Que retenir de l'actualité en réanimation?

Ventilation du SDRA

Tài Pham

Professeur des Universités – Praticien Hospitalier

Médecine intensive – Réanimation, Hôpitaux universitaires Paris-Saclay, Hôpital de Bicêtre, France

Epidémiologie Respiratoire intégrative, INSERM U1018, Centre de Recherche en Epidémiologie et Santé des Populations

Conflit d’intérêt

- Co-PI: BEARDS study (NCT.03447288)
  - Academic Collaboration: BetterCare system, Sabadell, Spain*
    - Dr L. Blanch, J Montanya

- Comité exécutif des LUNG SAFE, WIND et WEAN SAFE

WORKSHOP

ATS Journals

A New Global Definition of Acute Respiratory Distress Syndrome

Michael A. Matthay[1,2,3], Yaseen Arabi[5], Alejandro C. Arroliga[6], Gordon Bernard[7], Andrew D. Bersten[9], Laurent J. Brochard[10], Carolyn S. Calfee[1,2,3], Alain Combes[11], Brian M. Daniel[4], Niall D. Ferguson[12,13], Michelle N. Gong[14], Jeffrey E. Gotts[15], Margaret S. Herridge[16], John G. Laffey[17], Kathleen D. Liu[1,2], Flavia R. Machado[18], Thomas R. Martin[19], Danny F. McAuley[20], Alain Mercat[21], Marc Moss[22], Richard A. Mularski[23], Antonio Pesenti[24,25], Haibo Qiu[26], Nagarajan Ramakrishnan[27], V. Marco Ranieri[28], Elisabeth D. Riviello[29], Eileen Rubin[30], Arthur S. Slutsky[10], B. Taylor Thompson[31], Theogene Twagirumugabe[32], Lorraine B. Ware[8], and Katherine D. Wick[33]

1. Oxygène Humidifié Haut Débit
2. SpO2/FiO2 < 315 (si SpO2 ≤ 97%)
3. Echographie pulmonaire
4. PEP optionnelle (ressources limitées)

Matthay MA et al. *AJRCCM* 2024

Plan

1. Mode ventilatoire
2. Volumes courants
3. Décubitus ventral
4. PEP/Recrutabilité

Intensive Care Med (2024) 50:1647–1656
https://doi.org/10.1007/s00134-024-07612-3

ORIGINAL

Pressure control plus spontaneous ventilation versus volume assist-control ventilation in acute respiratory distress syndrome. A randomised clinical trial

Jean-Christophe M. Richard[1,2*], François M. Beloncle[1], Gaëtan Béduneau[3], Satar Mortaza[1,4], Stephan Ehrmann[5], Jean-Luc Diehl[6], Gwenaël Prat[7], Samir Jaber[8], Hassene Rahmani[9], Jean Reignier[10], Thierry Boulain[11], Hodane Yonis[12], Jack Richecoeur[13], Arnaud W. Thille[14], Pierre-Louis Declercq[15], Emmanuel Antok[16], Guillaume Carteaux[17], Bruno Vielle[18], Laurent Brochard[19] and Alain Mercat[1] on behalf of the REVA network

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- 22 centres français
- Modéré ou sévère
- <48h

ReVA

VAC « *ExPress* »

VAC « *ExPress* »

« APRV »

PEEP↔

P_{high}*(1s) pour 6ml/kg & Pplat<28*

P_{low} *pour FR ↔*

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ReVA

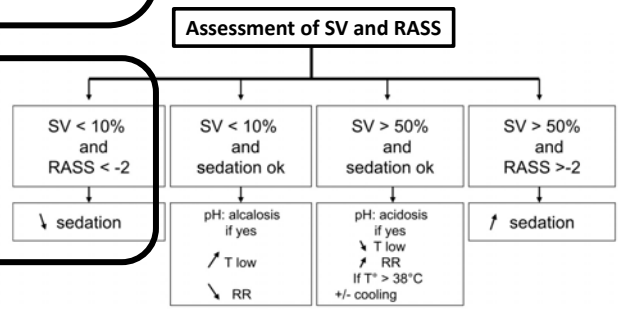
VAC
« *ExPress* »

« APRV »
PEEP↔
P_{high}*(1s) pour 6ml/kg & Pplat<28*
P_{low} *pour FR ↔*

24h

Puis arrêt curares et P_{low} pour FR=20/min
Diminution sédation pour *10-50% de VS*

Test de sevrage de PEP quotidien
si PF>150 mmHg



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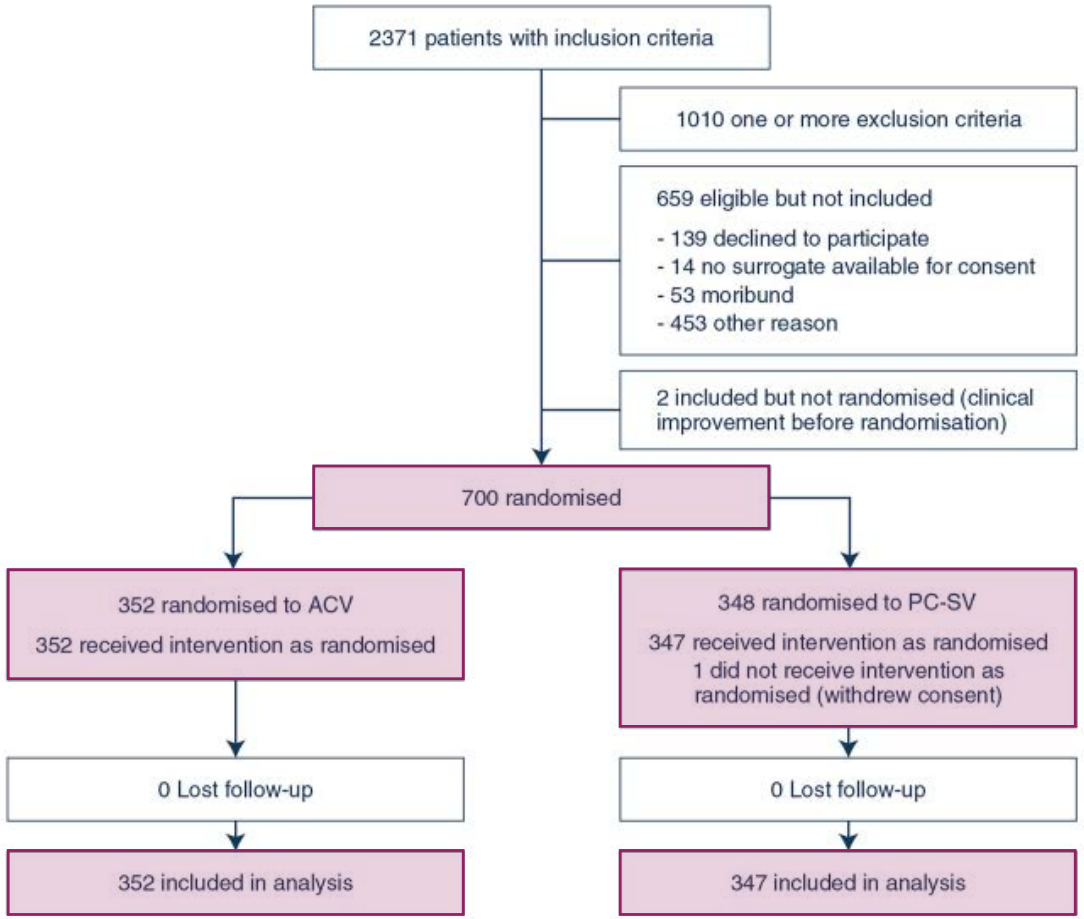

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Characteristic	PC-SV group (*N* = 347)	ACV group (*N* = 352)
Age (years)	62 ± 14	62 ± 15
Female sex	117 (34)	101 (29)
SAPS II score[a]	50 ± 16	48 ± 15
SOFA score[b]	9.7 ± 3.4	9.4 ± 3.5
Time since onset of ARDS (h)	17.8 ± 15.2	17.6 ± 17.1
Tidal volume (mL/kg predicted body weight)	6.4 ± 0.8	6.4 ± 1
Minute ventilation (L/min)	11.0 ± 2.4	11.2 ± 2.5
Respiratory rate (breaths/min)	27.5 ± 5.3	27.3 ± 5
PEEP (cmH_2O)	10.5 ± 4.1	10.5 ± 3.9
Plateau pressure (cmH_2O)	23.3 ± 4.6	24.0 ± 4.8
Driving pressure (cmH_2O)[c]	12.8 ± 3.6	13.5 ± 4.2
Respiratory-system compliance (mL/cmH_2O)[d]	34.1 ± 10.8	33.3 ± 11.9
PaO_2/FiO_2 (mmHg)	136 ± 39	132 ± 43
Cause of lung injury (%)		
Pneumonia	228 (66)	248 (71)
Aspiration	54 (16)	49 (14)
Intraabdominal sepsis	10 (3)	9 (3)
Other sepsis	9 (3)	10 (3)
Acute pancreatitis	18 (5)	9 (3)
Other	28 (8)	26 (7)

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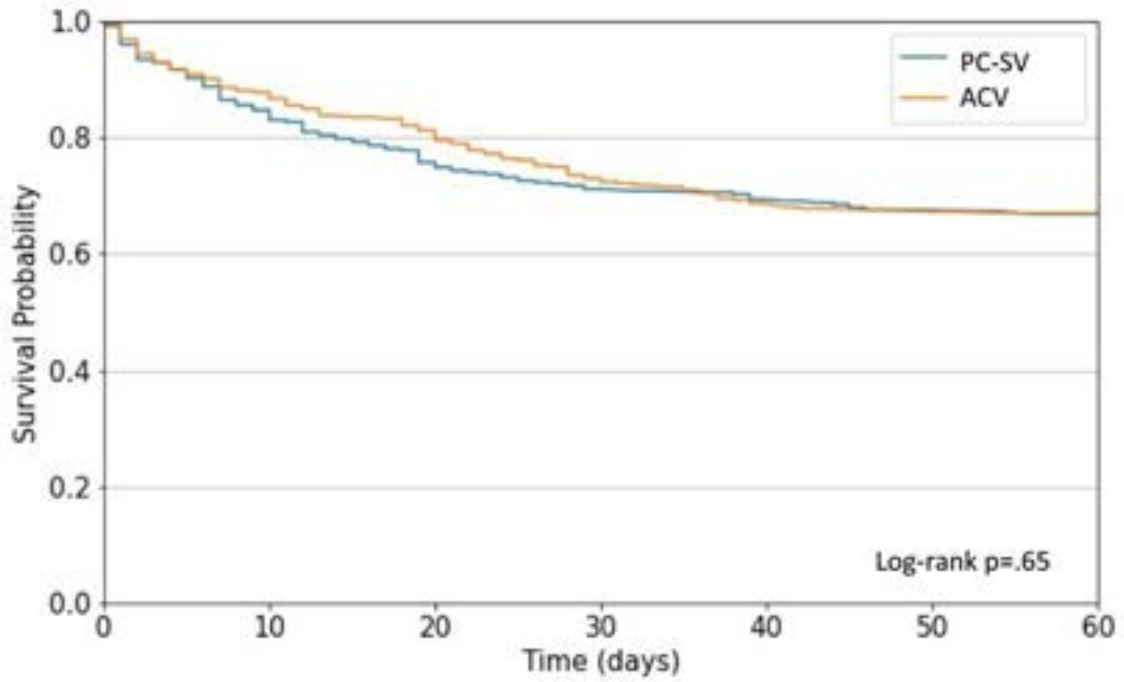
Mortalité: 34.6% (APRV) vs 33.5% (VAC): *p*=0.77; RR=1.03 (0.84–1.27)



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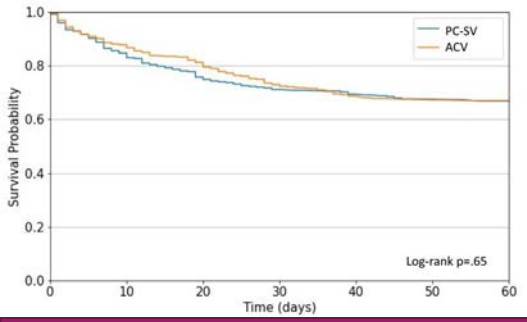
ReVA

Moins de recours au DV dans le groupe APRV: 29% vs. 38%, P=0,03

Moins de sédatifs, opiacés et curares à J7 dans le groupe APRV



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- COVID
- PaO_2/FIO_2<150mmHg
- VT<6mL/kg
- Sédation

VAC

Table PEP/FiO2

pH=7,20-7,45

VAC

6ml/kg

VAC

4ml/kg

FR jusqu'à 35 pour $V_{min.}$

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VAC

6ml/kg

VAC

4ml/kg

FR jusqu'à 35 pour $V_{min.}$

PaO_2/FIO_2>150mmHg

Epreuve de diminution de la sédation

PEP=5 cmH_2O, FiO_2=0,5 et VT=6mL/kg

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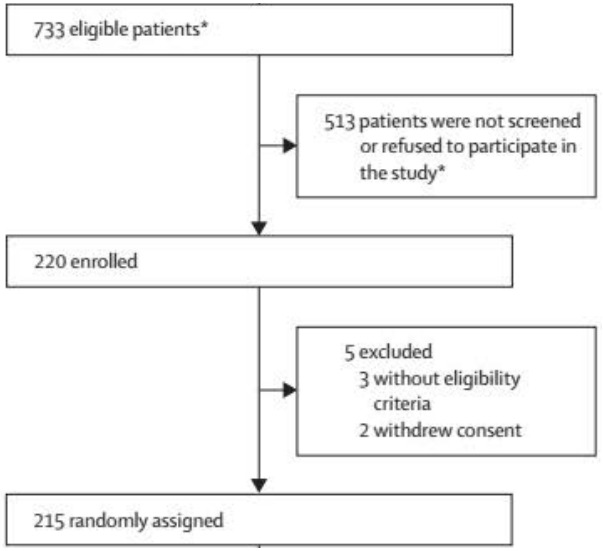

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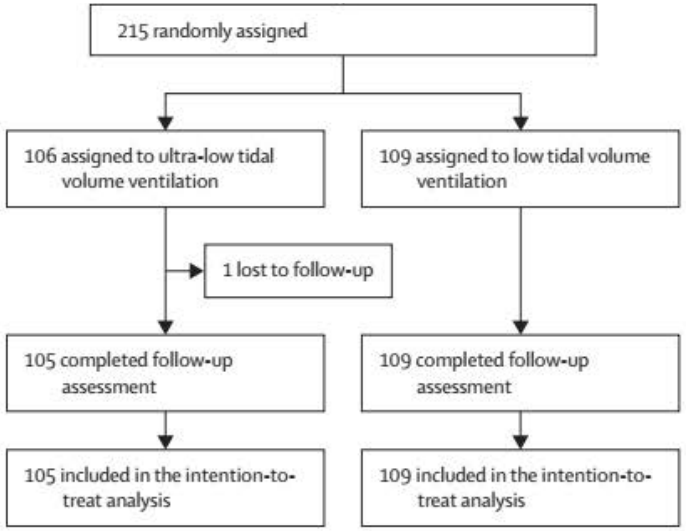

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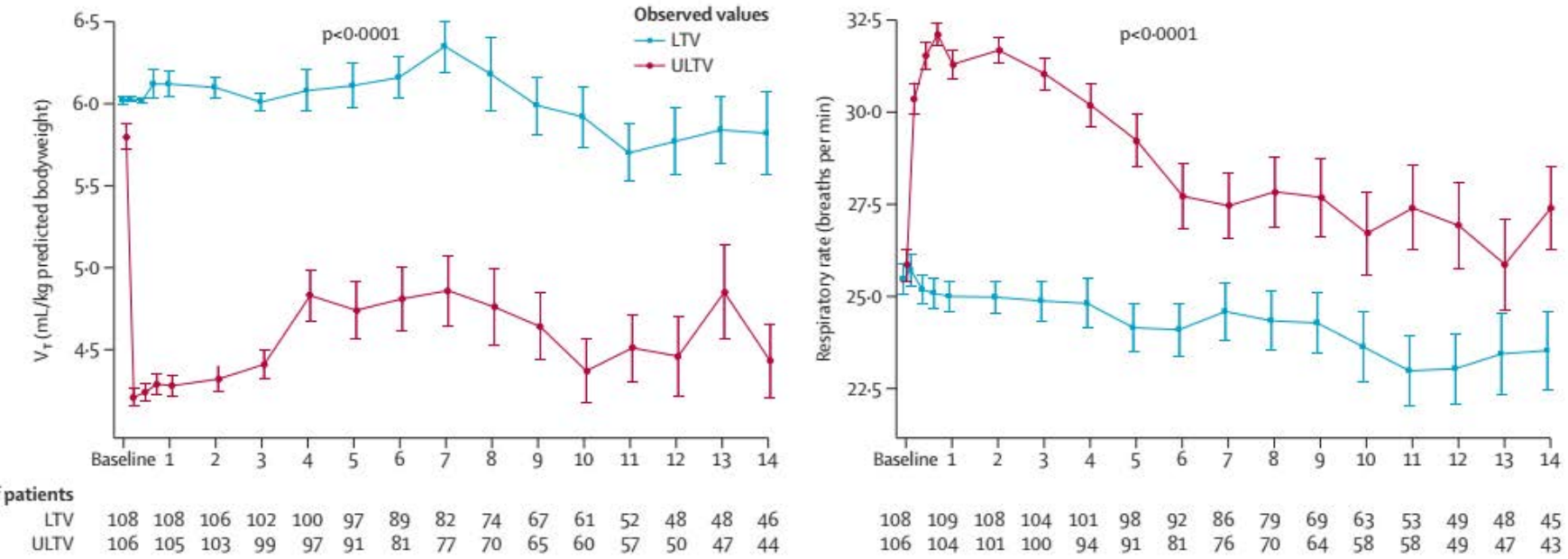

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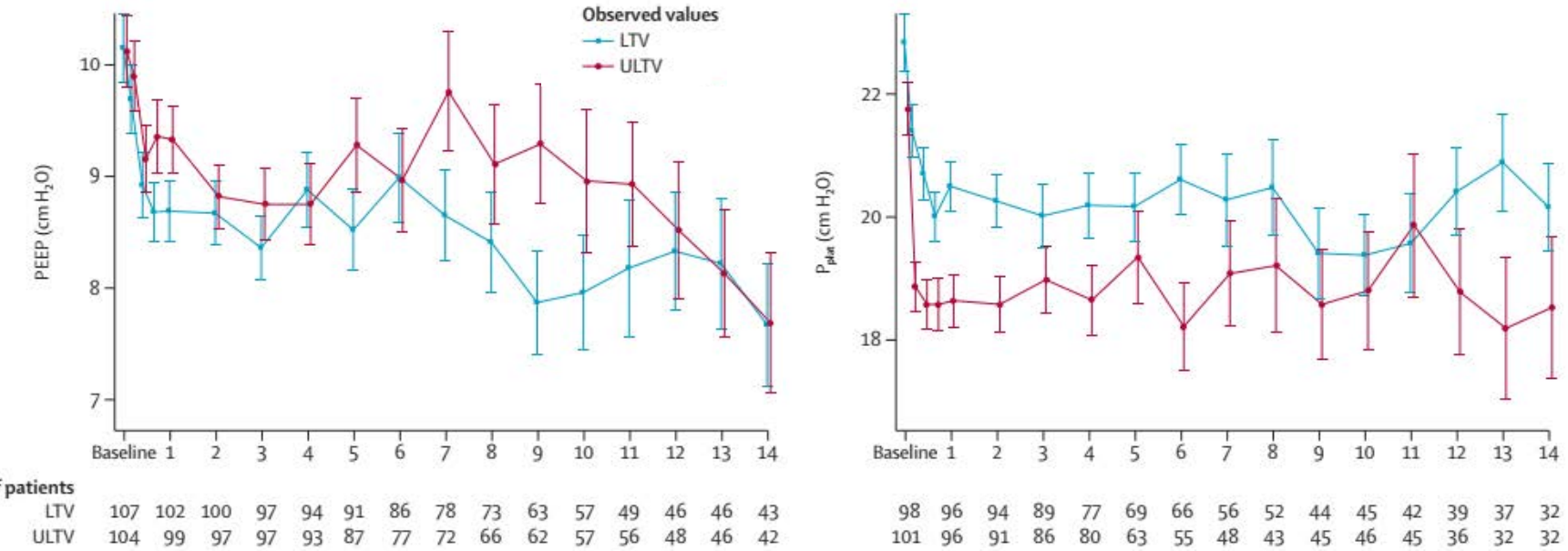

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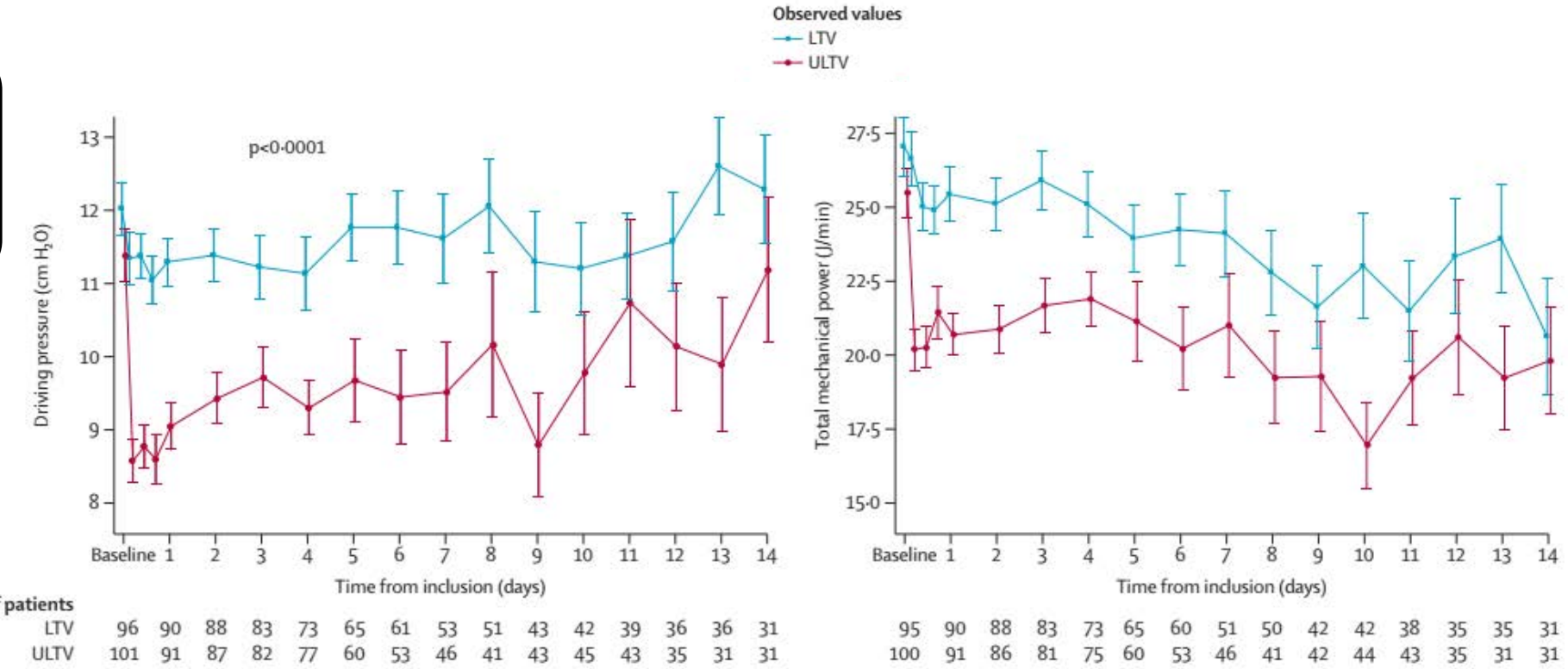

Richard JC et al. *Lancet Respir Med* 2023

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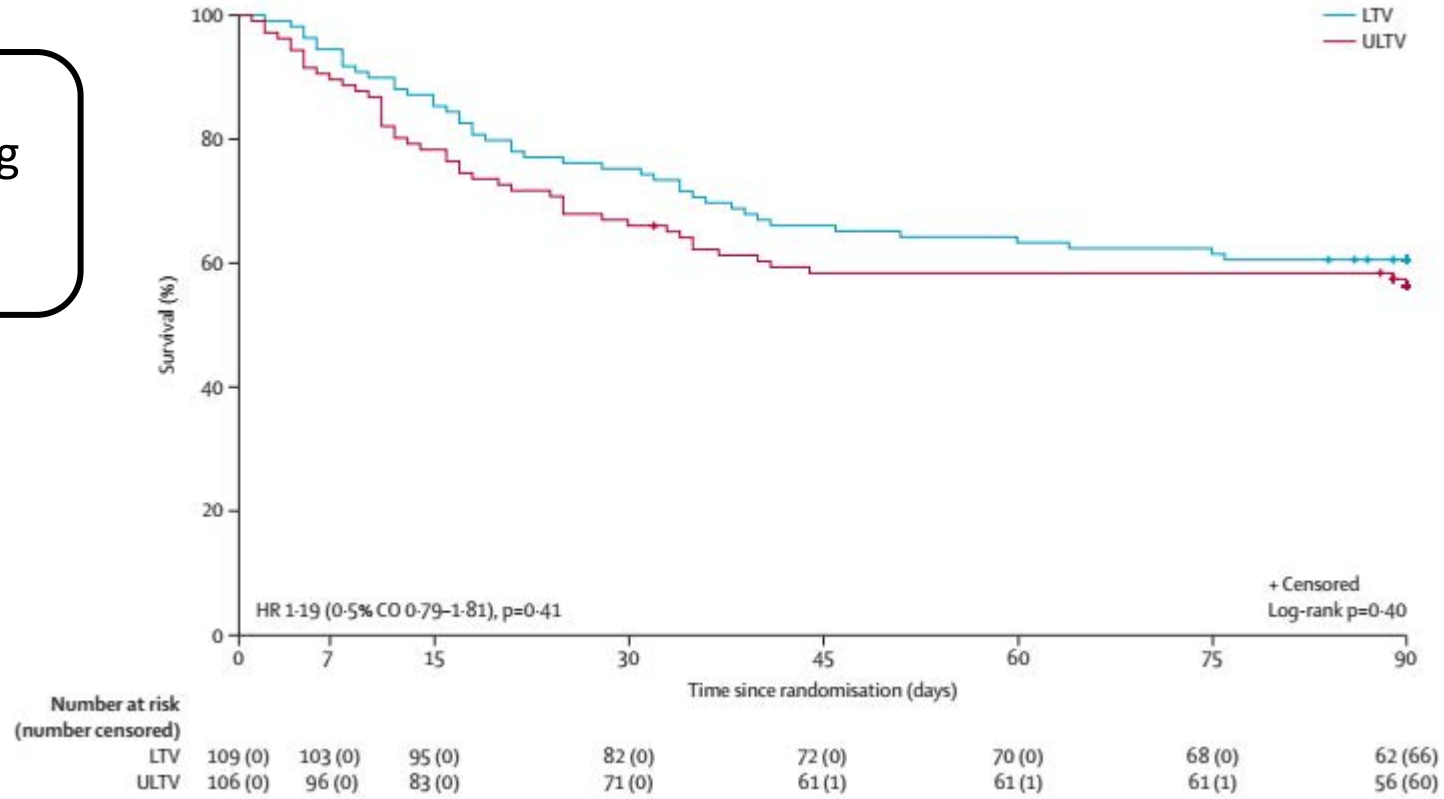

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	ULTV group (n=106)	LTV group (n=109)	Absolute difference (95% CI)	p value*
Primary outcome				
Unmatched win ratio (95% CI)†	0·85 (0·60 to 1·19)	NA‡	NA‡	0·38
Secondary outcomes				
90-day all-cause mortality	46/105 (44%)	43/109 (39%)	4% (−9% to 18%)	0·52
Ventilator-free days at day 60, days	7 (0 to 45)	31 (0 to 48)	0 (−2 to 0)§	0·30
Time from inclusion to successful extubation, days	18 (9 to 31)	15 (9 to 28)	1 (−6 to 3)§	0·49
Length of hospital stay from inclusion, days	41·5 (19 to 81)	35·5 (22 to 62)	3 (−6 to 16)§	0·49
90-day hospital costs, €	34 411 (29 839)	32 139 (24 835)	2417 (−6744 to 11 894)	NA¶
Safety outcomes				
Use of ARDS adjunct therapies‖	104 (98%)	108 (99%)	−1% (−4 to 2)	0·55
Number of ARDS adjunct therapies per patient‖	8 (4 to 12)	8 (5 to 12)	0 (−1 to 1)§	0·90
Severe respiratory acidosis**	35 (33%)	14 (13%)	20% (9 to 31)	0·0004
Ventilator-associated pneumonia**	74 (70%)	76 (70%)	0 (−12 to 12)	0·99
Acute cor pulmonale**	2 (2%)	4 (4%)	−2% (−6 to 3)	0·43
Barotrauma**	8 (8%)	9 (8%)	−1% (−8 to 7)	0·85
Any serious adverse events**	65 (61%)	56 (51%)	10% (−3 to 23)	0·14

Richard JC et al. *Lancet Respir Med* 2023


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- COVID
- PaO_2/FIO_2<150mmHg
- VT<6mL/kg
- Sédation

- Stratégie « ULTV »
  - Applicable chez 63% des patients
  - Sofa rénal≥2: win ratio= 0,18 [0,09-0,84]

Pas de différence (mortalité et jours sans ventilation)
Pas de bénéfice à l'utilisation systématique

Intensive Care Med (2021) 47:1044–1046
https://doi.org/10.1007/s00134-021-06466-3

LETTER

Differential effects of prone position in COVID-19-related ARDS in low and high recruiters

Martin Cour[1,2*], David Bussy[1,2], Neven Stevic[1,2], Laurent Argaud[1,2] and Claude Guérin[1,2]

- 18 patients
- SDRA COVID
- Decubitus ventral

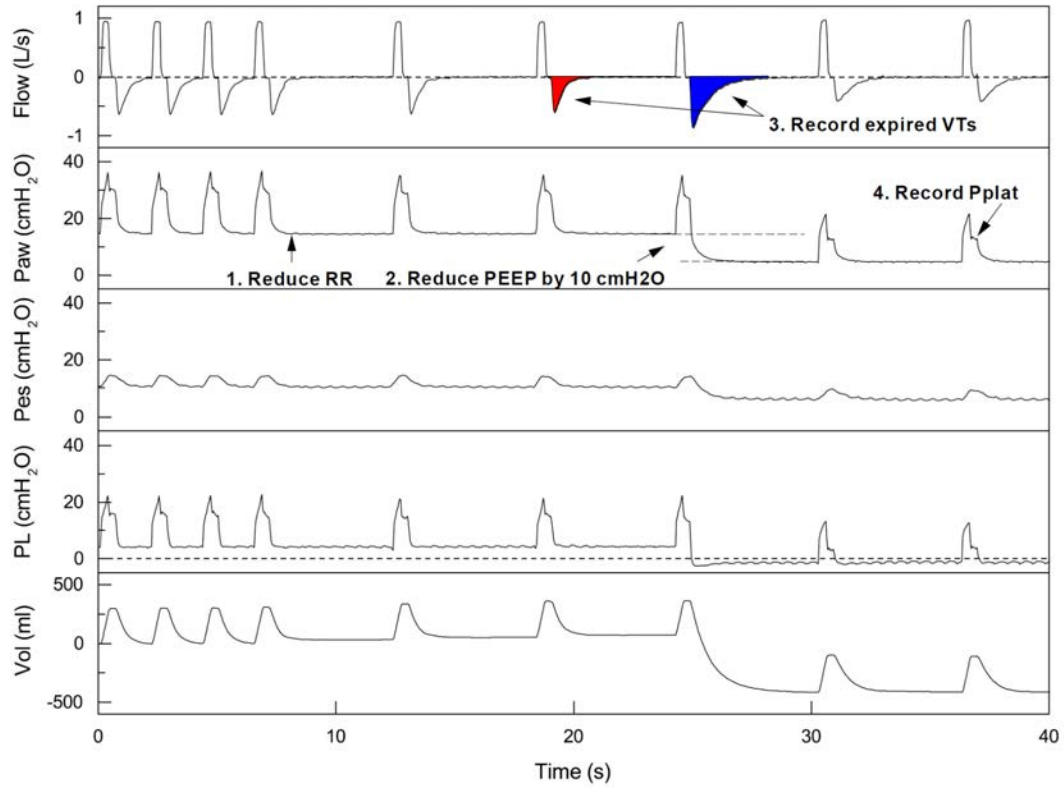
Haut vs. bas recruteurs
→ **R/I**

ORIGINAL ARTICLE

Potential for Lung Recruitment Estimated by the Recruitment-to-Inflation Ratio in Acute Respiratory Distress Syndrome

A Clinical Trial

Lu Chen[1,2,3], Lorenzo Del Sorbo[3,4], Domenico L. Grieco[5], Detajin Junhasavasdikul[6], Nuttapol Rittayamai[7], Ibrahim Soliman[8], Michael C. Sklar[3], Michela Rauseo[9], Niall D. Ferguson[3,4], Eddy Fan[3,4], Jean-Christophe M. Richard[10], and Laurent Brochard[1,2,3]*



Chen L et al. *Am J Respir Crit Care Med* 2020

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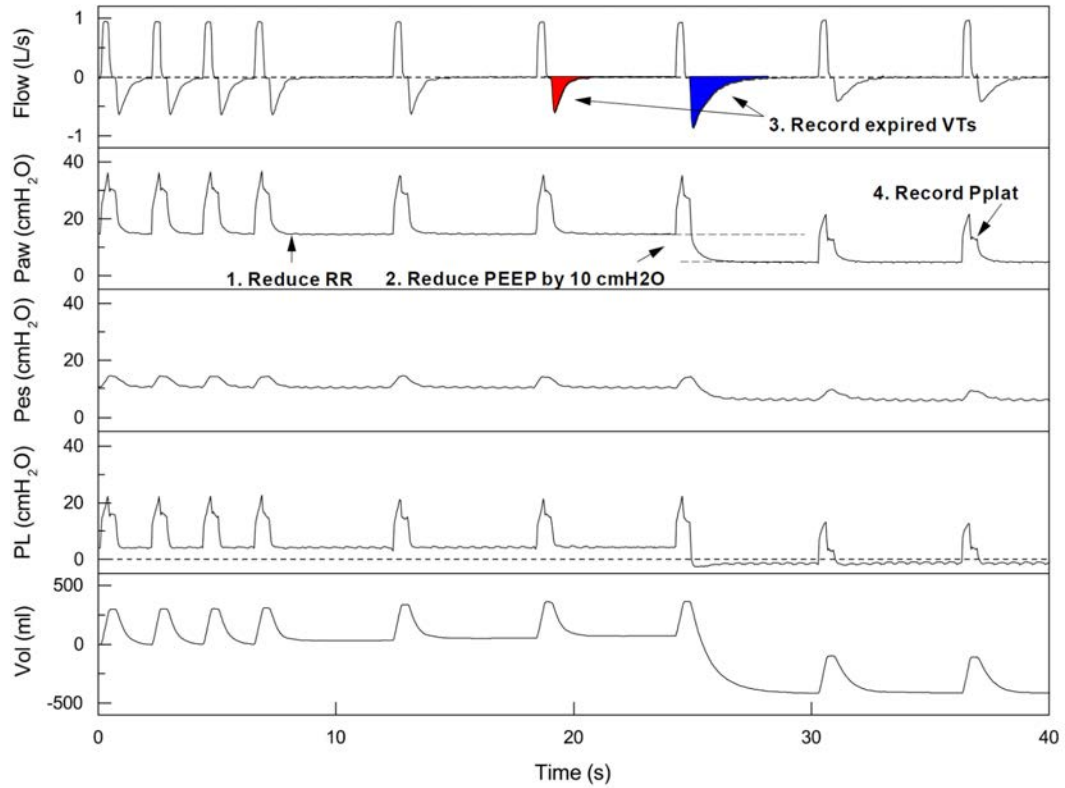
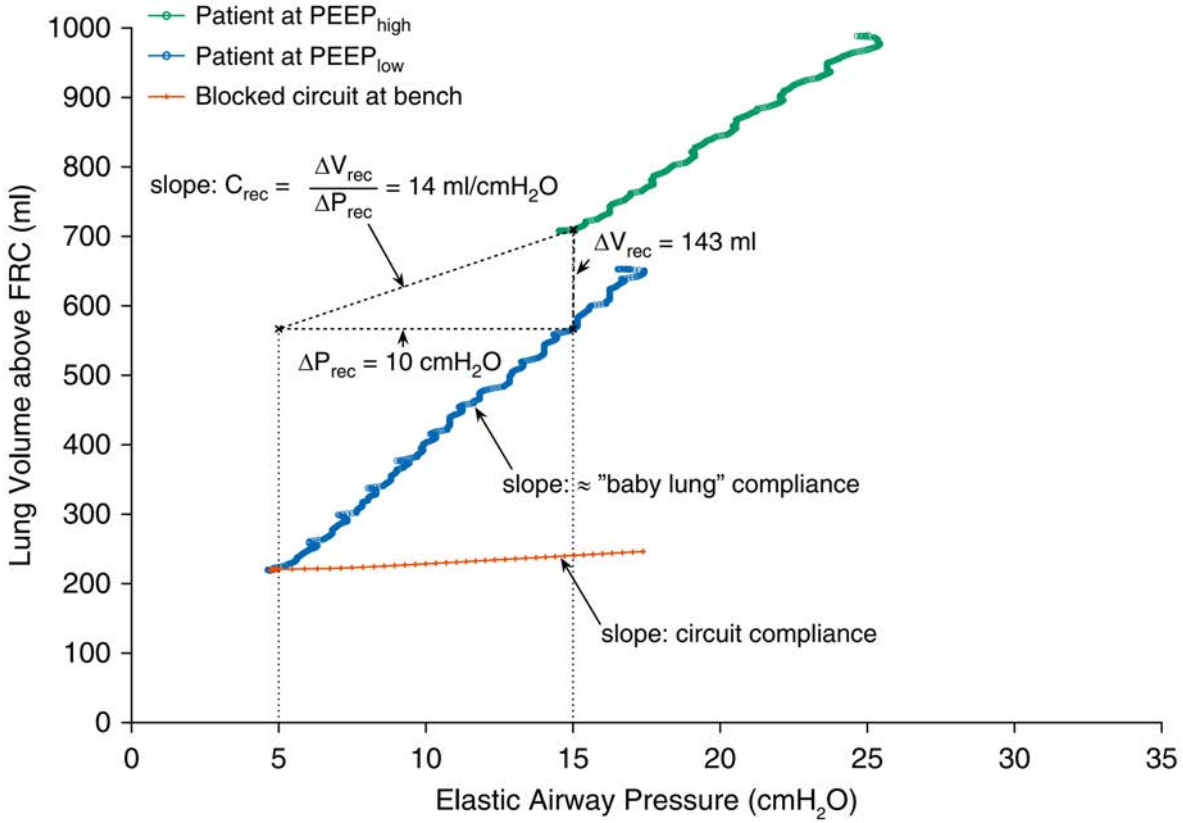
$$R/I = \frac{C_{rec}}{C_{baby\ lung}}$$





Chen L et al. *Am J Respir Crit Care Med* 2020

Intensive Care Med (2021) 47:1044–1046
https://doi.org/10.1007/s00134-021-06466-3

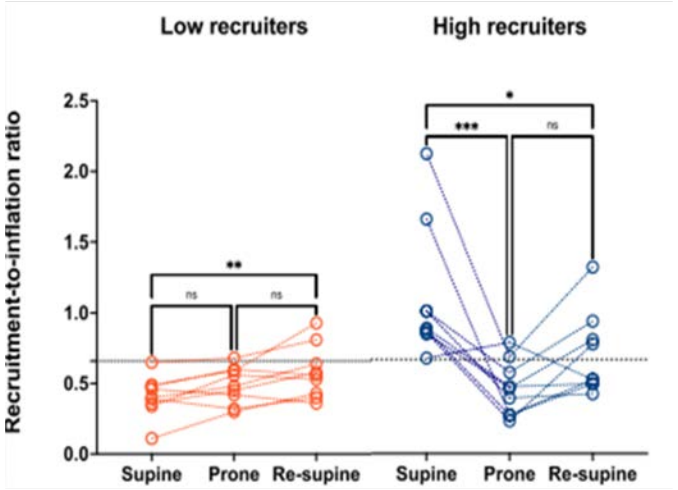
LETTER

Differential effects of prone position in COVID-19-related ARDS in low and high recruiters

Martin Cour[1,2*], David Bussy[1,2], Neven Stevic[1,2], Laurent Argaud[1,2] and Claude Guérin[1,2]

- 18 patients
- SDRA COVID
- Decubitus ventral

R/I médian: 0,66
[0,40;0,91]



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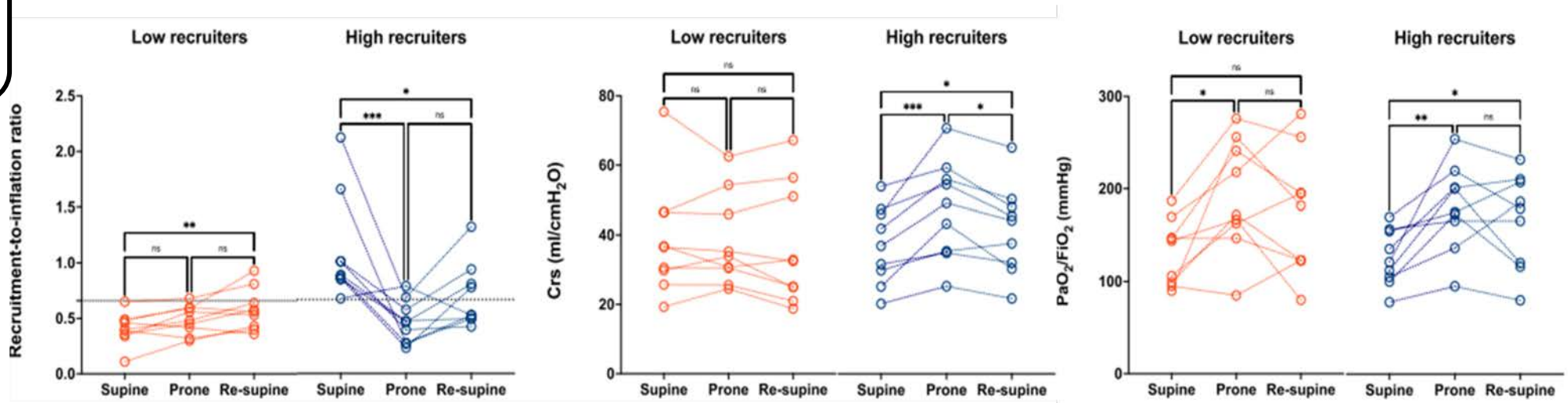


Lai et al. Annals of Intensive Care (2024) 14:146
https://doi.org/10.1186/s13613-024-01375-2

Annals of Intensive Care

RESEARCH Open Access

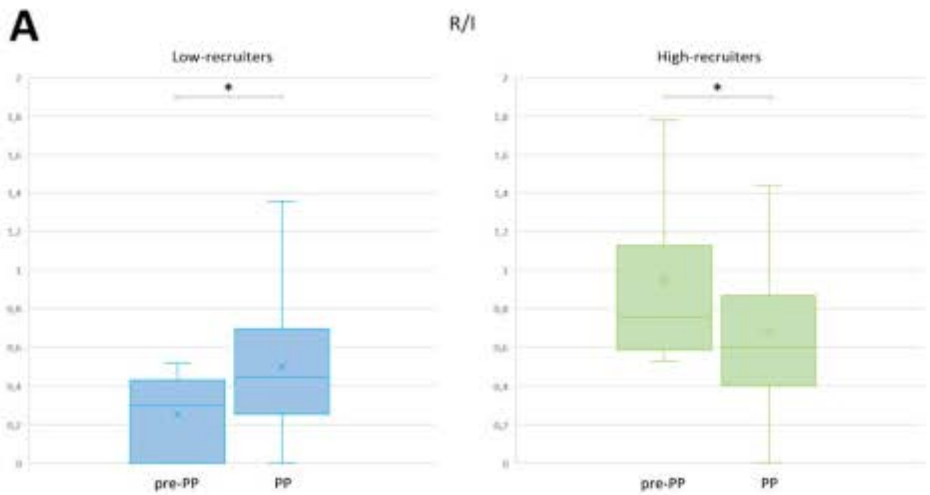
Respiratory effects of prone position in COVID-19 acute respiratory distress syndrome differ according to the recruitment-to-inflation ratio: a prospective observational study

Christopher Lai[1,2*], Rui Shi[1,2], Ludwig Jelinski[1], Florian Lardet[1], Marta Fasan[1,3], Soufia Ayed[1], Hugo Belotti[1], Nicolas Biard[1], Laurent Guérin[1], Nicolas Fage[1], Quentin Fossé[1], Thibaut Gobé[1], Arthur Pavot[1], Guillaume Roger[1], Alex Yhuel[1], Jean-Louis Teboul[1,2], Tai Pham[1,4], Xavier Monnet[1,2]for the EVALPRO Study group

50 patients
COVID
Decubitus ventral

201 sessions
3 [2-6] par patient

R/I médian: 0,53 [0,31;0,79]



R/I
- ↗ chez les faibles recruteurs
- ↘chez les hauts recruteurs

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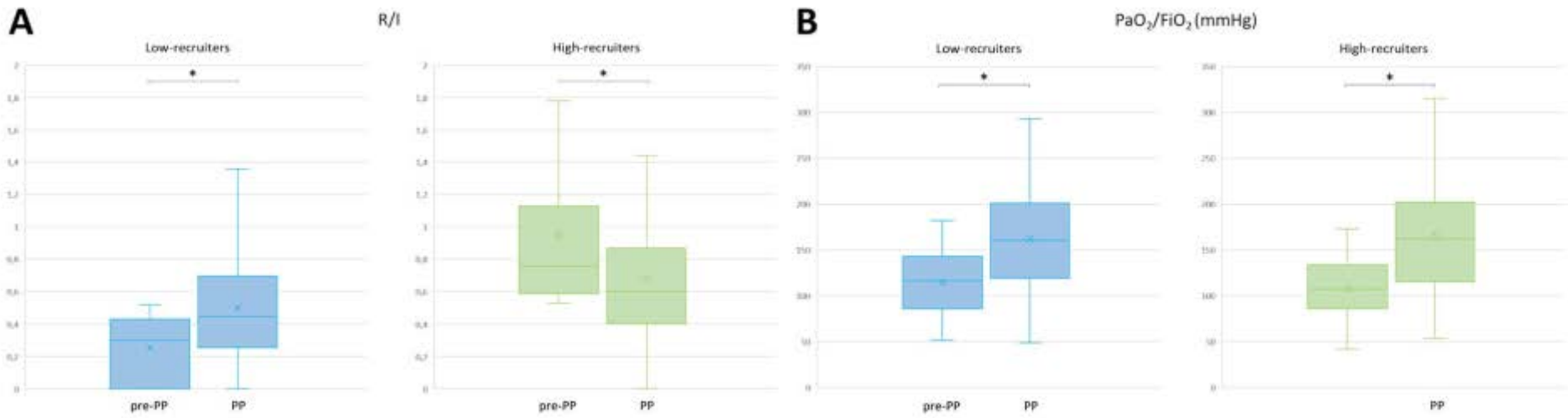

R/I
- ↗ chez les faibles recruteurs
- ↘chez les hauts recruteurs

PaO_2/FIO_2
- ↗ chez les tous

Lai et al. Annals of Intensive Care (2024) 14:146
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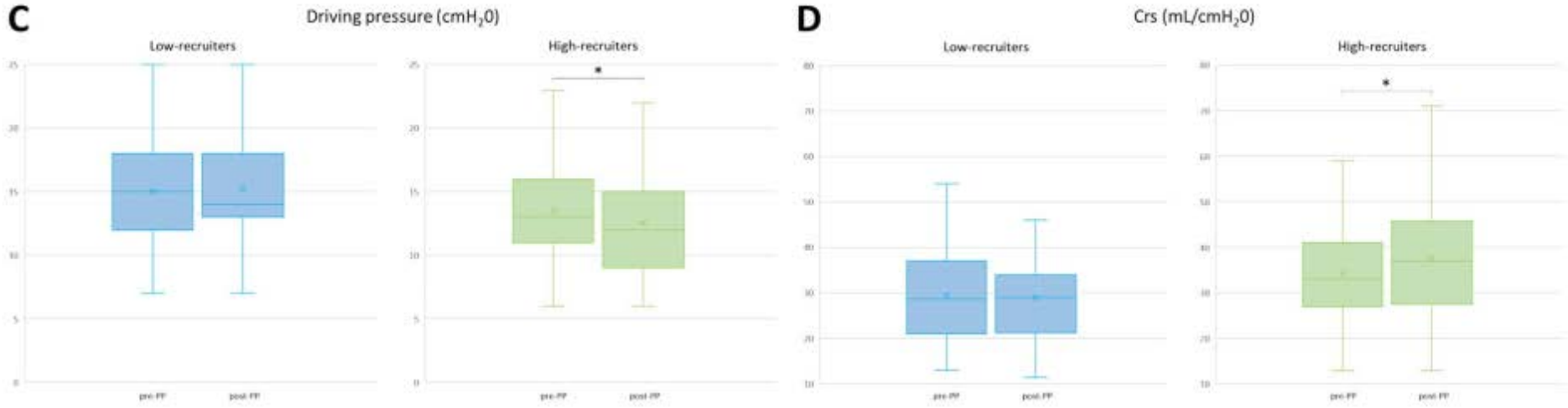

Pression motrice
- ↔ chez les faibles recruteurs
- ↘chez les hauts recruteurs

Compliance
- ↔ chez les faibles recruteurs
- ↗chez les hauts recruteurs

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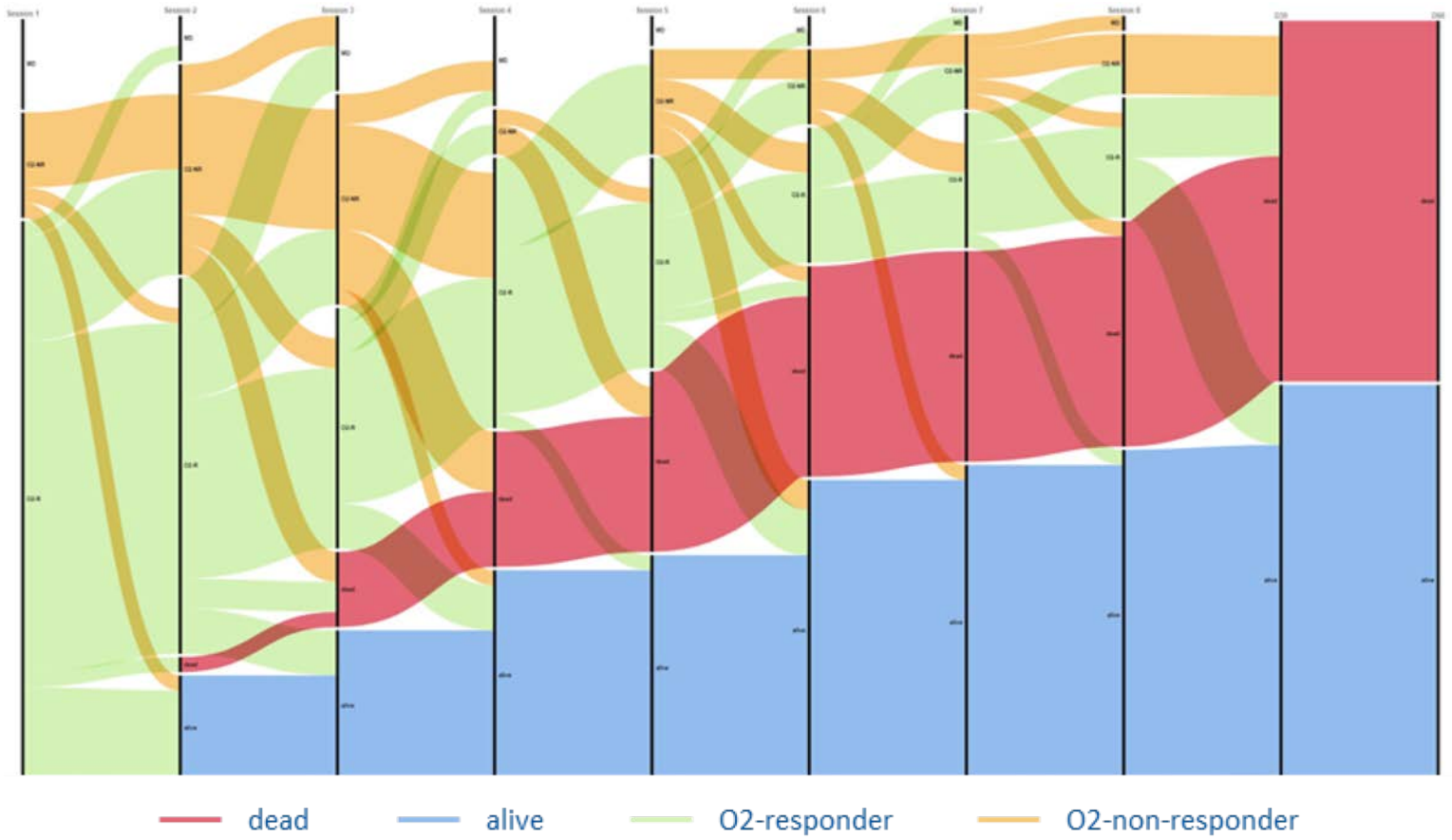

Réponse au DV
Varie d'une séance à l'autre

Scaramuzzo et al. Critical Care (2024) 28:377
https://doi.org/10.1186/s13054-024-05173-x

Critical Care

REVIEW Open Access

Electrical impedance tomography monitoring in adult ICU patients: state-of-the-art, recommendations for standardized acquisition, processing, and clinical use, and future directions

Gaetano Scaramuzzo[1], Bertrand Pavlovsky[2], Andy Adler[3], Walter Baccinelli[4], Dani L. Bodor[4], L. Felipe Damiani[5], Guillaume Franchineau[6], Juliette Francovich[7], Inéz Frerichs[8], Juan A. Sánchez Giralt[9], Bartłomiej Grychtol[3], Huaiwu He[10], Bhushan H. Katira[11], Alette A. Koopman[12], Steffen Leonhardt[13], Luca S. Menga[14], Amne Mousa[15], Mariangela Pellegrini[16], Thomas Piraino[17], Paolo Priani[1], Peter Somhorst[7], Elena Spinelli[18], Claas Händel[8], Fernando Suárez-Sipmann[9,19], Jantine J. Wisse[7], Tobias Becher[8] and Annemijn H. Jonkman[7,20*]

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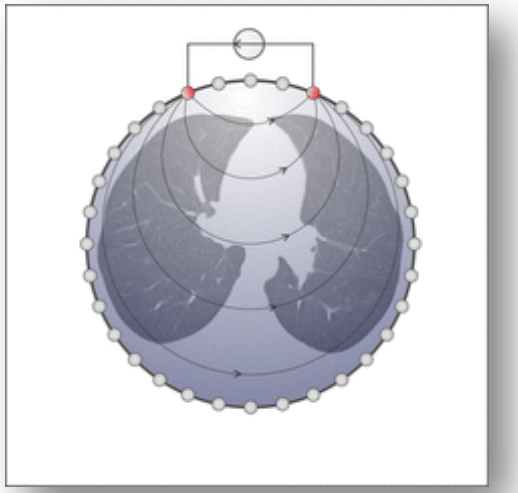

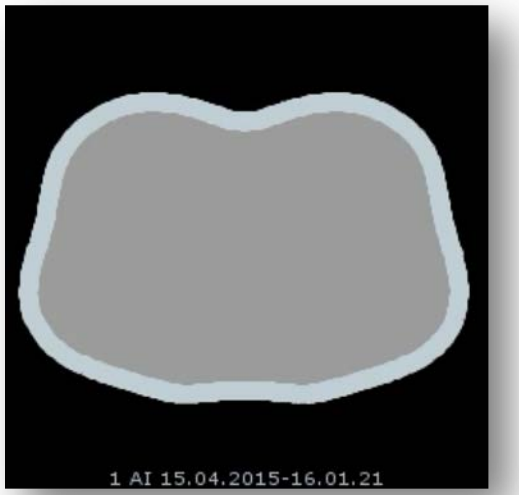

- Visualisation de la ventilation ±perfusion
  - Non-invasif
  - Peu/pas de complication
  - Validé
- Changements au cours du temps
- Physiologie au lit du patient
- Réponse au traitement (PEP, DV)

Scaramuzzo et al. Critical Care (2024) 28:377
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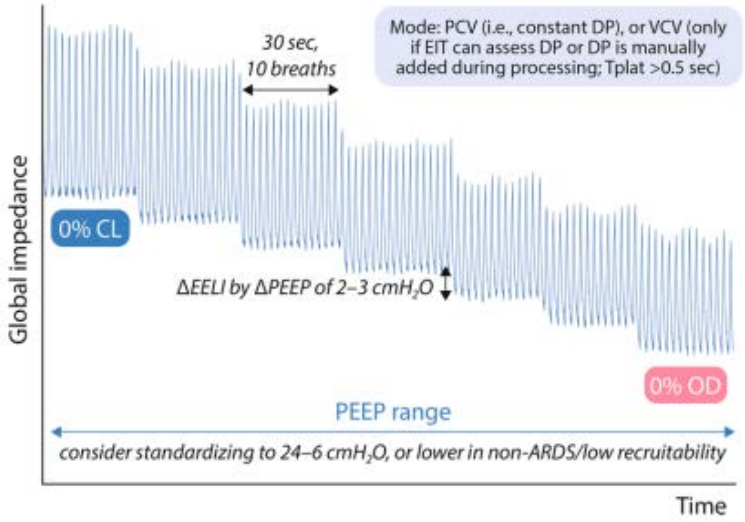
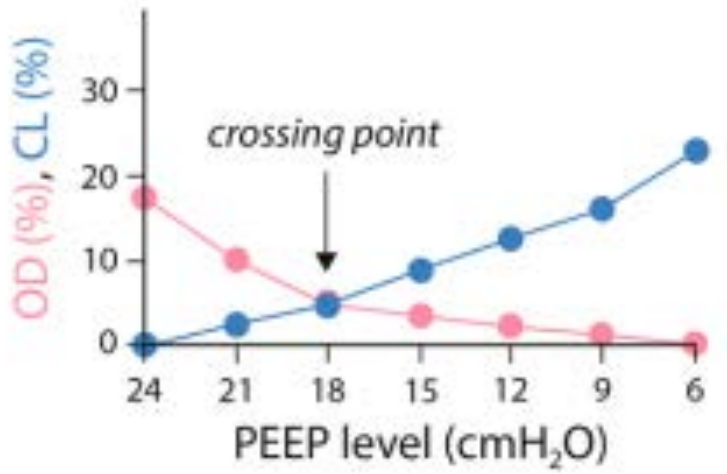




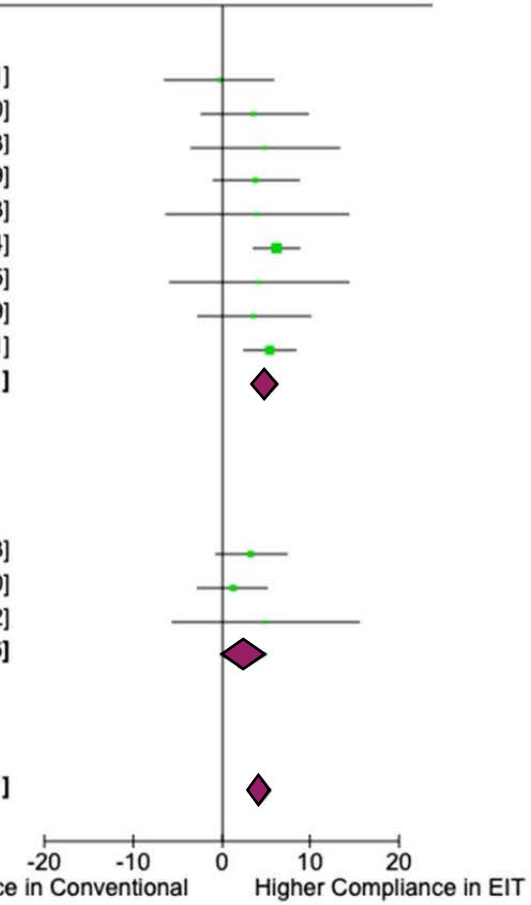
Intensive Care Med (2024) 50:617–631
https://doi.org/10.1007/s00134-024-07362-2

SYSTEMATIC REVIEW

Electrical impedance tomography-guided positive end-expiratory pressure titration in ARDS: a systematic review and meta-analysis

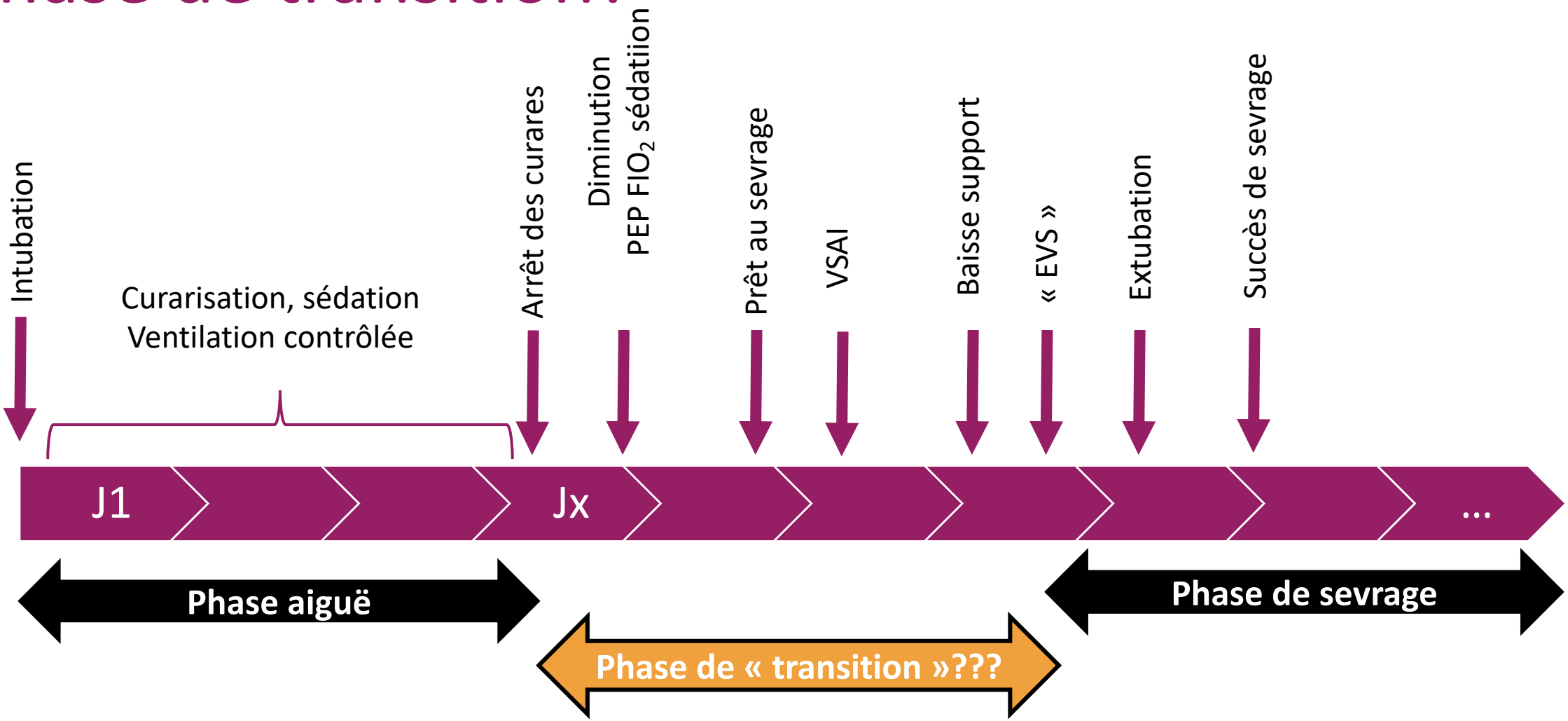
Nickjaree Songsangvorn[1,2], Yonghao Xu[1,3*], Cong Lu[1], Ori Rotstein[1,4], Laurent Brochard[1,5], Arthur S. Slutsky[1,5], Karen E. A. Burns[1,5] and Haibo Zhang[1,5,6,7*]

Study or Subgroup	EIT Mean	EIT SD	EIT Total	Conventional Mean	Conventional SD	Conventional Total	Weight	Mean difference IV, Random, 95% CI
5.1.1 NRS								
Becher 2021	37.9	11.4	20	38.2	8.8	20	4.8%	-0.30 [-6.61 , 6.01]
Di Pierro 2022	27.67	14.7	31	23.96	9.64	31	5.0%	3.71 [-2.48 , 9.90]
Eronia 2017	49.5	12	14	44.6	11	14	2.6%	4.90 [-3.63 , 13.43]
Gibot 2021	39	8.15	17	35.11	11.49	51	7.7%	3.89 [-1.11 , 8.89]
Heines 2019	49	24	39	45	23	39	1.8%	4.00 [-6.43 , 14.43]
Jonkman 2023	34.46	10.84	108	28.2	9.19	108	26.7%	6.26 [3.58 , 8.94]
Liu 2022	42.61	13.77	14	38.39	13.86	14	1.8%	4.22 [-6.01 , 14.45]
Somhorst 2022	49.33	21.48	75	45.67	19.26	75	4.5%	3.66 [-2.87 , 10.19]
Zhao 2019	25.9	5.9	24	20.4	5.3	31	21.2%	5.50 [2.49 , 8.51]
Subtotal (95% CI)			**342**			**383**	**76.0%**	**4.92 [3.34 , 6.51]**
Heterogeneity: Tau² = 0.00; Chi² = 4.23, df = 8 (P = 0.84); I² = 0%								
Test for overall effect: Z = 6.08 (P < 0.00001)								
5.1.2 RCT								
He 2021	33.67	13.33	61	30.33	9.63	56	10.9%	3.34 [-0.85 , 7.53]
Hsu 2021	33.7	7.6	42	32.5	11.6	45	11.4%	1.20 [-2.90 , 5.30]
Jimenez 2023	39.56	10.91	6	34.62	7.68	6	1.7%	4.94 [-5.74 , 15.62]
Subtotal (95% CI)			**109**			**107**	**24.0%**	**2.43 [-0.39 , 5.26]**
Heterogeneity: Tau² = 0.00; Chi² = 0.74, df = 2 (P = 0.69); I² = 0%								
Test for overall effect: Z = 1.69 (P = 0.09)								
Total (95% CI)			**451**			**490**	**100.0%**	**4.33 [2.94 , 5.71]**
Heterogeneity: Tau² = 0.00; Chi² = 7.24, df = 11 (P = 0.78); I² = 0%								
Test for overall effect: Z = 6.13 (P < 0.00001)								



Diminution de la mortalité à partir de 3 études RR: 0,64 [0,45;0,91], P=0,01

Phase de transition?

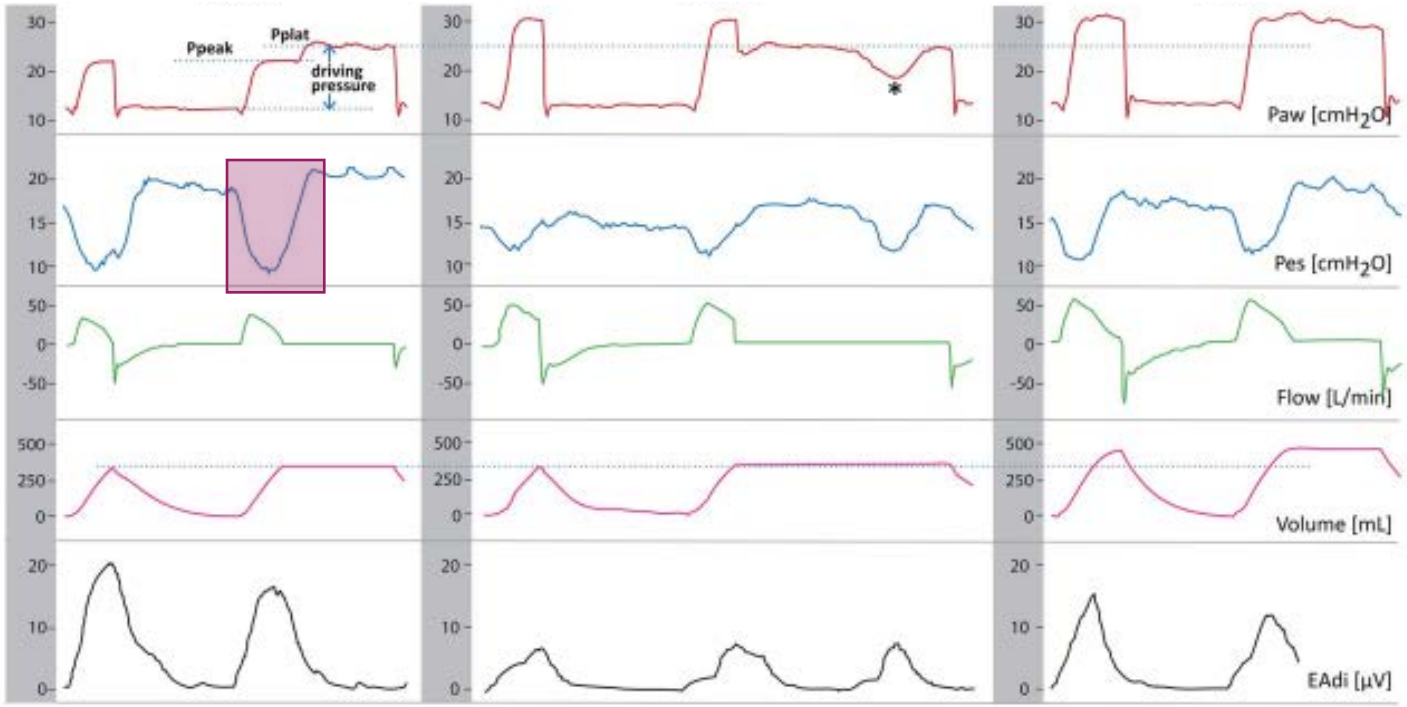


Intensive Care Med
https://doi.org/10.1007/s00134-018-5311-9

IMAGING IN INTENSIVE CARE MEDICINE

Plateau and driving pressure in the presence of spontaneous breathing

Giacomo Bellani[1,2*], Alice Grassi[1], Simone Sosio[1] and Giuseppe Foti[1,2]



Slobod et al. Critical Care (2022) 26:314
https://doi.org/10.1186/s13054-022-04198-4

Critical Care

BRIEF REPORT Open Access

Integrating electrical impedance tomography and transpulmonary pressure monitoring to personalize PEEP in hypoxemic patients undergoing pressure support ventilation

Douglas Slobod[1,2], Marco Leali[3], Elena Spinelli[1], Domenico Luca Grieco[4], Savino Spadaro[5] and Tommaso Mauri[1,3*]

Titration décrémentale
- Dépend de Pression Motrice

En VS:
- Pas directement évaluable
- Intégration P_{lung} à la place $P_{motrice}$

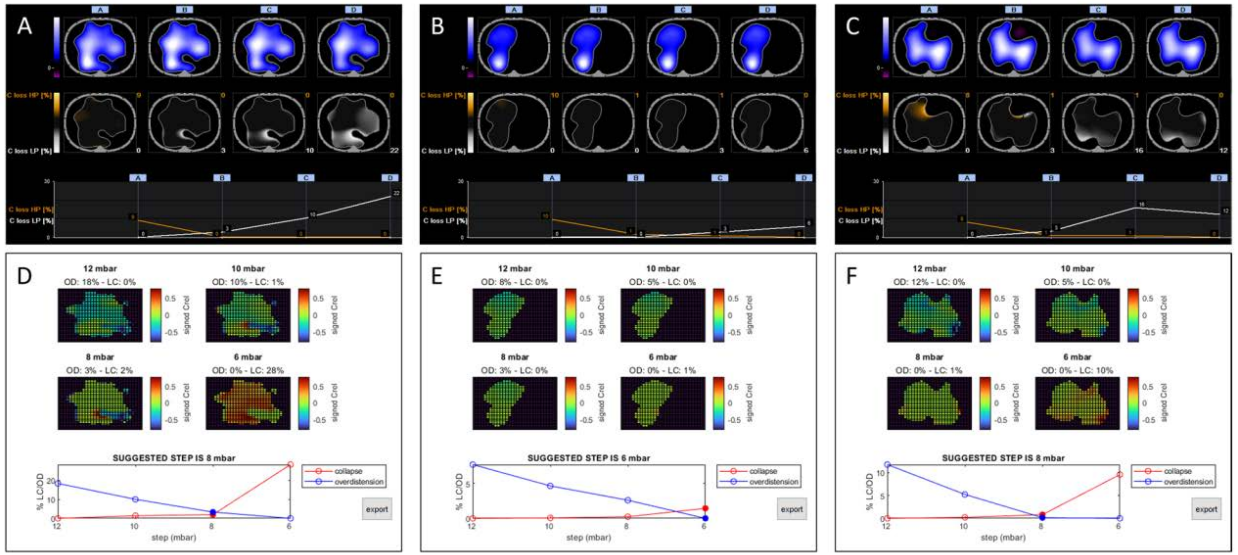


Fig. 1 Decremental PEEP trial performed with the conventional and experimental approach. Results from a decremental PEEP trial performed during pressure support ventilation in patients 1, 2, and 3 using the conventional approach that assumes a fixed airway driving pressure (Panels A, B, and C) and the experimental approach that uses the measured dynamic transpulmonary driving pressure (Panels D, E, and F). Regional compliance maps and the percentage of overdistension and collapse are plotted against PEEP steps for both approaches. *PEEP* Positive end-expiratory pressure

$$C_L,\ px = \Delta Z\ \text{tidal}, px / \Delta P_{Ldyn}$$

Chaque pixel: Variation d'impédance normalisée par Plung dyn

Intensive Care Med
https://doi.org/10.1007/s00134-024-07695-y

ORIGINAL

Personalized positive end-expiratory pressure in spontaneously breathing patients with acute respiratory distress syndrome by simultaneous electrical impedance tomography and transpulmonary pressure monitoring: a randomized crossover trial

Tommaso Mauri[1,2*], Domenico L. Grieco[3,4], Elena Spinelli[2], Marco Leali[1], Joaquin Perez[5,6], Valentina Chiavieri[1], Tommaso Rosà[3,4], Pierluigi Ferrara[7,8], Gaetano Scaramuzzo[7], Massimo Antonelli[3,4], Savino Spadaro[7,8] and Giacomo Grasselli[1,2]

3 centres
18 patients
VSAI
Peso et EIT

Titration décrémentale de PEEP
- PEP 18 à 4 cmH_2O
- Paliers de 2 cmH_2O et 2 min

PEP clinique 5 min
Calculs offline « PEP_{EIT} »

Table PEP/FiO2

PEP_{EIT}

PEP_{EIT}

Table PEP/FiO2

Fin de chaque étape
- Mécanique ventilatoire
- Efforts
- Gaz du sang
- Hémodynamique

Intensive Care Med
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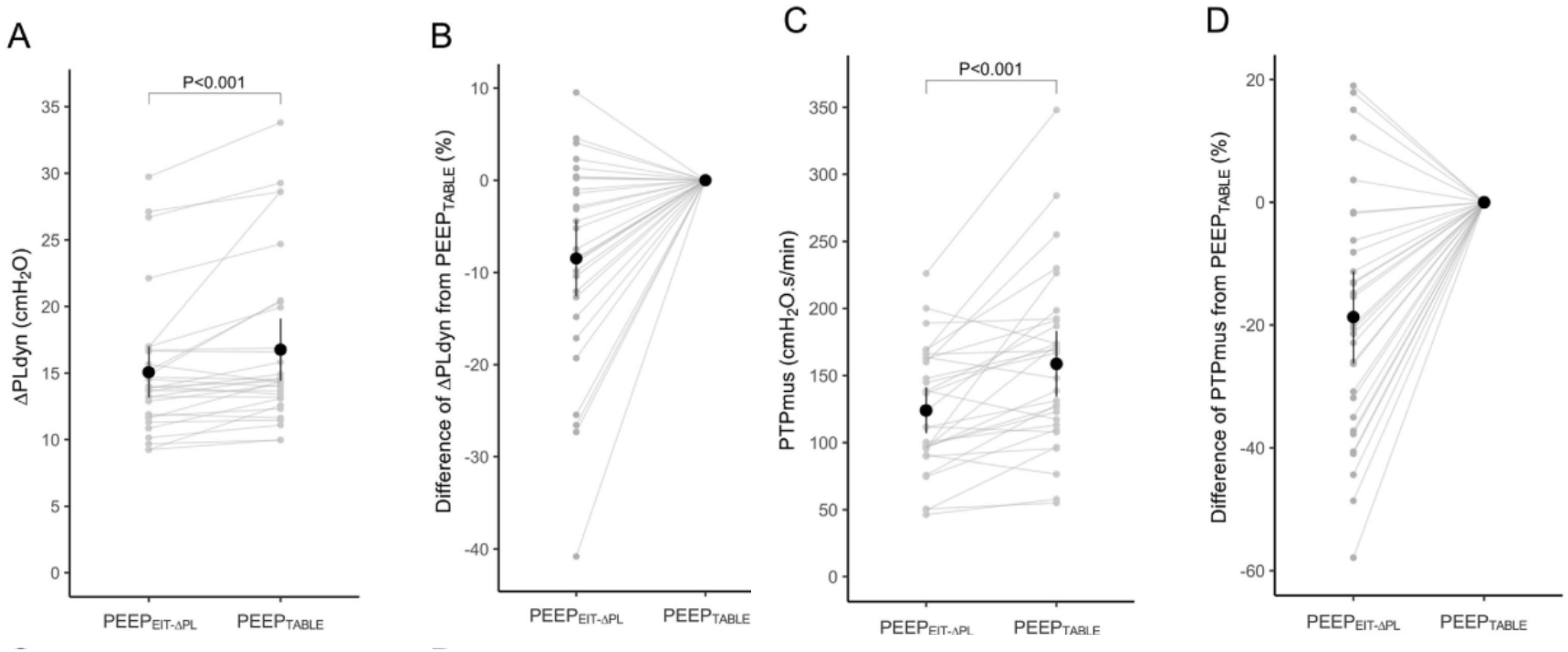

Réglage PEP_{EIT} ↘ effort inspiratoire

Intensive Care Med
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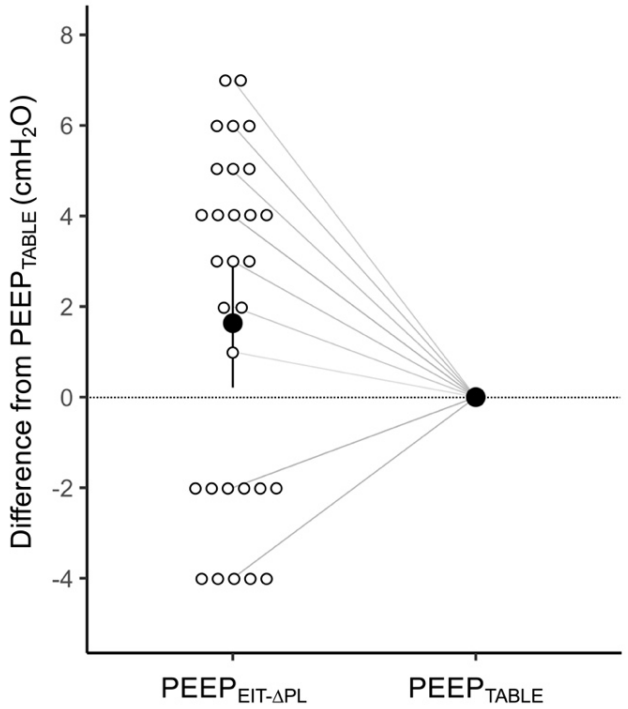

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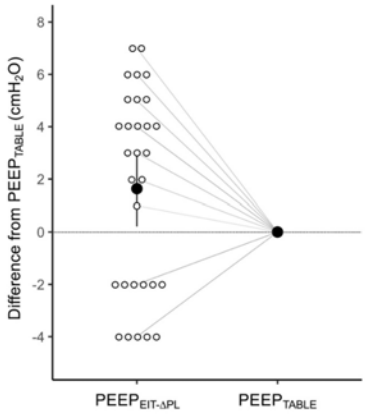

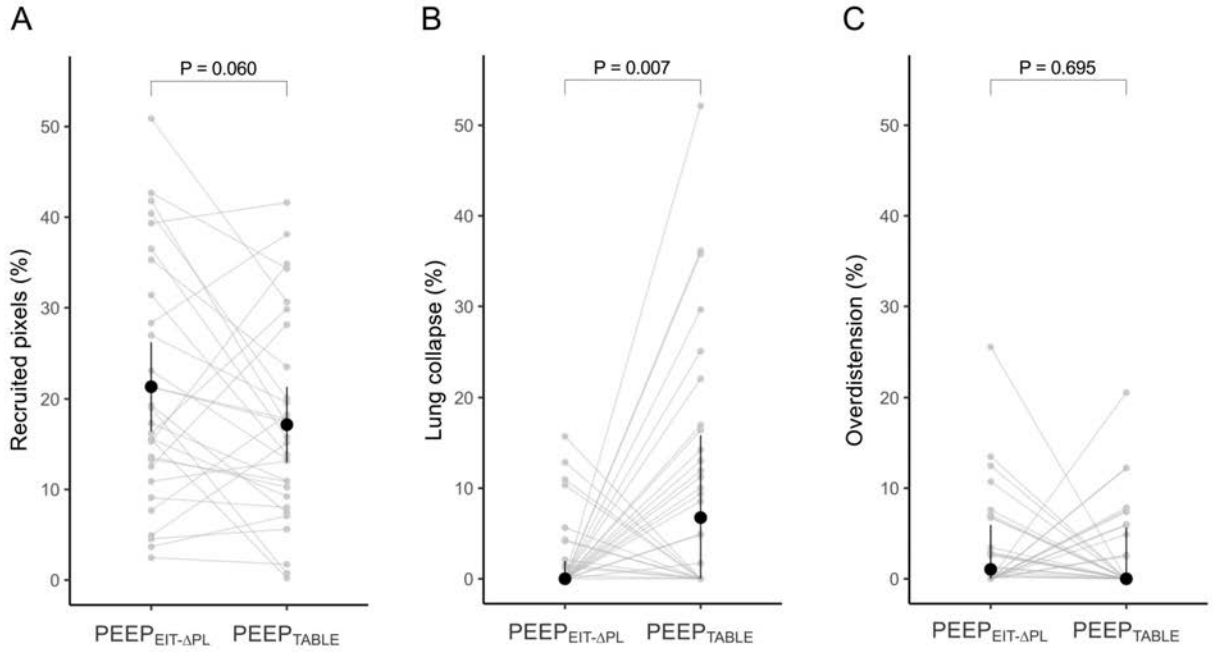

PEP$_{EIT}$ > PEP$_{table}$

- ↗recrutement
- ↘ collapsus
- Surdistension ↔

ORIGINAL ARTICLE

The Effect of Positive End-Expiratory Pressure on Pulmonary Vascular Resistance Depends on Lung Recruitability in Patients with Acute Respiratory Distress Syndrome

Simone Cappio Borlino[1,2,3*], Julien Hagry[1,2*], Christopher Lai[1,2], Eduardo Rocca[1,2,4,5], Gaëlle Fouqué[1,2], Daniela Rosalba[1,2,4,5], Marta Fasan[1,2,6], Rui Shi[1,2], Agnese Recanatini[1,2], Irene Cisterna[1,2], Mattia Barotti[1,2,6], Tài Pham[1,7], Jean-Louis Teboul[1,2], and Xavier Monnet[1,2]

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Echocardiographie

Lever de jambe passif

Résistances vasculaires pulmonaires

Echocardiographie

Résistances vasculaires pulmonaires

Δ = 10 cmH_2O

PEEP haute

Pour Pplat ≈ 28-30 cmH_2O

PEEP basse

PEEP clinique

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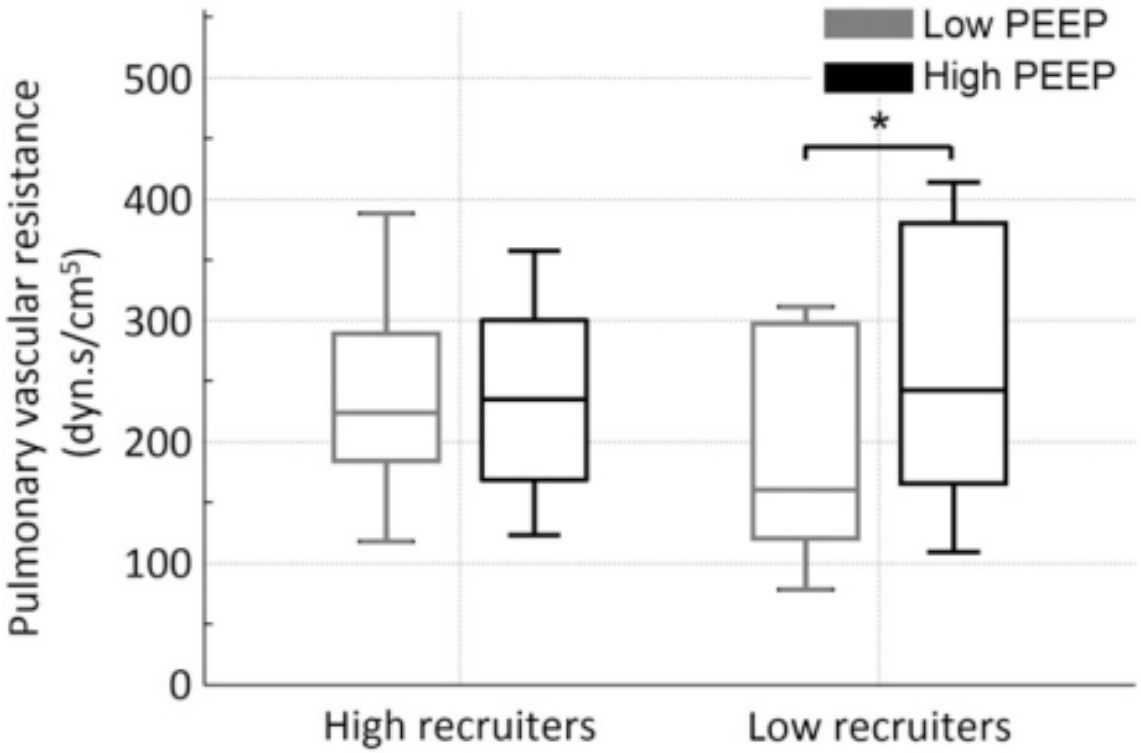
23 patients
57 mesures
Cath. artériel pulm.

R/I médian: 0,56
[0,36;0,72]



PEP haute

- ↗ Résistances artérielles pulmonaires
- Chez les faible recruteurs

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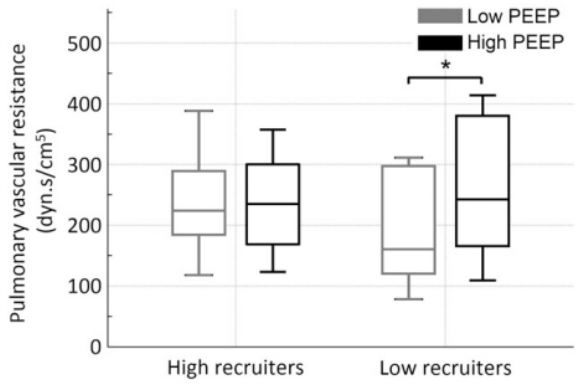

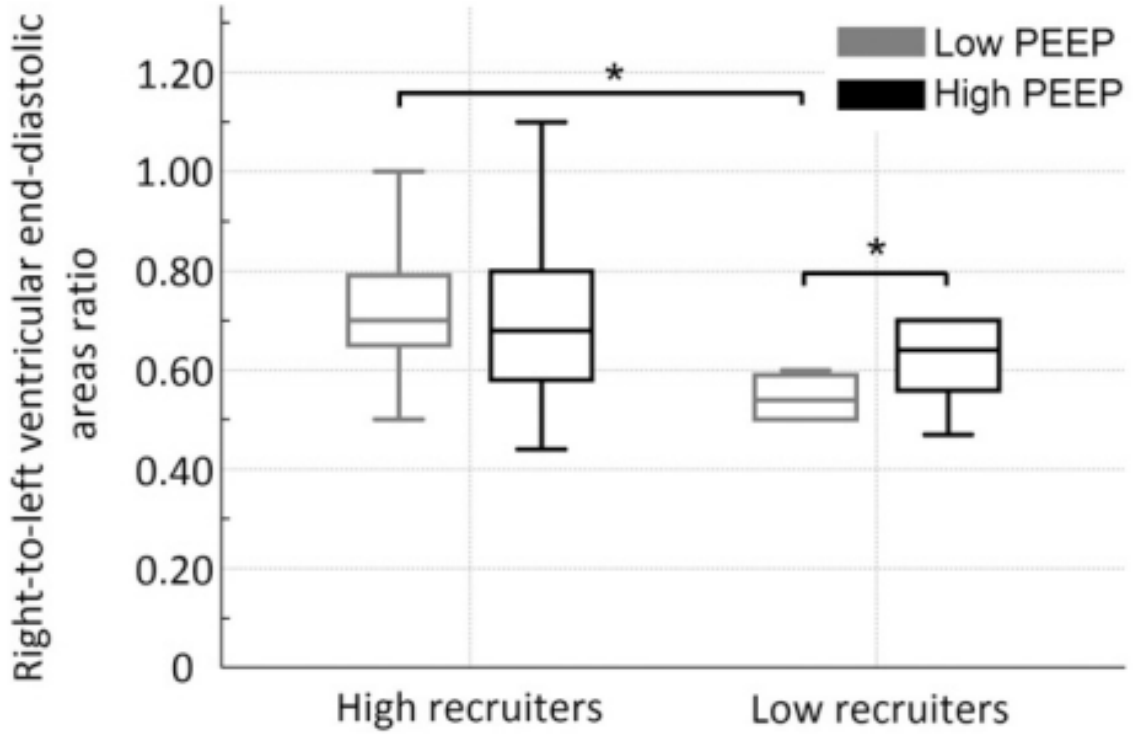

PEP haute

- ↗ VD/VG
- Chez les faible recruteurs

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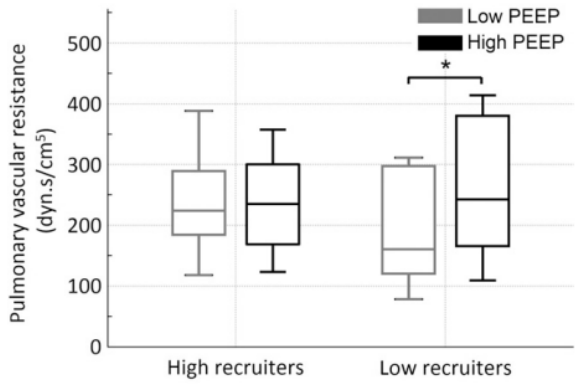
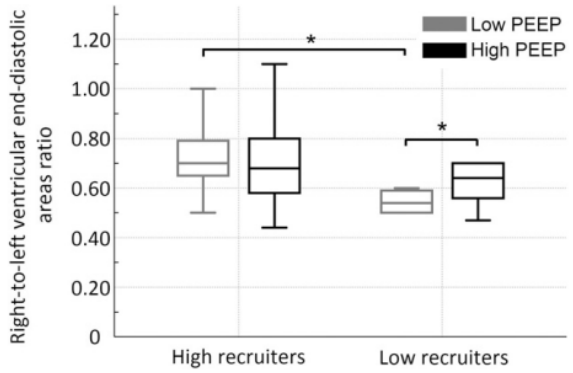
Effet de la PEP

- Augmentation des RVP
- Augmentation de la postcharge VD
- Aggravation dysfonction droite

Seulement chez les patients faiblement recruteurs





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1 Mode ventilatoire

Mode en Pression avec VS
Pas de difference de Mortalité
Moins de recours au DV
Moins de sédatifs, opiacés et curares à J7

2 Volumes courants

“ULTV” dans le SDRA COVID
Pas de benefice clinique
Possibles difficultés d’application

3 Décubitus ventral

DV
Amélioration de la mécanique respiratoire
Chez les patients au haut potential de recrutement

4 PEP/Recrutabilité

EIT
Optimisation de la PEP: VAC **ET** VSAI

Haute PEP
RVP et dysfunction droite chez les faibles recruteurs

Merci de votre attention

Tai.pham@aphp.fr