Nouveaux concepts en ventilation mécanique

Strain - Stress

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- **Lungpacer Med Inc. (contrats de recherche, expertise, transports, congrès)**

- **Bioserenity SA. (contrats de recherche)**

- **Dräger (inscription congrès SRLF 2021)**
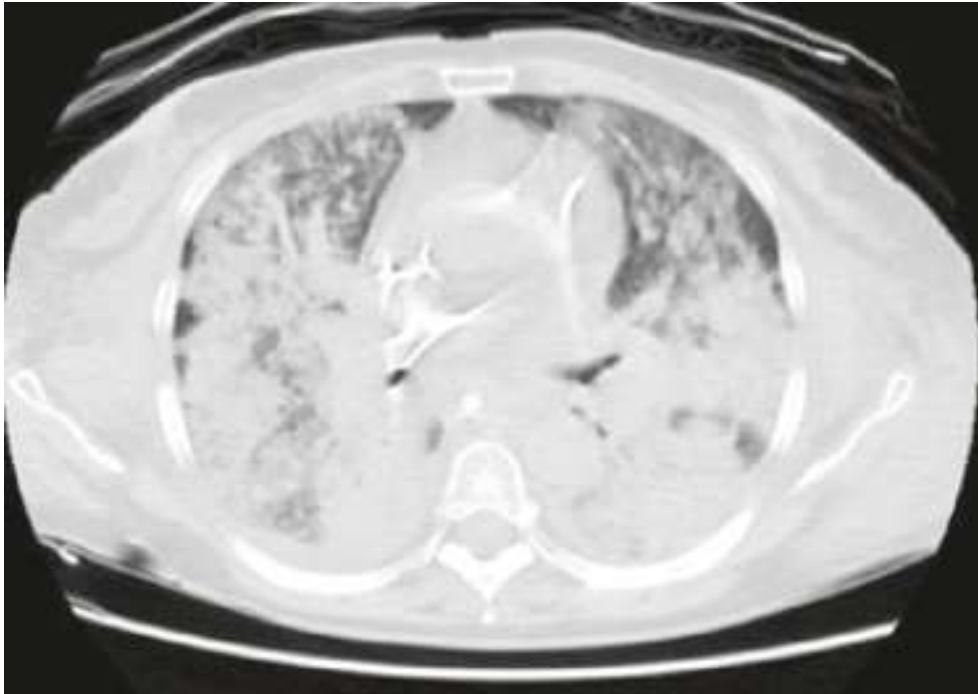
Assurer les échanges gazeux

Ventilation mécanique
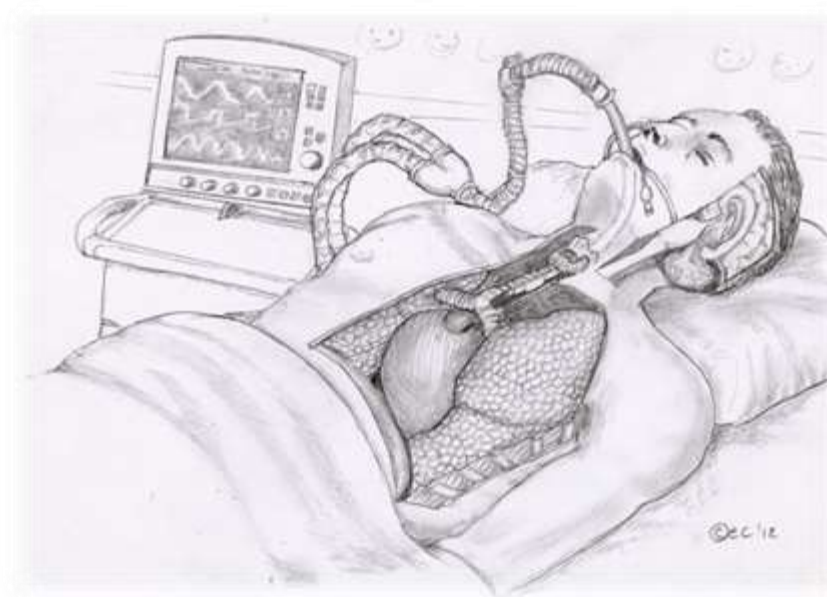
Minimiser les effets délétères

Oxygénation
Décarboxylation

Insufflation cyclique
Pression positive

SDRA
réduction du volume pulmonaire disponible

Baby lung
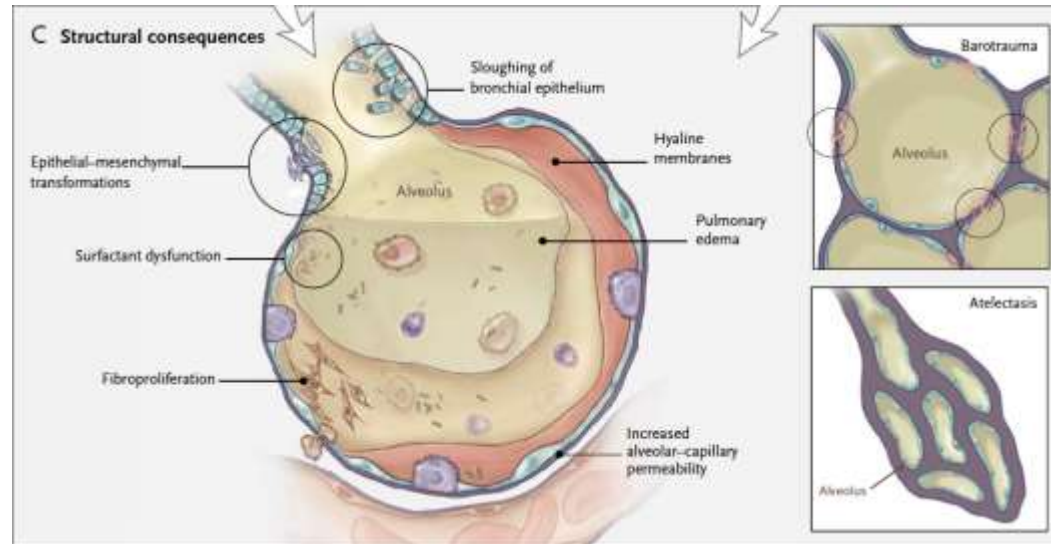≉Poumons de bébé
**mais bébé poumon
(petit poumon)**

Pneus sous gonflés = danger
Pneus sur gonflés = danger

Ventilator-Induced Lung Injury

Arthur S. Slutsky, M.D., and V. Marco Ranieri, M.D.

Monitoring

Ventilation
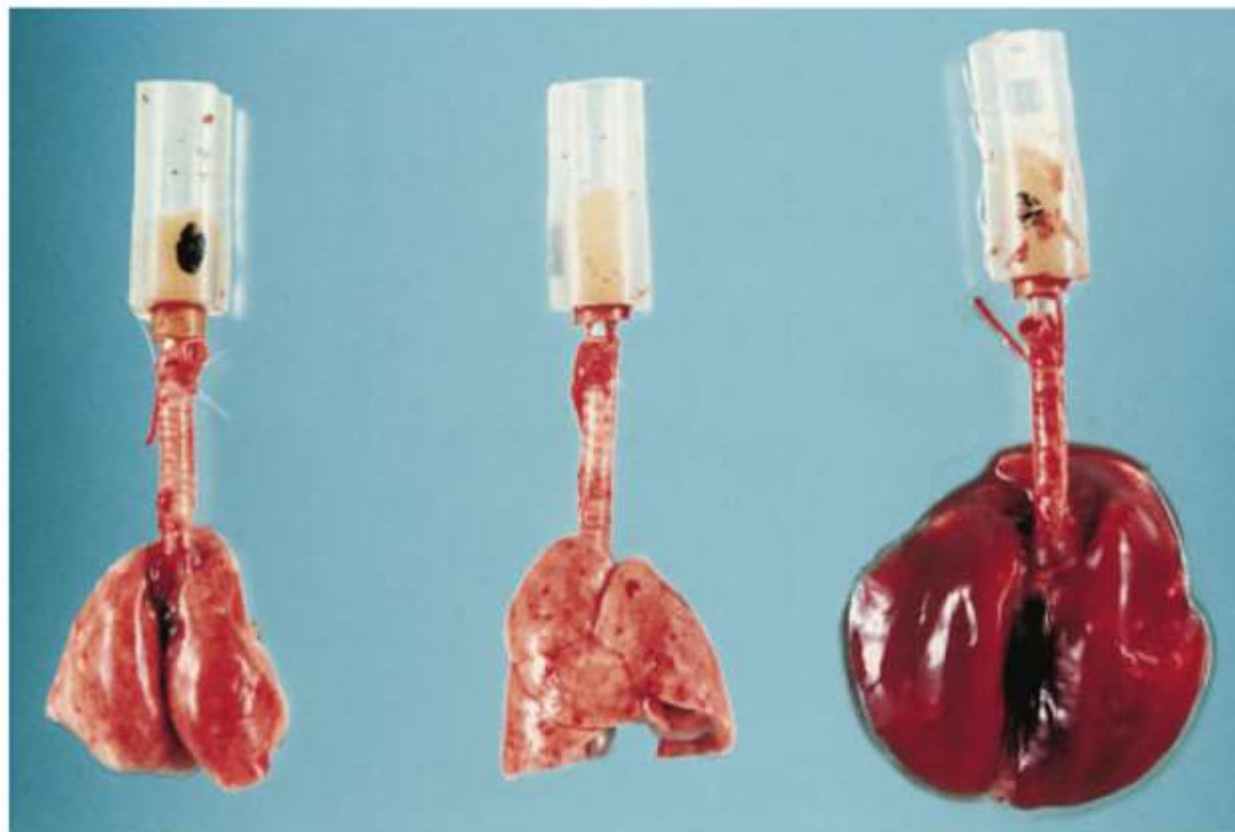
hauts volumes pulmonaires

faibles volumes pulmonaires

Surdistension régionale
« Volotrauma »

Lésions de cisaillement
Ouverture-fermeture répétées
« Atelectrauma »

Ventilator-induced Lung Injury
Lessons from Experimental Studies

DIDIER DREYFUSS and GEORGES SAUMON

Normal   5 min   20 min

High Inflation Pressure Pulmonary Edema

Respective Effects of High Airway Pressure, High Tidal Volume, and Positive End-expiratory Pressure[1-3]

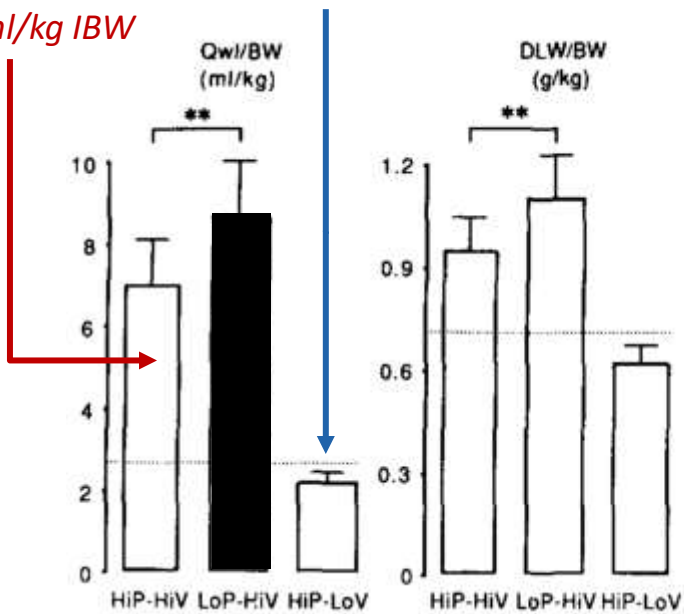DIDIER DREYFUSS, PAUL SOLER, GUY BASSET, and GEORGES SAUMON

AM REV RESPIR DIS 1988; 137:1159–1164
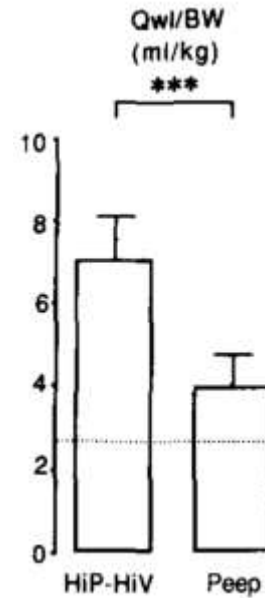

Pression 45 cmH2O
VT 40 ml/kg IBW
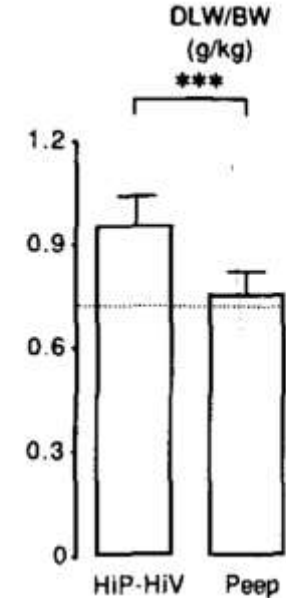
Pression 45 cmH2O
VT 20 ml/kg IBW
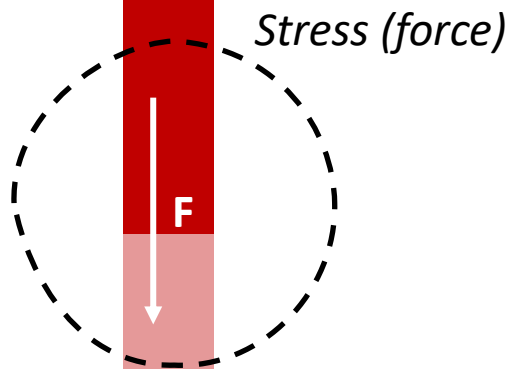
Eau pulmonaire extravasculaire

Poids pulmonaire

Eau pulmonaire extravasculaire

Poids pulmonaire

Modèle linéaire

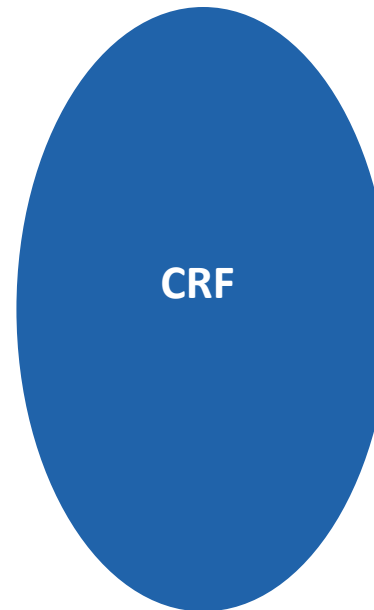**repos** **attraction**

L_0 L_0

Stress (force)

F

Strain (déformation)

$$\frac{(L_1+L_0)-L_0}{L_0}$$

L_1

$$\text{Stress} = k \times \text{strain} = k \times \frac{(L_1+L_0)-L_0}{L_0}$$

expiration

insufflation
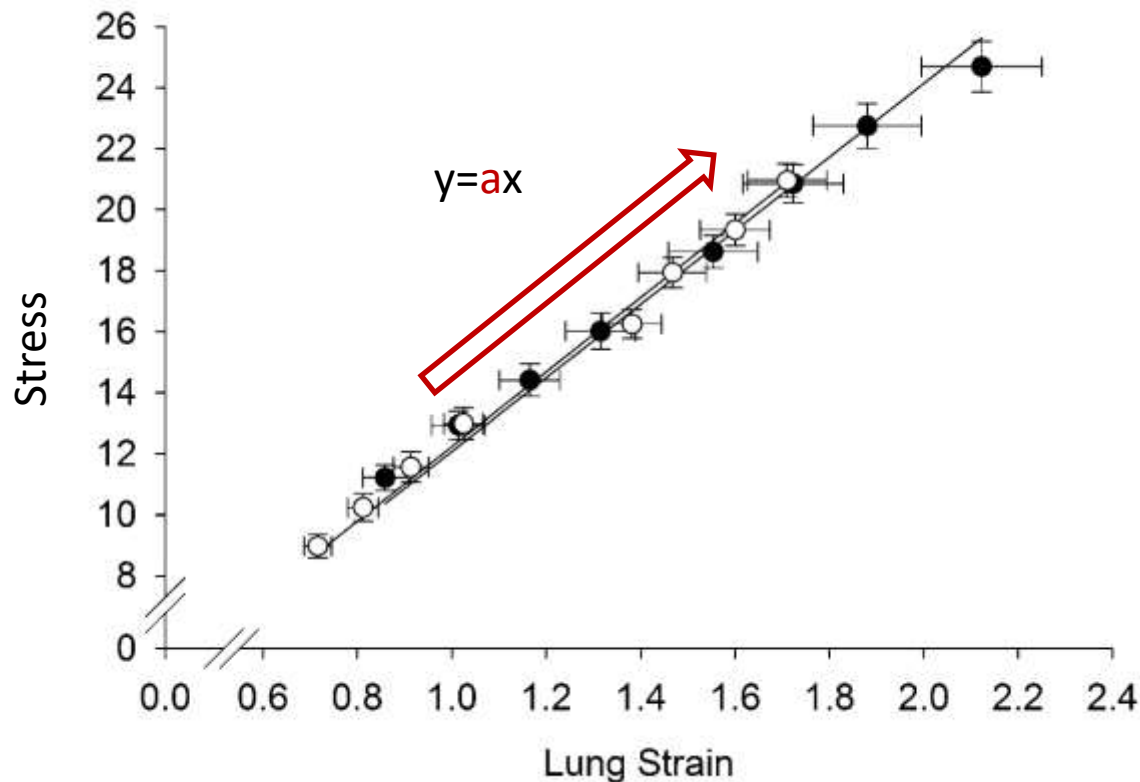
CRF

CRF

stress

+V_T
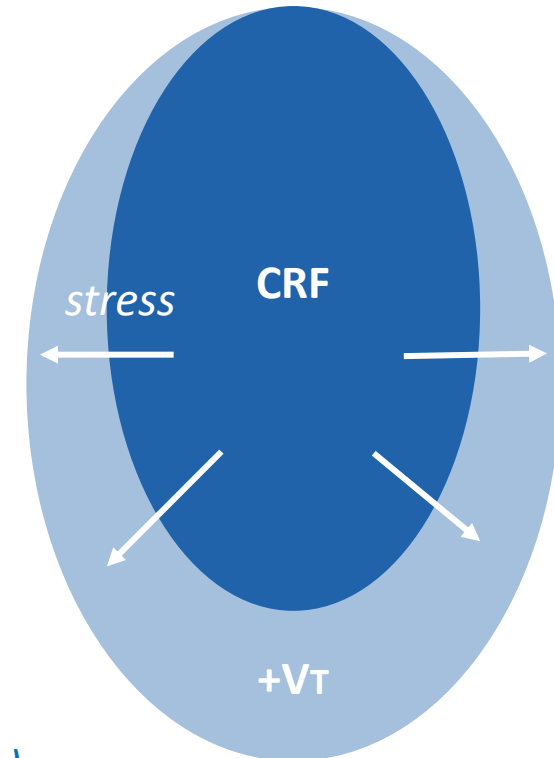
Strain (déformation)

$$\frac{(CRF+V_T)- CRF}{CRF}$$

Stress (pression)

k*Strain

Lung Stress and Strain during Mechanical Ventilation for Acute Respiratory Distress Syndrome

Davide Chiumello[1], Eleonora Carlesso[2], Paolo Cadringher[2], Pietro Caironi[1,2], Franco Valenza[1,2], Federico Polli[2], Federica Tallarini[2], Paola Cozzi[2], Massimo Cressoni[2], Angelo Colombo[1], John J. Marini[3], and Luciano Gattinoni[1,2]

# Lung Stress and Strain during Mechanical Ventilation for Acute Respiratory Distress Syndrome

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grande hétérogénéité
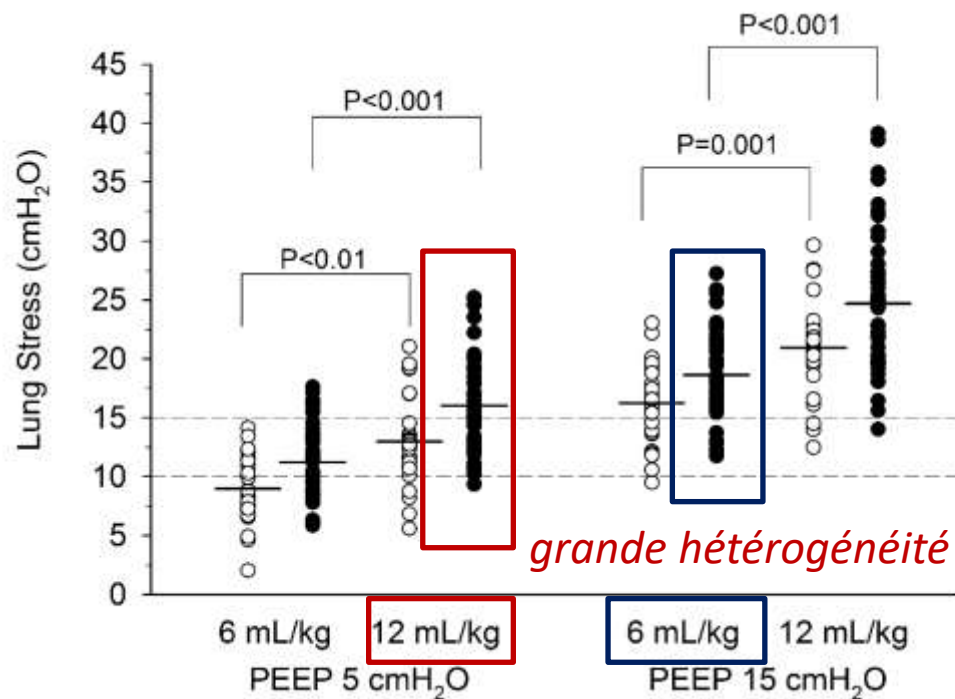
Lung Stress and Strain during Mechanical Ventilation
Any Safe Threshold?

Alessandro Protti[1], Massimo Cressoni[1], Alessandro Santini[1], Thomas Langer[1], Cristina Mietto[1], Daniela Febres[1], Monica Chierichetti[1], Silvia Coppola[1], Grazia Conte[2], Stefano Gatti[2], Orazio Leopardi[1], Serge Masson[3], Luciano Lombardi[4], Marco Lazzerini[4], Erica Rampoldi[5], Paolo Cadringher[1], and Luciano Gattinoni[1,6]
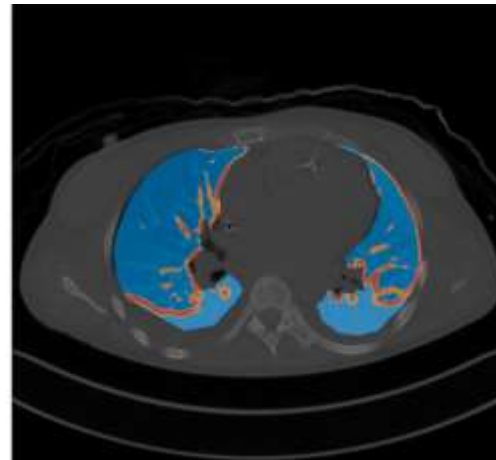

Limiter le V_T
au cours du SDRA
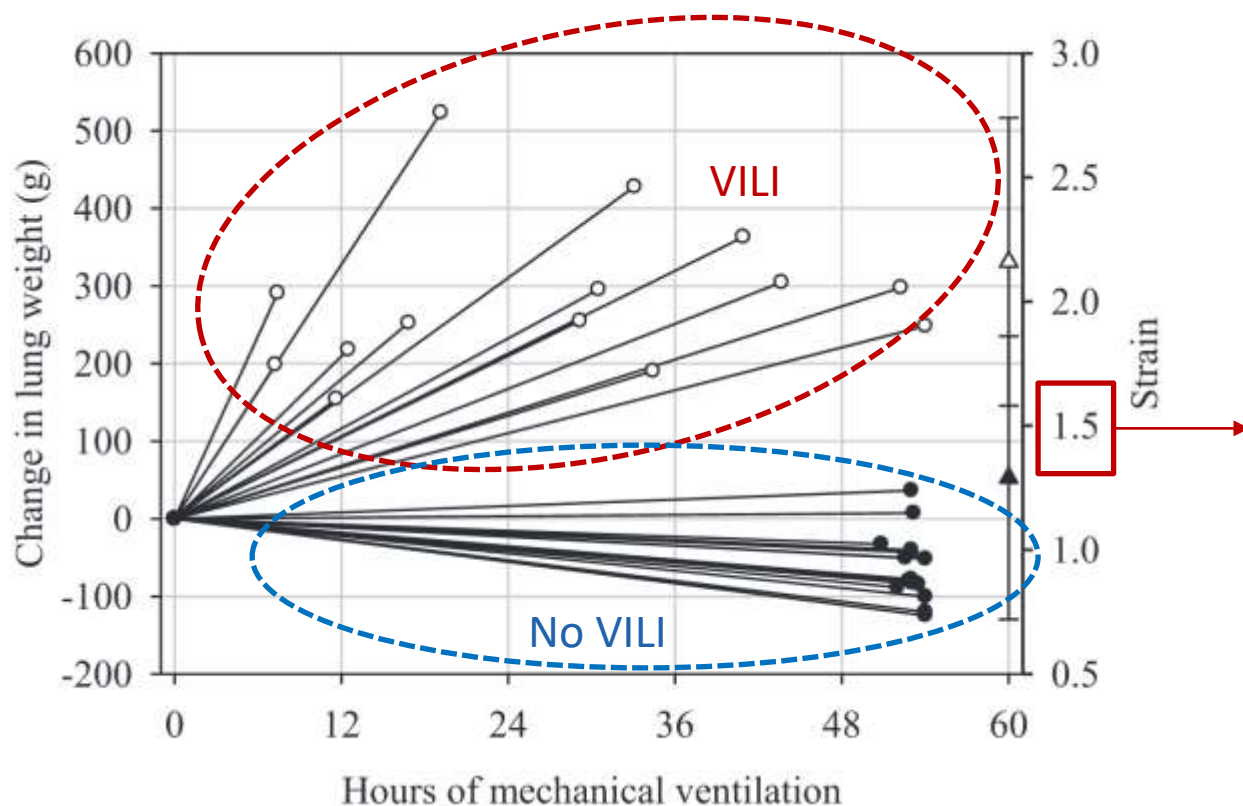
Lung Inhomogeneity in Patients with Acute Respiratory Distress Syndrome

Massimo Cressoni[1], Paolo Cadringher[1], Chiara Chiurazzi[1], Martina Amini[1], Elisabetta Gallazzi[1], Antonella Marino[1], Matteo Brioni[1], Eleonora Carlesso[1], Davide Chiumello[2], Michael Quintel[3], Guillermo Bugedo[4], and Luciano Gattinoni[1,2]
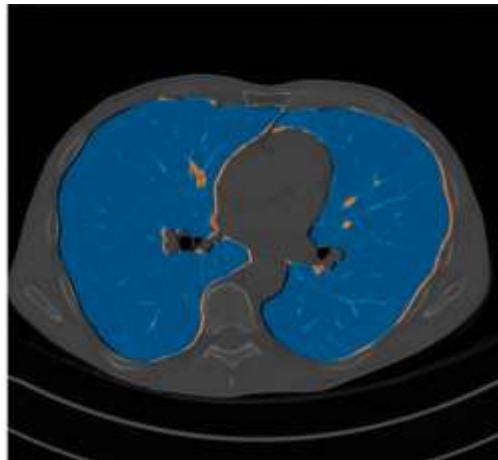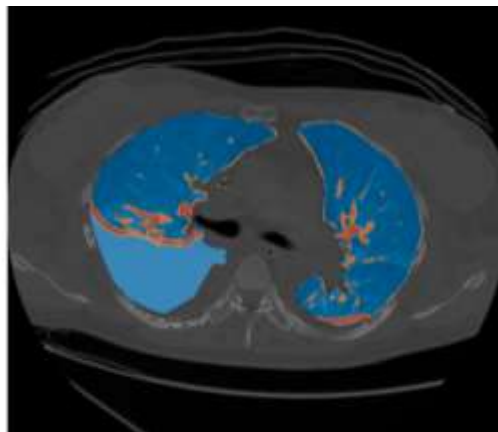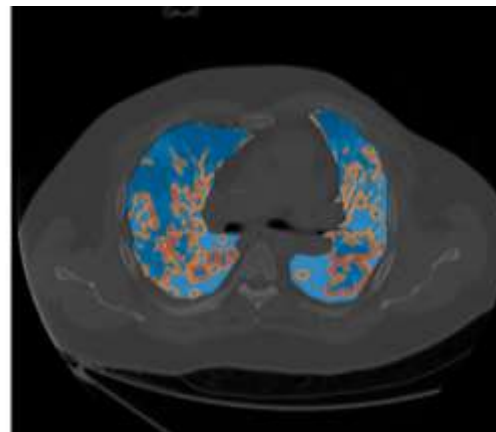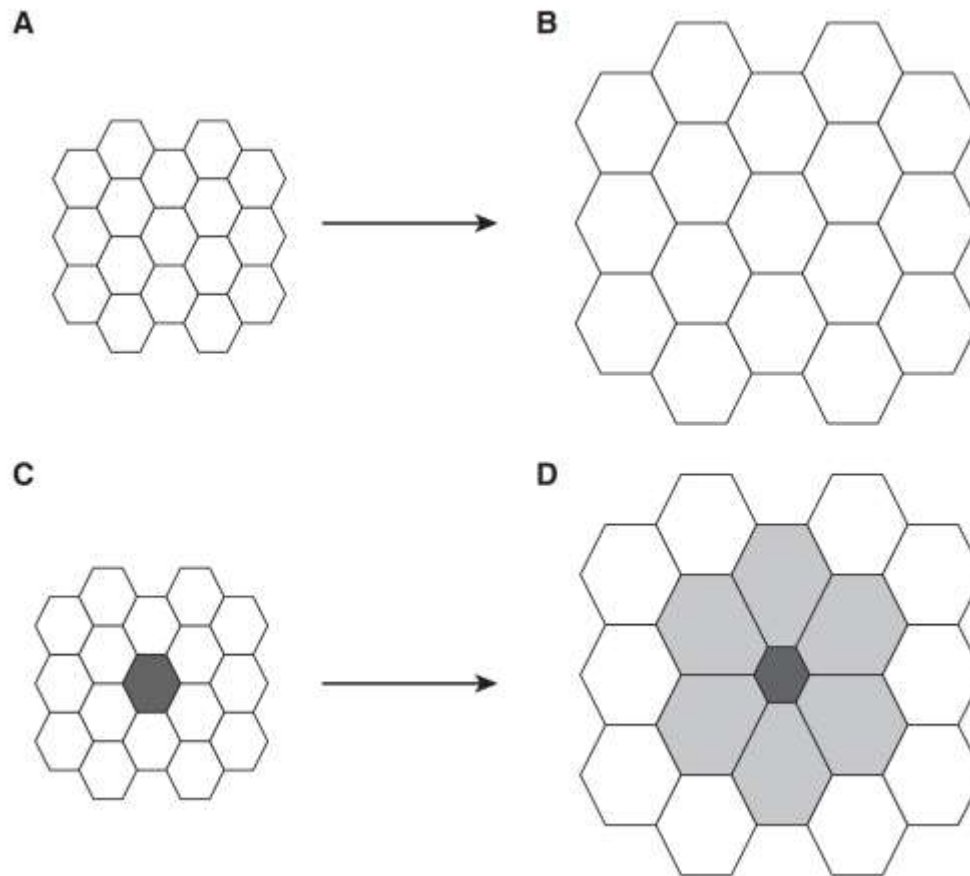

Poumons sains — SDRA léger — SDRA modéré — SDRA sévère

FIFTY YEARS OF RESEARCH IN ARDS
Respiratory Mechanics in Acute Respiratory Distress Syndrome

William R. Henderson[1]*, Lu Chen[2,3]*, Marcelo B. P. Amato[4], and Laurent J. Brochard[2,3]

A   B

C   D

Stress raiser
↗ ↗ ↗ Stress
↗ ↗ ↗ Strain

Recrutement
vs.
Hyperinflation

Concept de strain et stress

UMR-S 1158
Inserm

AP-HP.
Sorbonne
Université

Variables dérivées de la mécanique respiratoire

Equation de mouvement

pause inspiratoire

$$P_{voies\ aériennes} = PEEP + R_{rs} \times Débit + V_T/C_{RS} \rightarrow \textit{pression motrice}$$

stress

$P_{alvéolaire}$

$P_{pleurale}$ P_{eso}
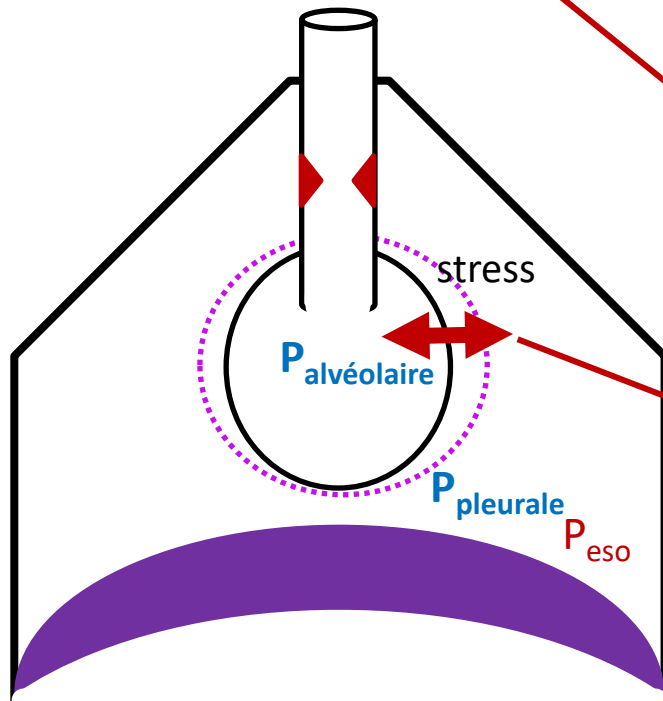
2

$P_{plateau}$ **« Pression qui distend les poumons »**

1 Stress

Pression transpulmonaire ($P_{voies\ aériennes}$ - P_{eso})
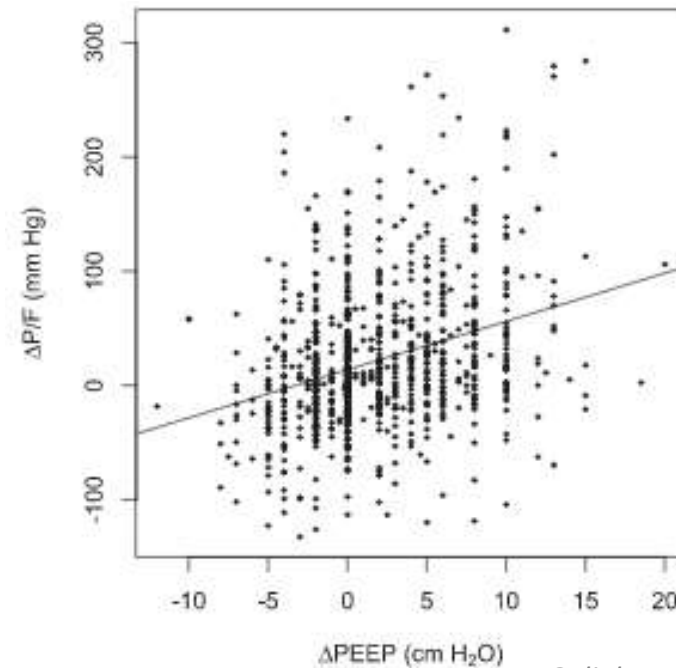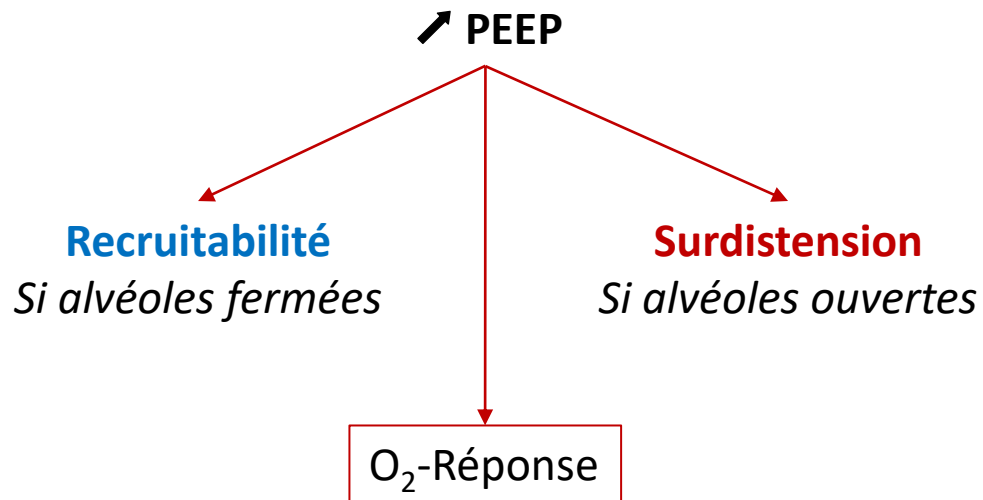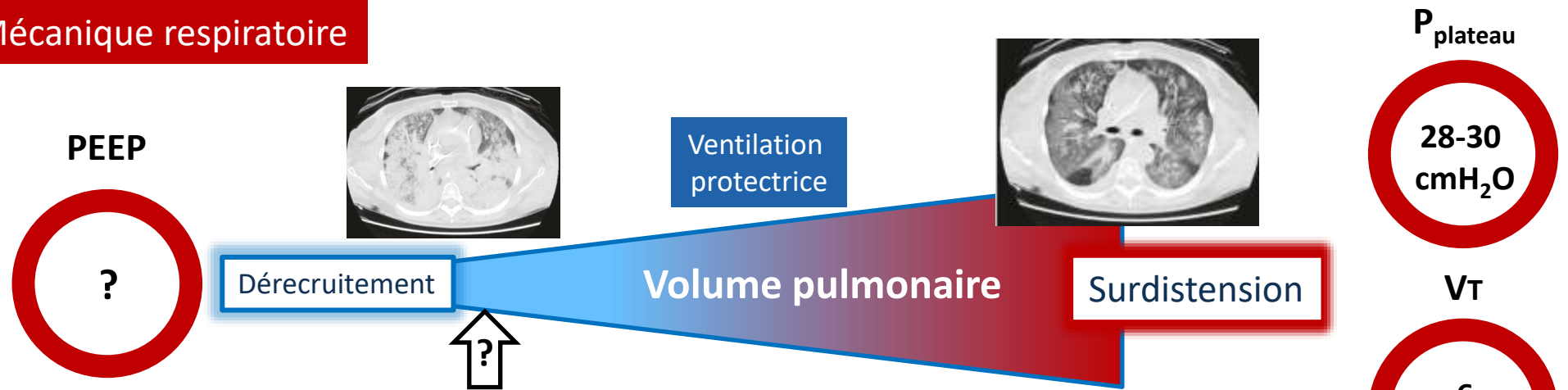
Flow

Airway pressure

esophageal pressure

Stress = Pression transpulmonaire (P$_L$) = Plateau - Peso

Strain = V$_T$/CRF *approché* par ΔP

Quelle stratégie au cours du SDRA?

Mécanique respiratoire

$P_{plateau}$

28-30 cmH₂O

PEEP

?

Dérecruitement

Ventilation protectrice

Volume pulmonaire

Surdistension

?

V_T

6 mL/kg

↗ **PEEP**

Recruitabilité
Si alvéoles fermées

O₂-Réponse

Surdistension
Si alvéoles ouvertes

Goligher et al. AJRCCM 2014

Stress et strain : application au cours du syndrome de détresse respiratoire aiguë

Stress and Strain in Acute Respiratory Distress Syndrome

L. Piquilloud · A. Mercat

Repos   insufflation