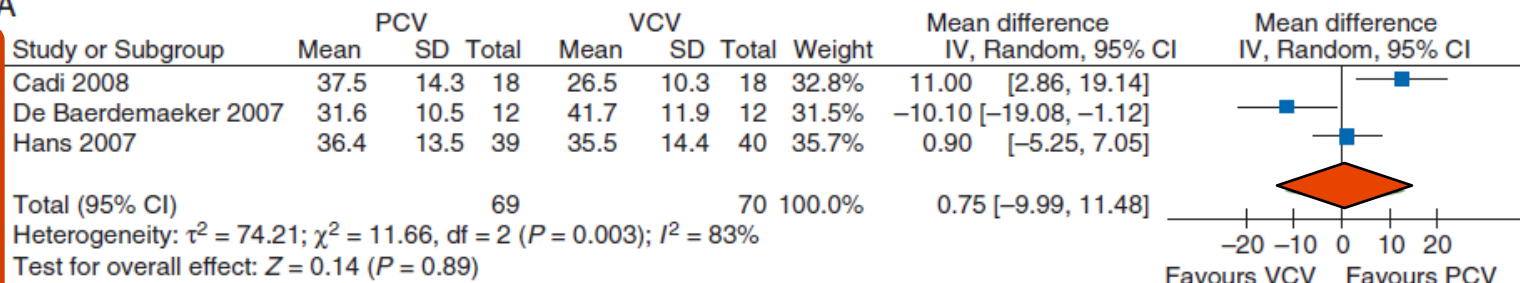
REVIEW

Ventil
a qua

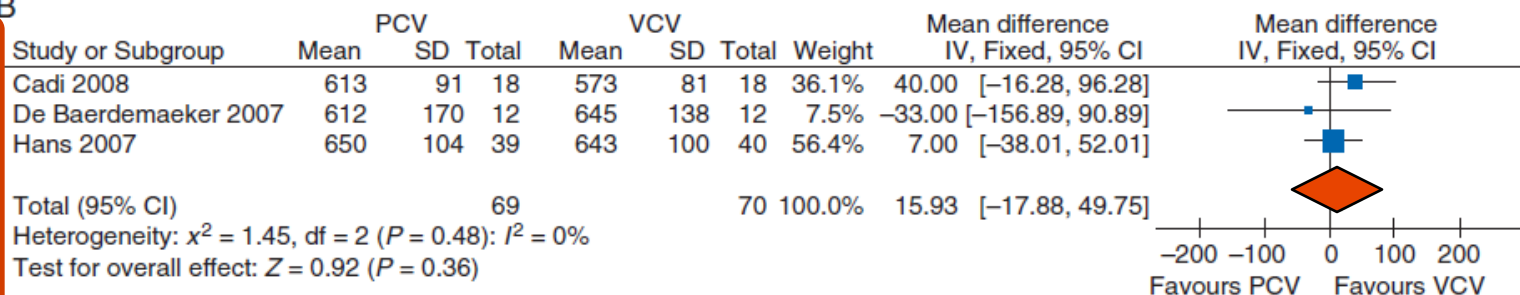
???

PaO₂/FiO₂

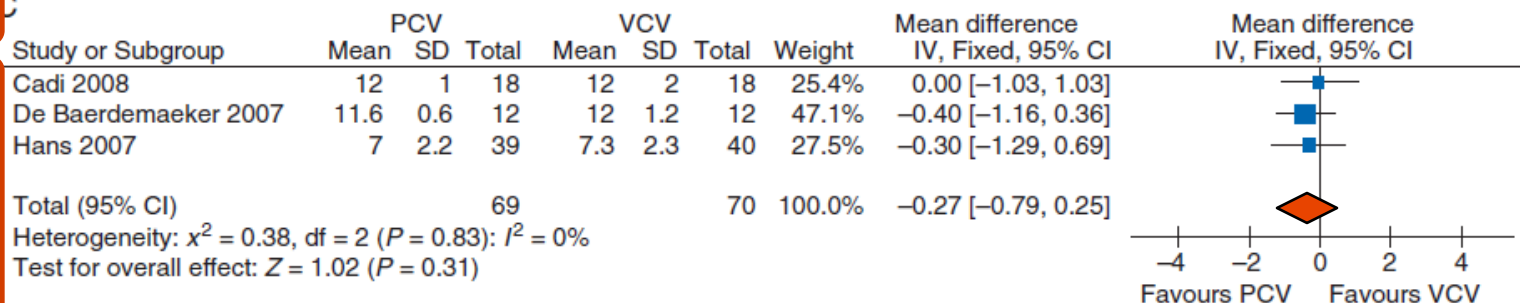
A



B



C



Airways Pressure

Tidal Volume

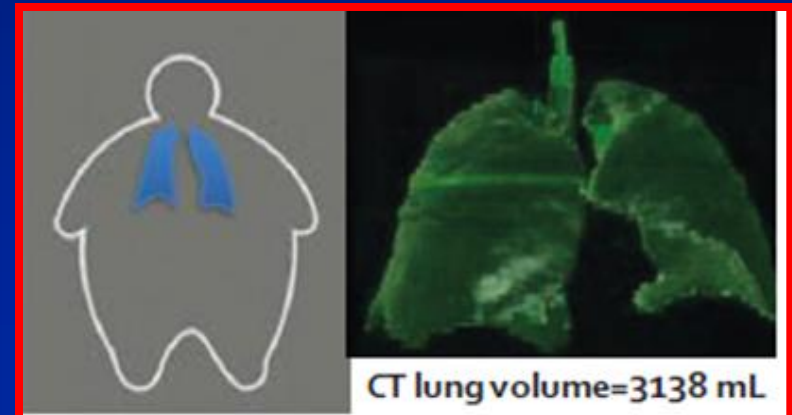
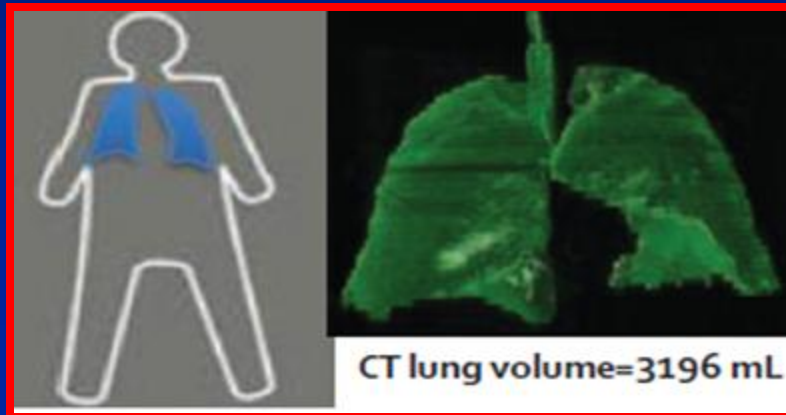
3 VCV vs PCV. (A) Impact on intraoperative PaO₂/F_iO₂ ratio (kPa). (a) Impact on intraoperative tidal volume (ml). (c) Impact on intraoperative mean airway pressure (cm H₂O).

Règles de la Ventilation: Ventilation Protectrice

- Volume courant: 6-8 ml/kg du poids idéal:

Poids idéal **chez l'homme** : taille (cm) – 100

Poids idéal **chez la femme** : taille (cm) – 110



Règles de la Ventilation: Ventilation Protectrice

- ❑ Maintenir une pression de Plateau ≤ 30 cmH₂O
- ❑ FR: 15-21 cycles/min
- ❑ Utiliser une PEP de 8-10 Cm H₂O +++
- ❑ Utiliser une PEP de: 2/3 Auto PEP
- ❑ Manœuvres de recrutement +++

Anesthesiology

1999; 91:1221-31

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Lippincott Williams & Wilkins, Inc.

Positive End-expiratory Pressure Improves Respiratory Function in Obese but not in Normal Subjects during Anesthesia and Paralysis

Paolo Pelosi, M.D.,* Irene Ravagnan, M.D.,† Gabriella Giurati, M.D.,† Mauro Panigada, M.D.,‡
Nicola Bottino, M.D.,‡ Stefano Tredici, M.D.,‡ Giuditta Eccher, M.D.,‡ Luciano Gattinoni, M.D.§

• **Application d'une PEP:** très bénéfique chez le patient obèse dès l'intubation

- Permet d'éviter le collapsus alvéolaire
- Recrutement alvéolaire
- Peu de retentissement hémodynamique
- Niveau de PEP: Pas de niveau optimal!

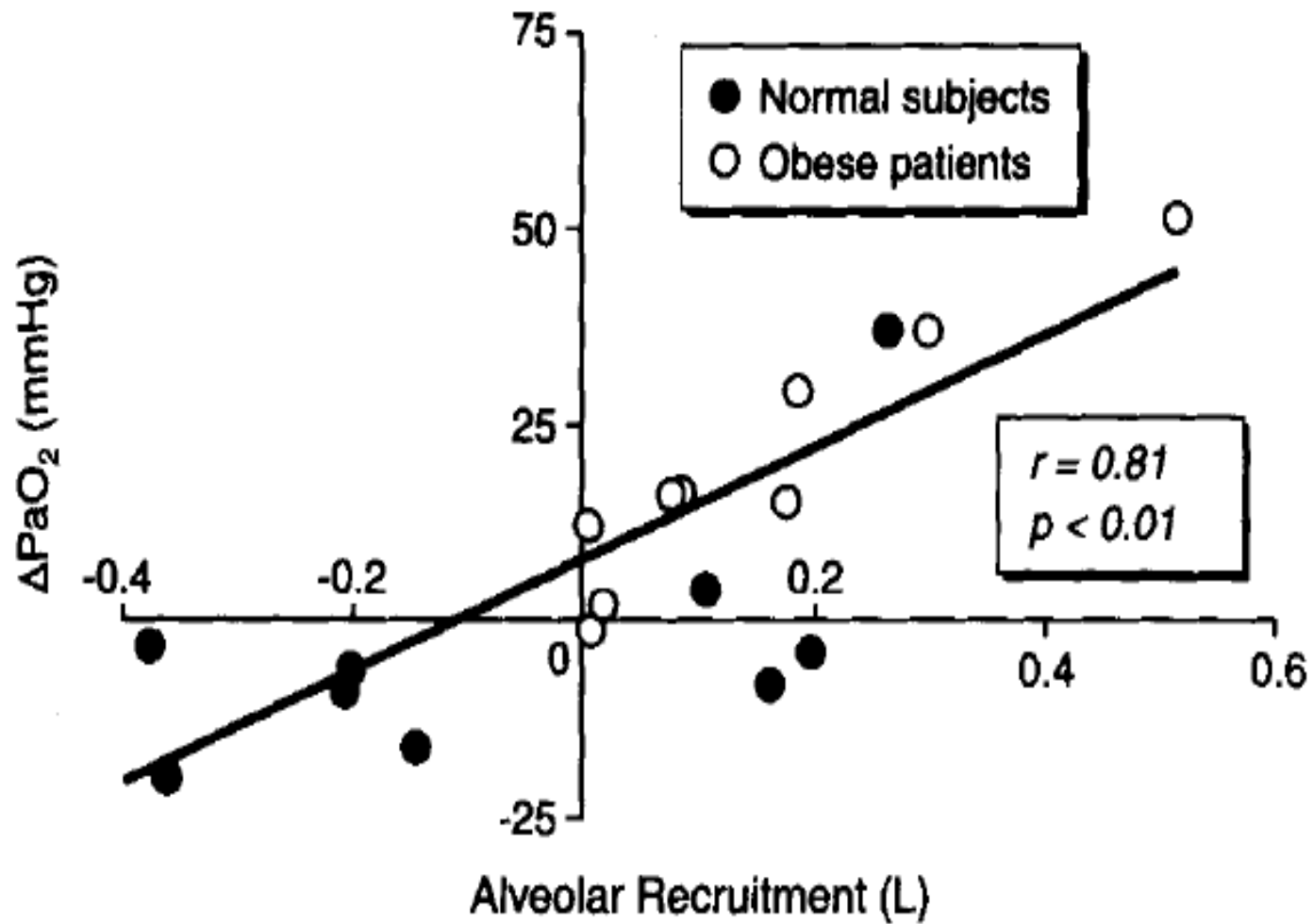
NORMAL

N: 9

PEP: 10CmH2O

OBESE

N: 9



Manœuvre de recrutement alvéolaire

Recruitment Maneuvers and Positive End-Expiratory Pressure Titration in Morbidly Obese ICU Patients

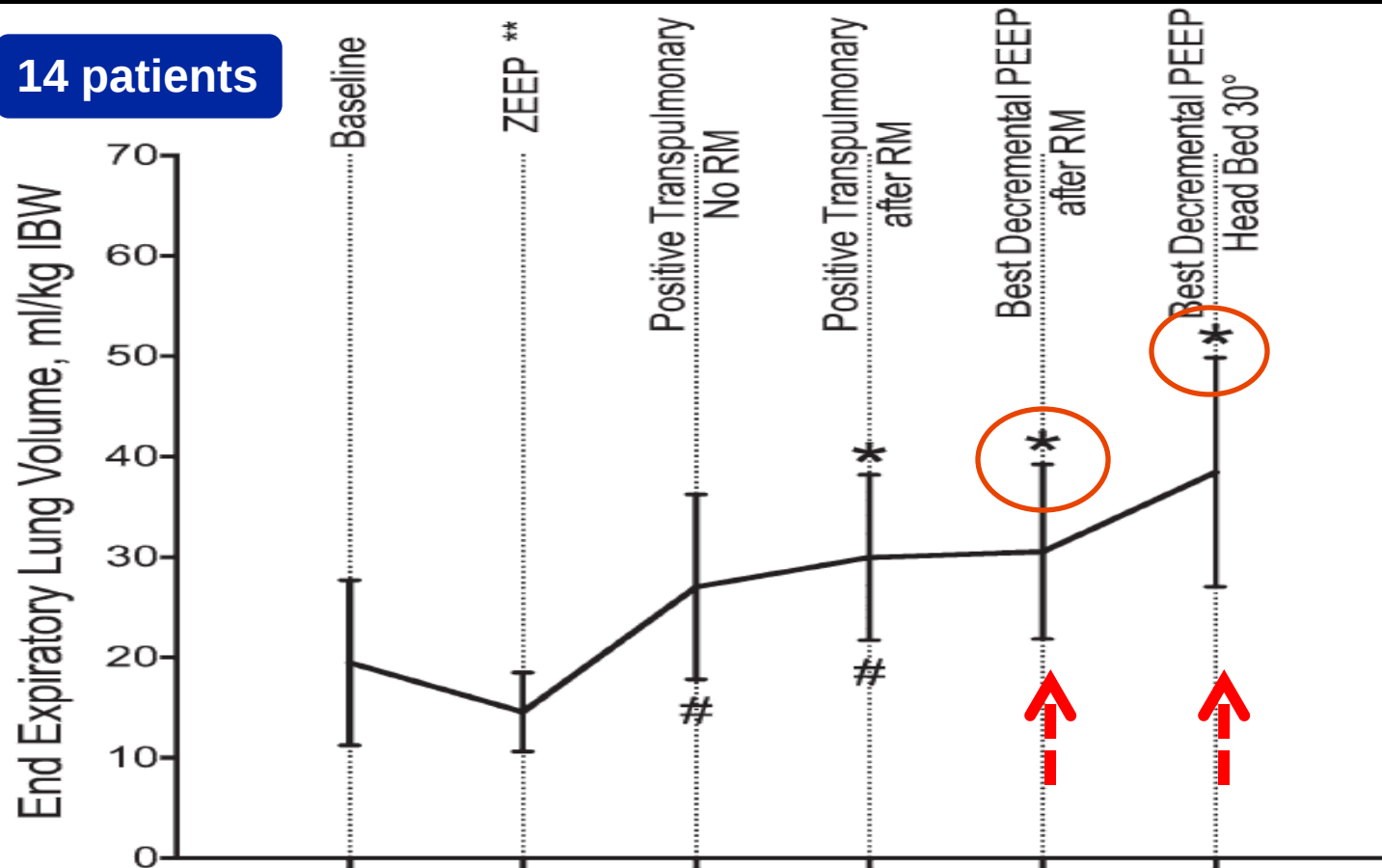
Massimiliano Pirrone, MD^{1,2}; Daniel Fisher, RRT³; Daniel Chipman, RRT³; David A. E. Imber, BA¹; Javier Corona, MD^{1,4}; Cristina Mietto, MD^{1,2}; Robert M. Kacmarek, RRT, PhD^{1,3}; Lorenzo Berra, MD¹

- **Améliore les volumes pulmonaires**
- **Améliore l'élastance pulmonaire**
- **Améliore l'oxygénation**

Recruitment Maneuvers and Positive End-Expiratory Pressure Titration in Morbidly Obese ICU Patients

Massimiliano Pirrone, MD^{1,2}; Daniel Fisher, RRT³; Daniel Chipman, RRT³; David A. E. Imber, BA¹; Javier Corona, MD^{1,4}; Cristina Mietto, MD^{1,2}; Robert M. Kacmarek, RRT, PhD^{1,3}; Lorenzo Berra, MD¹

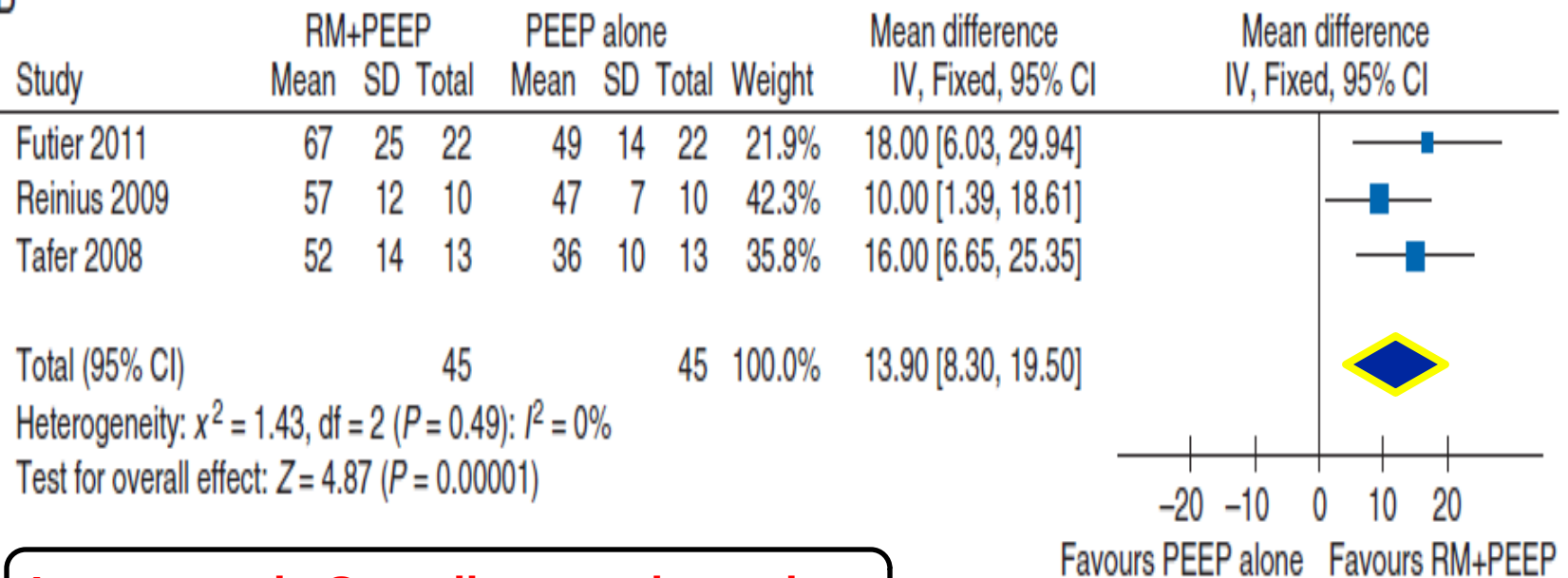
14 patients



REVIEW ARTICLES

Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis[†]

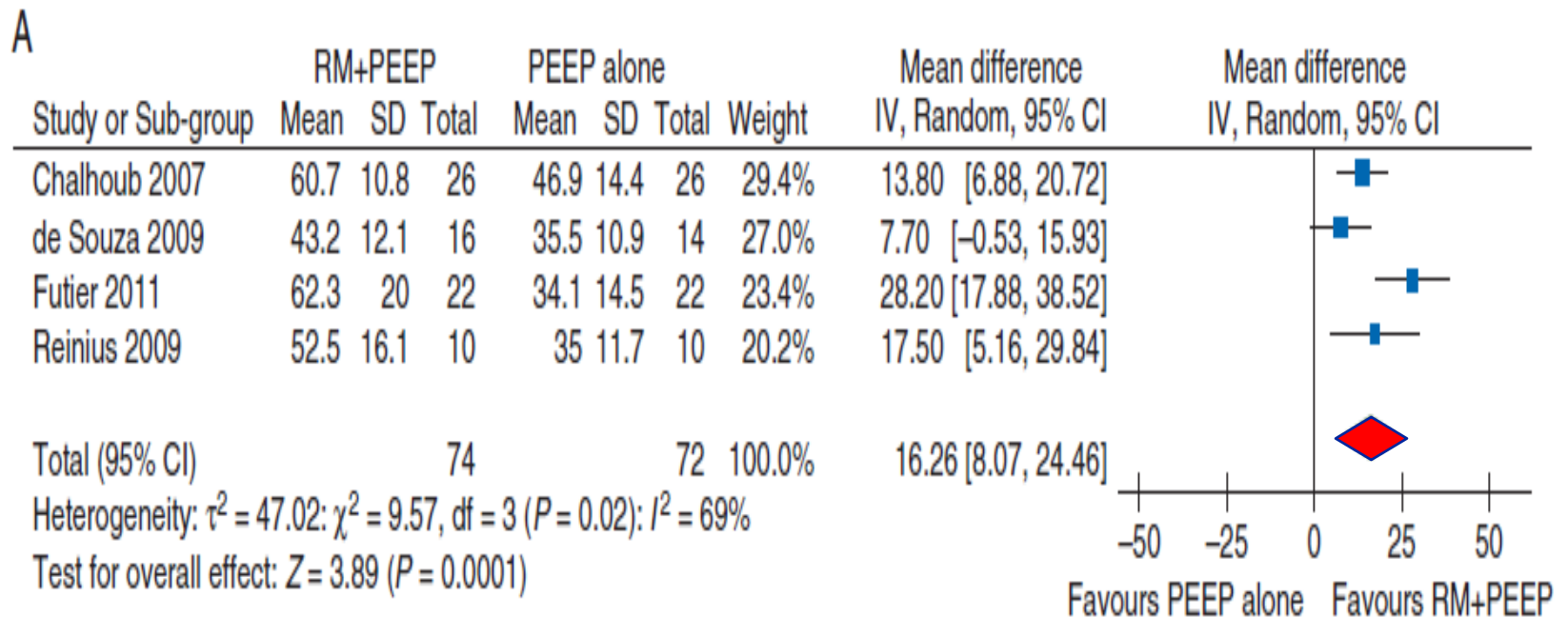
B



Impact sur la Compliance pulmonaire

REVIEW ARTICLES

Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis[†]



Impact sur PaO₂/FiO₂

Effets de la position

Obèse : $\frac{1}{2}$ assis (proclive 25-30°)



Figure 2. A morbidly obese patient placed in the sitting position during invasive mechanical ventilation in the ICU.

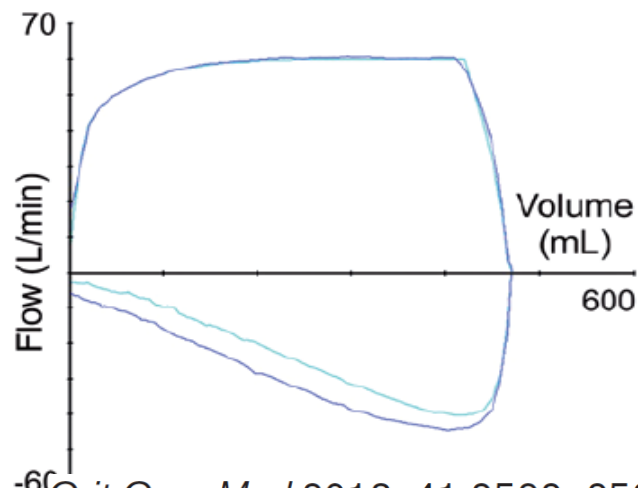
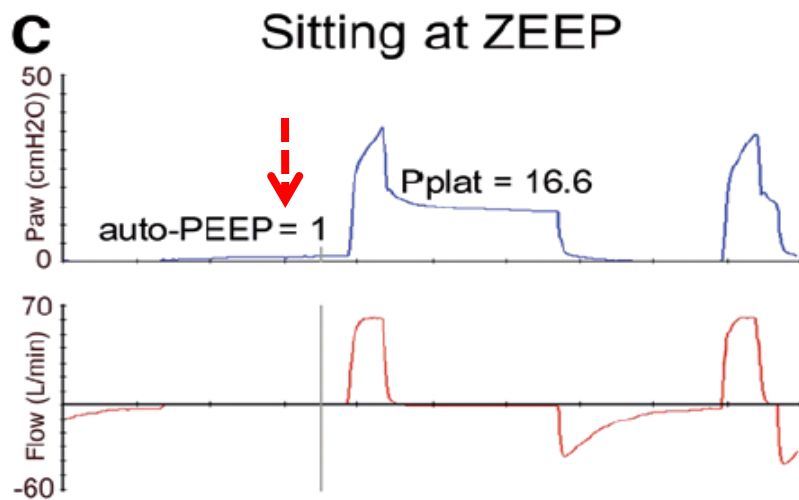
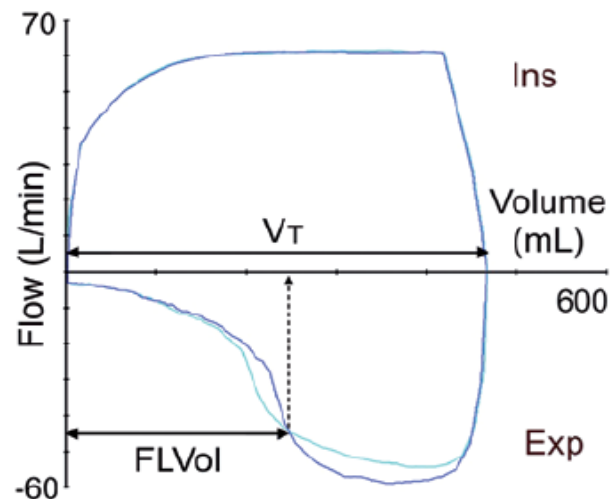
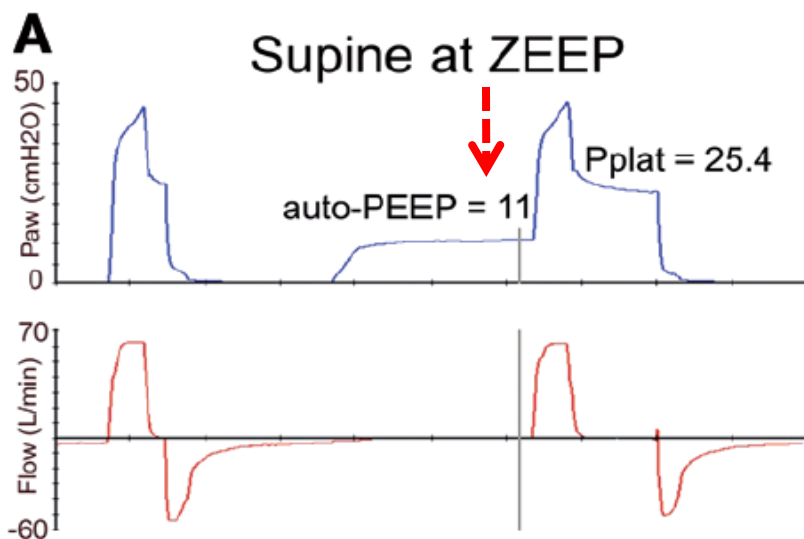
Crit Care Med 2013; 41:2592–2599

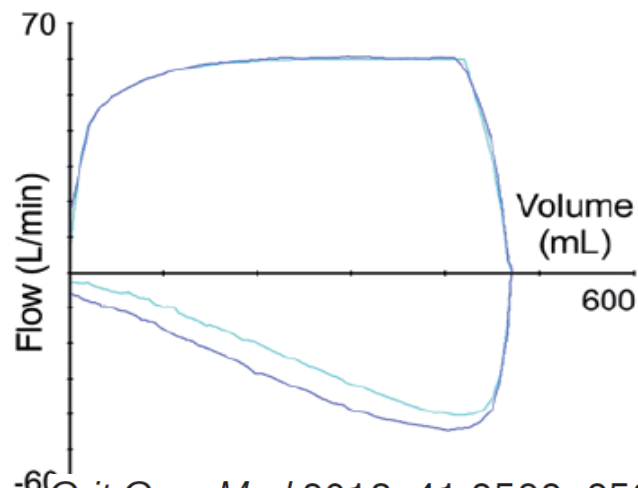
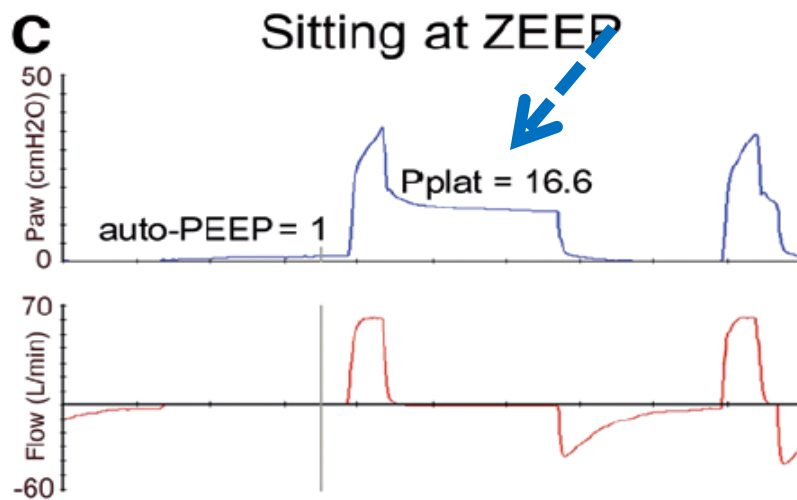
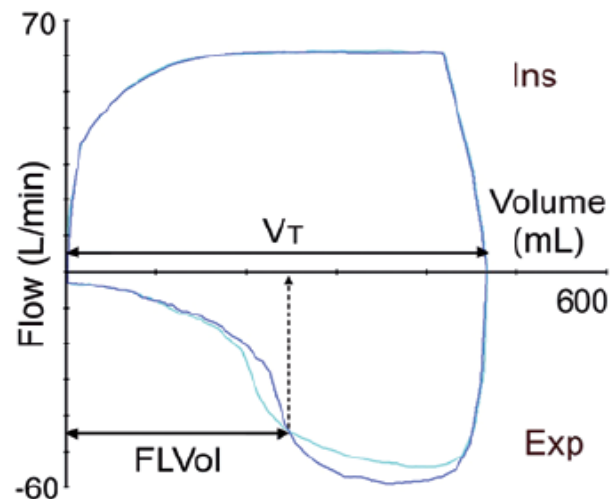
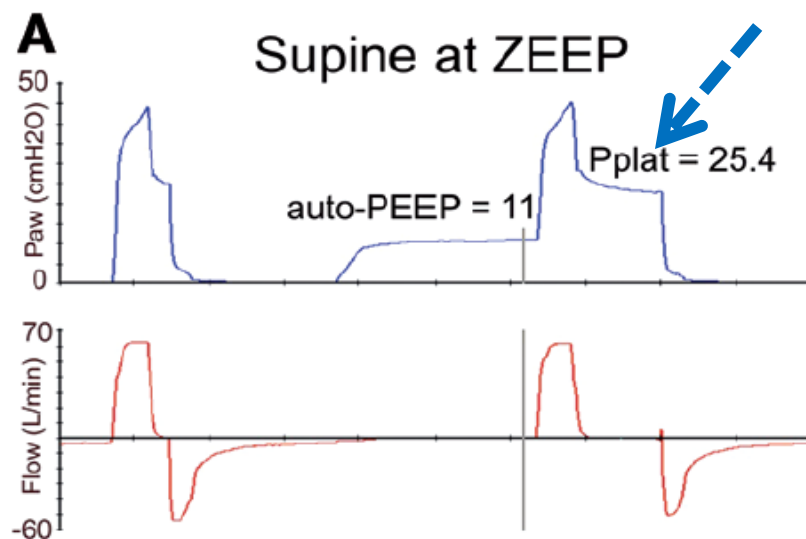
Effects of Sitting Position and Applied Positive End-Expiratory Pressure on Respiratory Mechanics of Critically Ill Obese Patients Receiving Mechanical Ventilation*

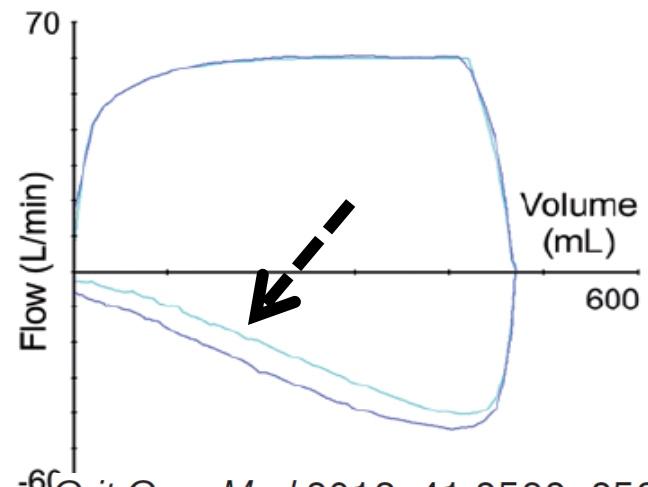
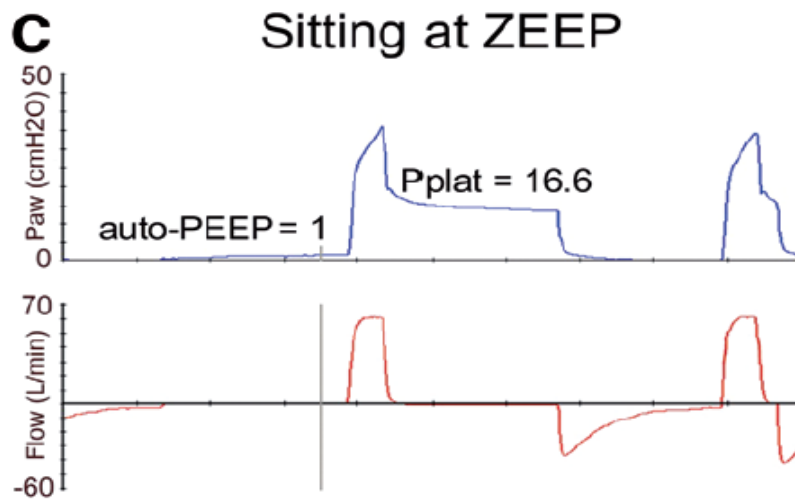
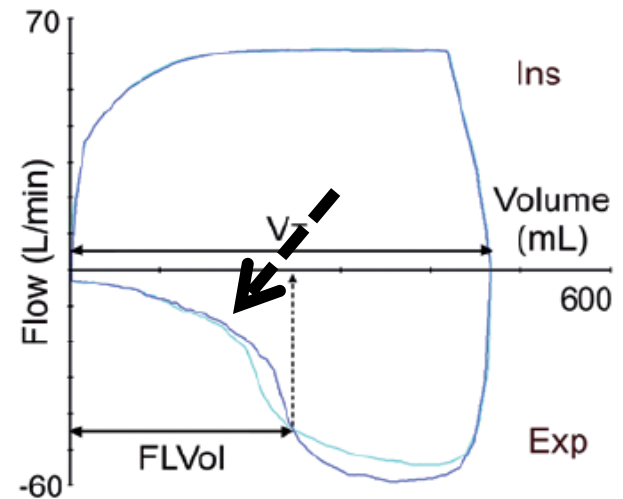
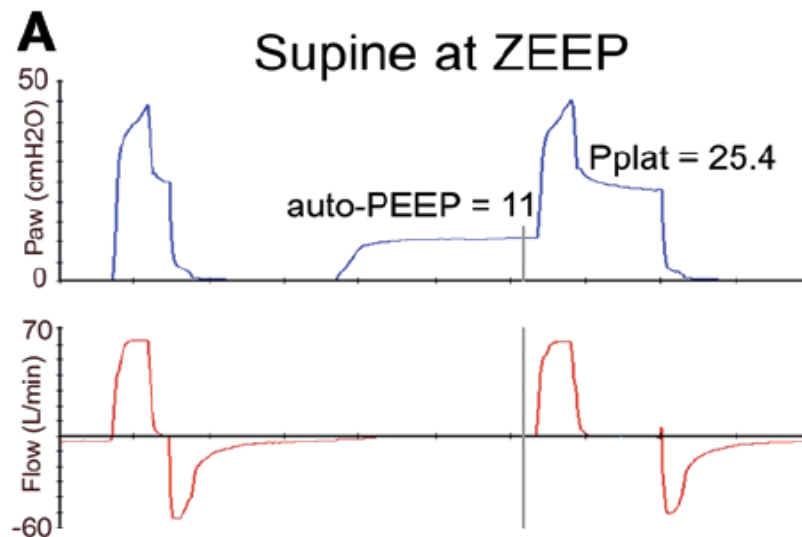
Crit Care Med 2013; 41:2592–2599

Bénéfices:

- Améliore la CV, La compliance pulmonaire
- Améliore la CRF (positionnement du diaphragme)
- Baisse de l'auto PEP
- Eviter le Reflux Gastro-oesophagien







Décubitus Ventral ???



CHEST

Original Research

CRITICAL CARE

Feasibility and Effectiveness of Prone Position in Morbidly Obese Patients With ARDS

A Case-Control Clinical Study

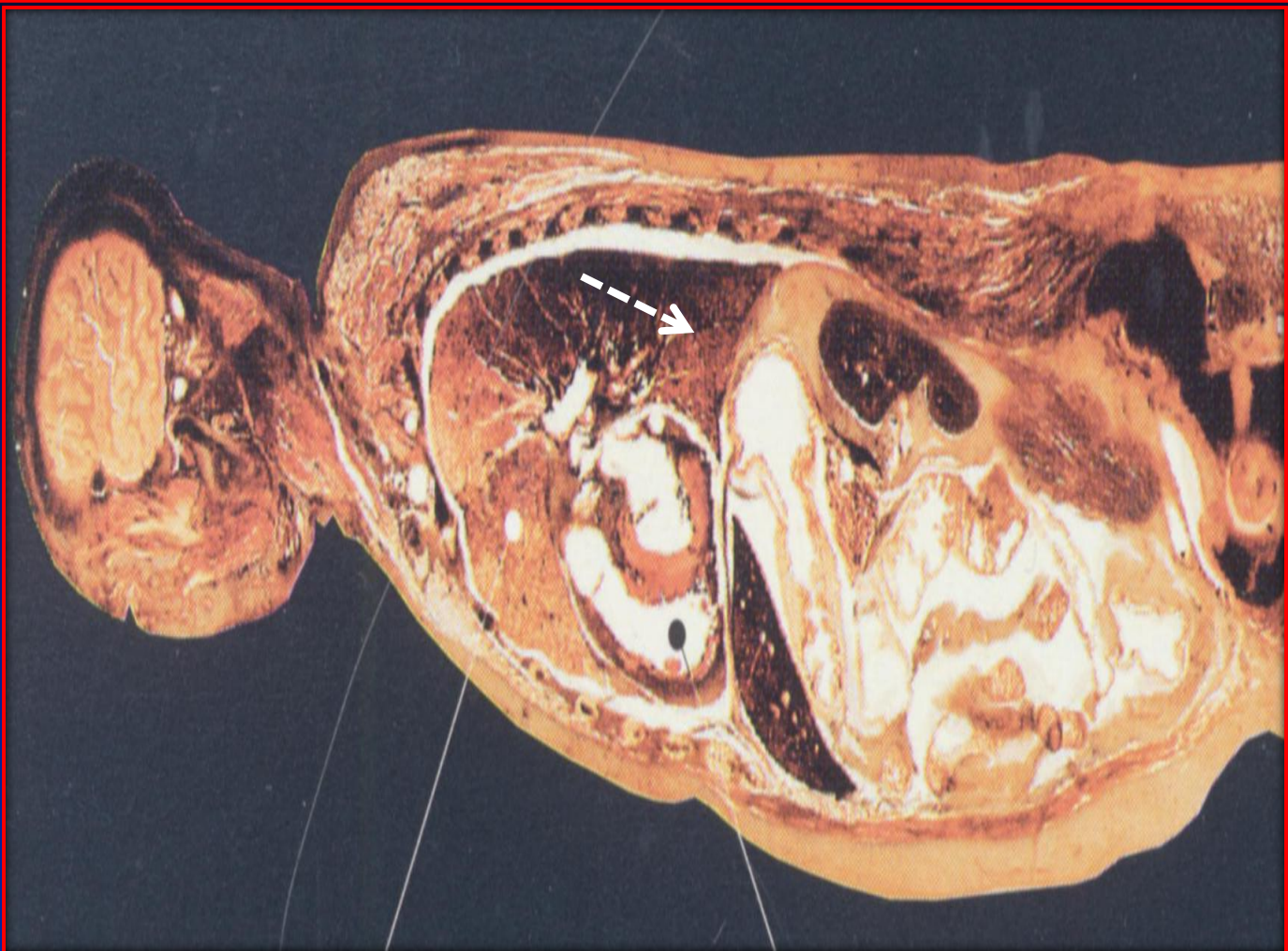
Audrey De Jong, MD; Nicolas Molinari, PhD; Mustapha Sebbane, MD; Albert Prades, Nursing Fellow; Emmanuel Futier, MD; Boris Jung, MD; Gérald Chanques, MD; and Samir Jaber, MD

CHEST 2013; 143(6):1554–1561

Feasibility and Effectiveness of Prone Position in Morbidly Obese Patients With ARDS



CHEST 2013; 143(6):1554–1561

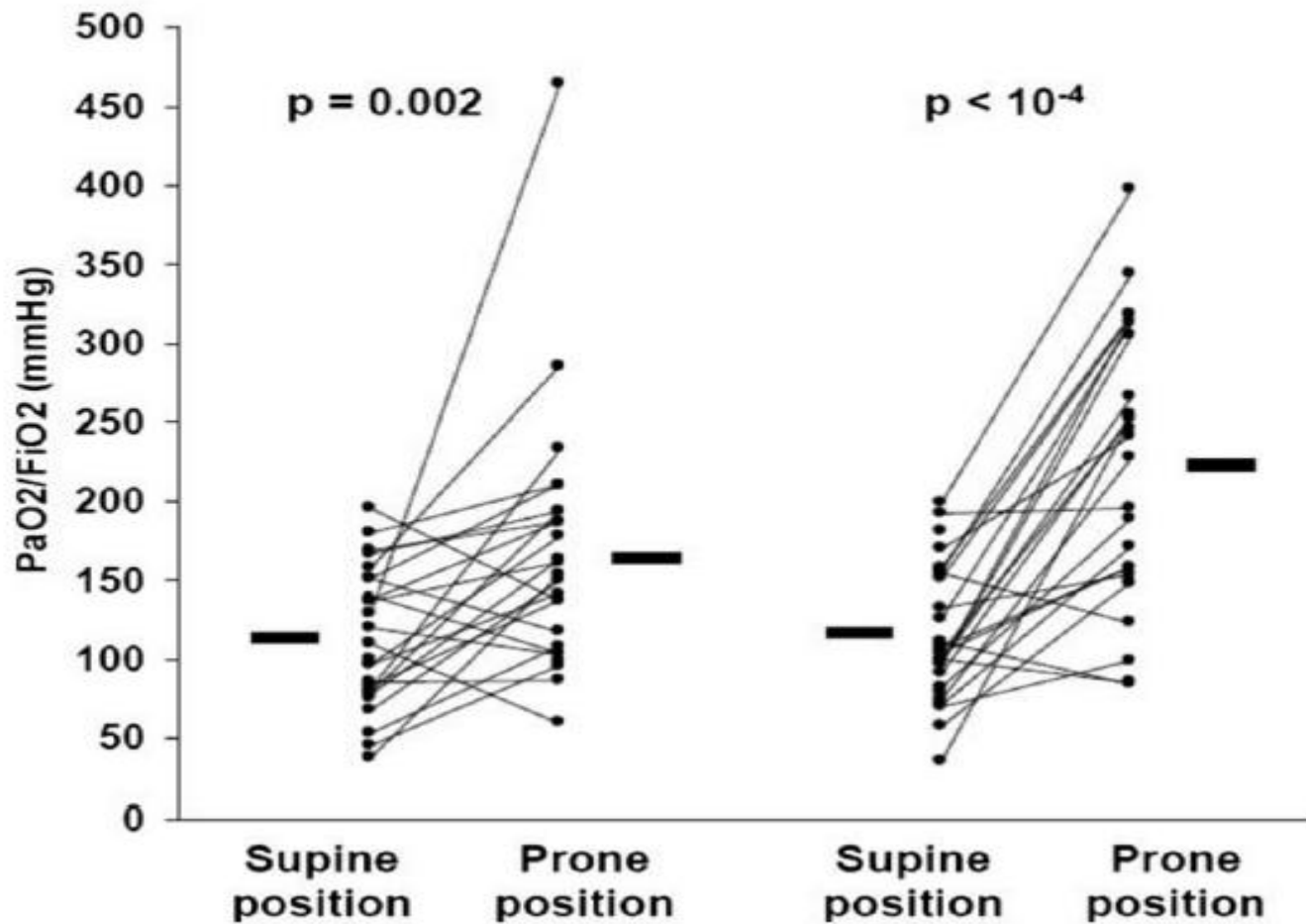


$\text{PaO}_2/\text{FiO}_2 < 200$

Non obese
(n=26)

Obese
(n=26)

$\text{BMI} > 35$



CHEST 2013; 143(6):1554-1561



Conclusion:

- * **PP** seems safe in obese patients and may improve oxygenation more than in nonobese patients.
- * **Obese patients could be a subgroup of patients with ARDS who may benefit the most of PP.**

FIGURE 4. The survival curve of obese vs nonobese patients. There was a significant difference in survival curves based on Kaplan-Meier analysis ($\chi^2 = 4.9601$; $P = .0259$).

Sevrage - Extubation

Mahul *et al. Critical Care* (2016) 20:346
DOI 10.1186/s13054-016-1457-4

Critical Care

RESEARCH

Open Access

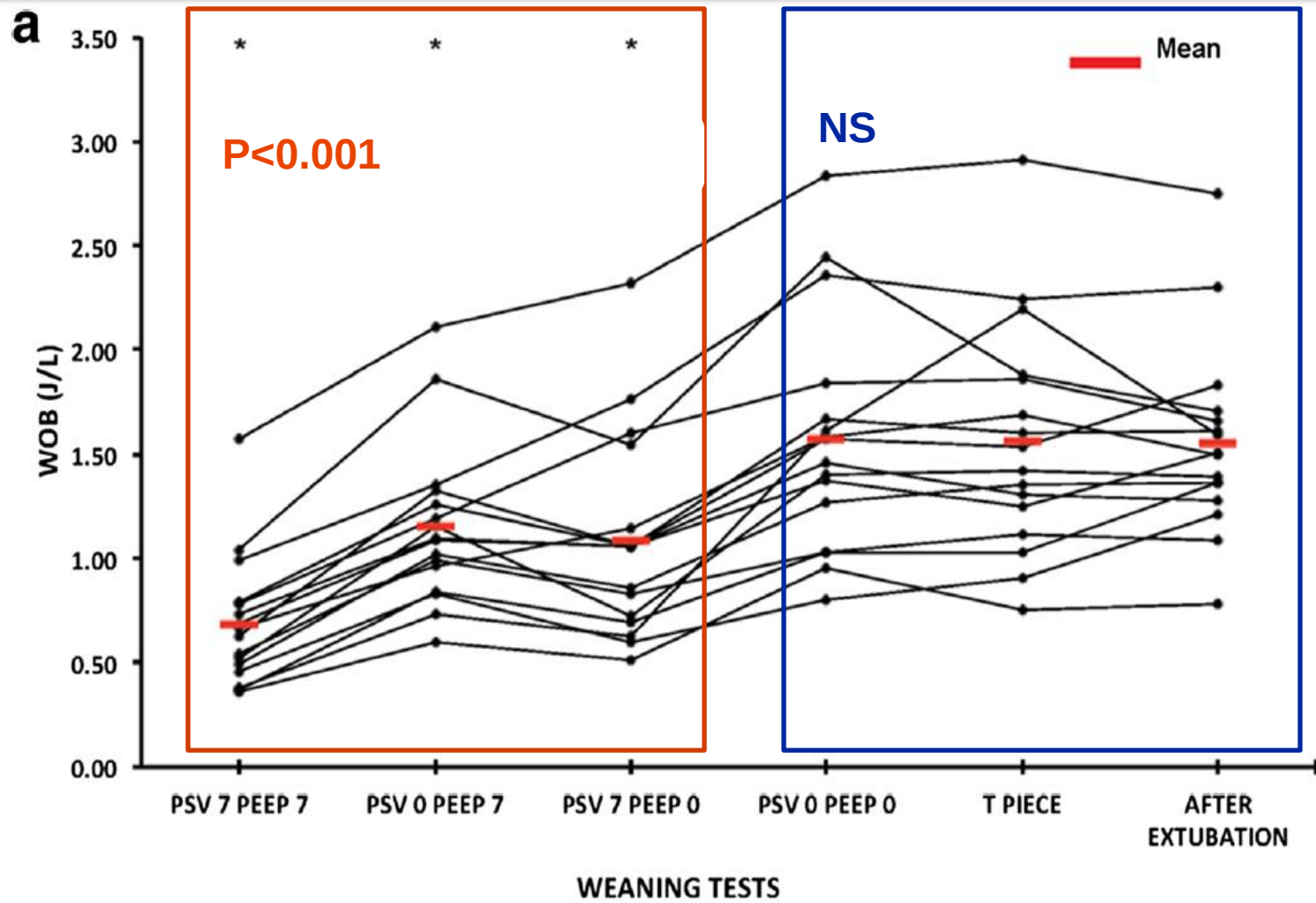


Spontaneous breathing trial and post-extubation work of breathing in morbidly obese critically ill patients

17 patients (BMI > 35)

Martin Mahul^{1†}, Boris Jung^{1,4†}, Fabrice Galia¹, Nicolas Molinari², Audrey de Jong¹, Yannaël Coisel^{1,4}, Rosanna Vaschetto³, Stefan Matecki⁴, Gérald Chanques^{1,4}, Laurent Brochard^{5,6} and Samir Jaber^{1,4*}

Mahul *et al. Critical Care* (2016) 20:346



Jean-Pierre Frat
Valérie Gissot
Stéphanie Ragot
Arnaud Desachy
Isabelle Runge
Christine Lebert
René Robert
for the Association des
Réanimateurs
du Centre-Ouest (ARCO)
study group

Impact of obesity in mechanically ventilated patients: a prospective study

Table 2 ICU course in obese and nonobese patients

Complication	Obese (<i>n</i> = 82)	Nonobese (<i>n</i> = 124)
Post-extubation stridor: no. (%)	10/65 (15.3%)	3/90 (3.3%)*

SD Standard deviation



Noninvasive ventilation for prevention of post-extubation respiratory failure in obese patients

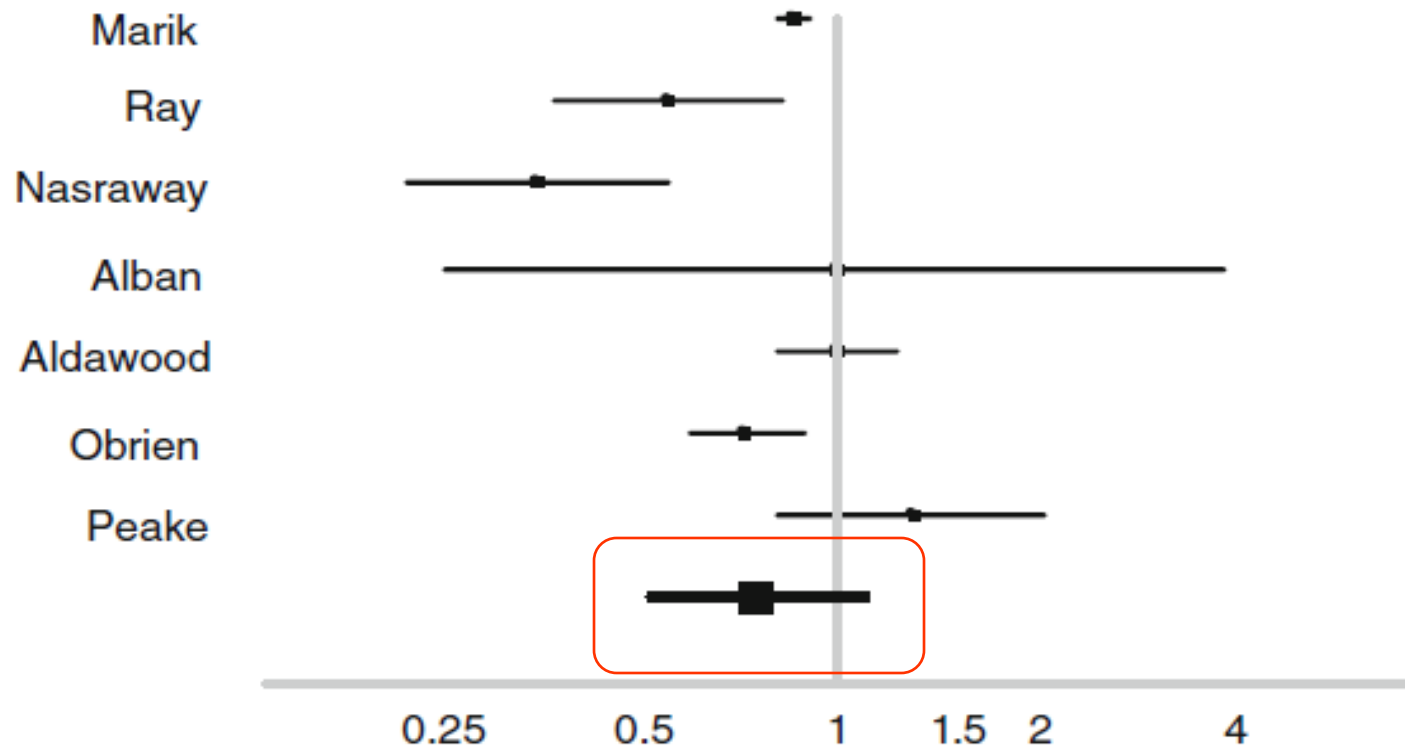
A.A. El Solh*, A. Aquilina*, L. Pineda*, V. Dhanvantri*, B. Grant*,[#] and P. Bouquin*

Paramètres	VNI (+) (62)	VNI (–) (62)	P
Détresse Respiratoire	6 (10%)	16 (26%)	0.03
Réintubation	6 (10%)	13 (21%)	0.14
Durée de Séjour Réa	11.8 ± 8	18 ± 11	<0.001
Durée de Séjour Hôpital	20.6 ± 11	26 ± 11	0.007
Mortalité	8 (13%)	15 (24%)	0.17

The impact of obesity on outcomes after critical illness: a meta-analysis

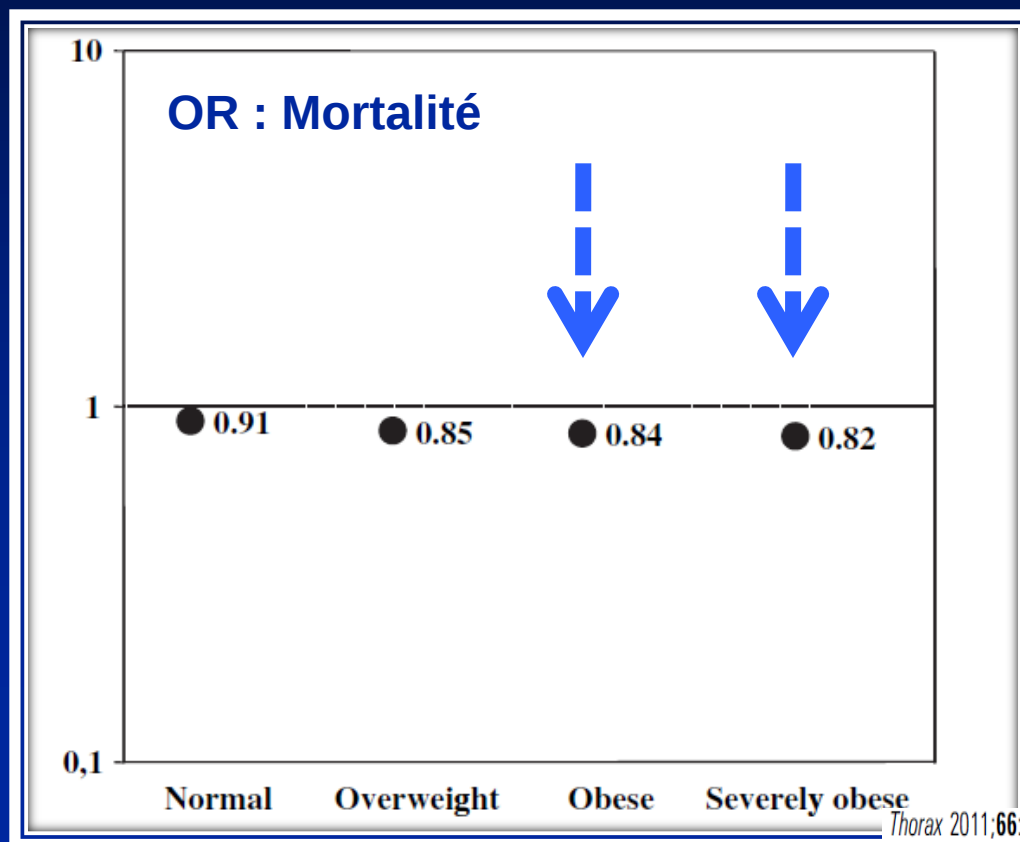
Obese vs. Normal

ICU Mortality



Influence of body mass index on outcome of the mechanically ventilated patients

Avril 2004, 349 réanimations, 4968 patients, 1008 patients obèses (20.2%) dont 216 (4.3%) Obésité Morbide.



Conclusion

Ventilation du Patient Obèse En Réanimation

- ❖ Patient obèse: Haut risque de Détresse Respiratoire et à l'hypoxémie
- ❖ Une Bonne Pré-oxygénation avant Intubation (VNI + **Position Proclive**)
- ❖ Intubation Difficile +++
- ❖ Volume courant: 6-8 ml/kg du poids idéal +++

Conclusion

Ventilation du Patient Obèse En Réanimation

- ❑ **Maintenir une pression de Plateau ≤ 30 cmH₂O**
- ❑ **FR: 15-21 cycles/min**
- ❑ **Utiliser une PEP de 8-10 Cm H₂O +++**
- ❑ **Manœuvres de recrutement +++**
- ❑ **Décubitus ventral si Hypoxémie Majeur**
- ❑ **VNI après Extubation**

Critical care 3



Prevention and care of respiratory failure in obese patients

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Merci