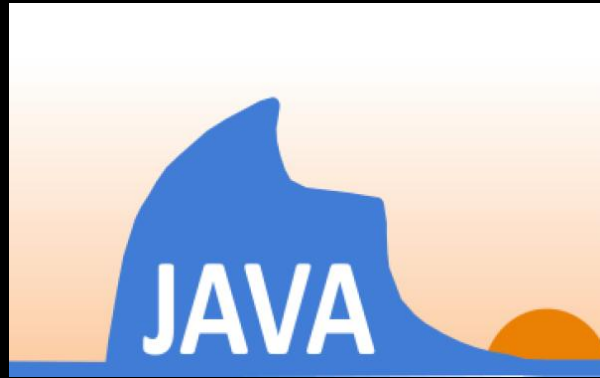




Non l'Open Lung Approach n'est pas morte !
(même si elle n'est pas très en forme)

Alain Mercat



Liens d'intérêts



OLA : Le slogan

Open up the lung and keep the lung open

B. Lachmann

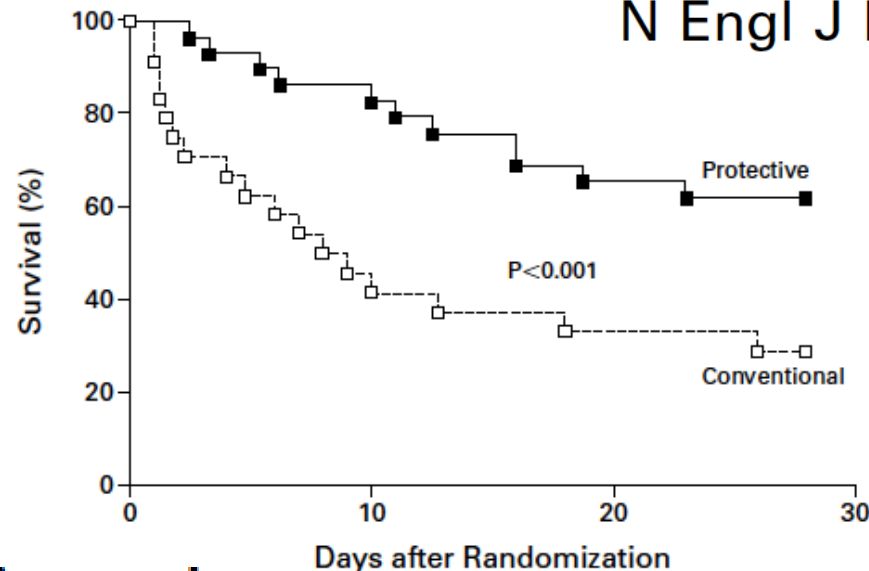
Intensive Care Med (1992) 18:319–321



EFFECT OF A PROTECTIVE-VENTILATION STRATEGY ON MORTALITY IN THE ACUTE RESPIRATORY DISTRESS SYNDROME

MARCELO BRITTO PASSOS AMATO, M.D., CARMEN SILVIA VALENTE BARBAS, M.D., DENISE MACHADO MEDEIROS, M.D., RICARDO BORGES MAGALDI, M.D., GUILHERME DE PAULA PINTO SCHETTINO, M.D., GERALDO LORENZI-FILHO, M.D., RONALDO ADIB KAIRALLA, M.D., DANIEL DEHEINZELIN, M.D., CARLOS MUNOZ, M.D., ROSELAINE OLIVEIRA, M.D., TERESA YAE TAKAGAKI, M.D., AND CARLOS ROBERTO RIBEIRO CARVALHO, M.D.

N Engl J Med 1998;338:347-54.



Protective Approach

...

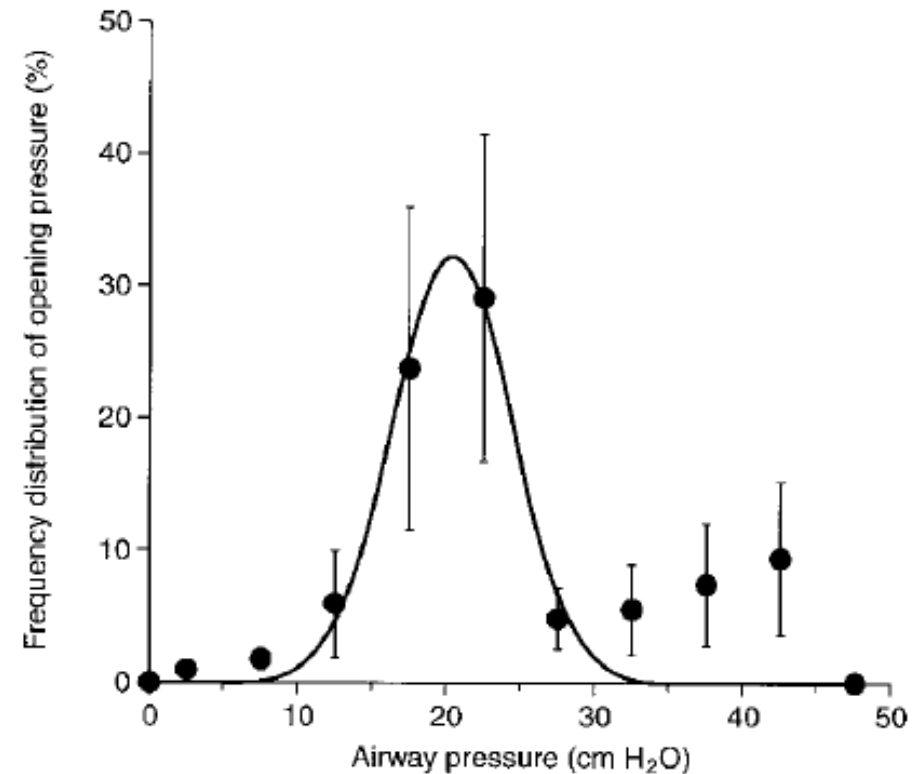
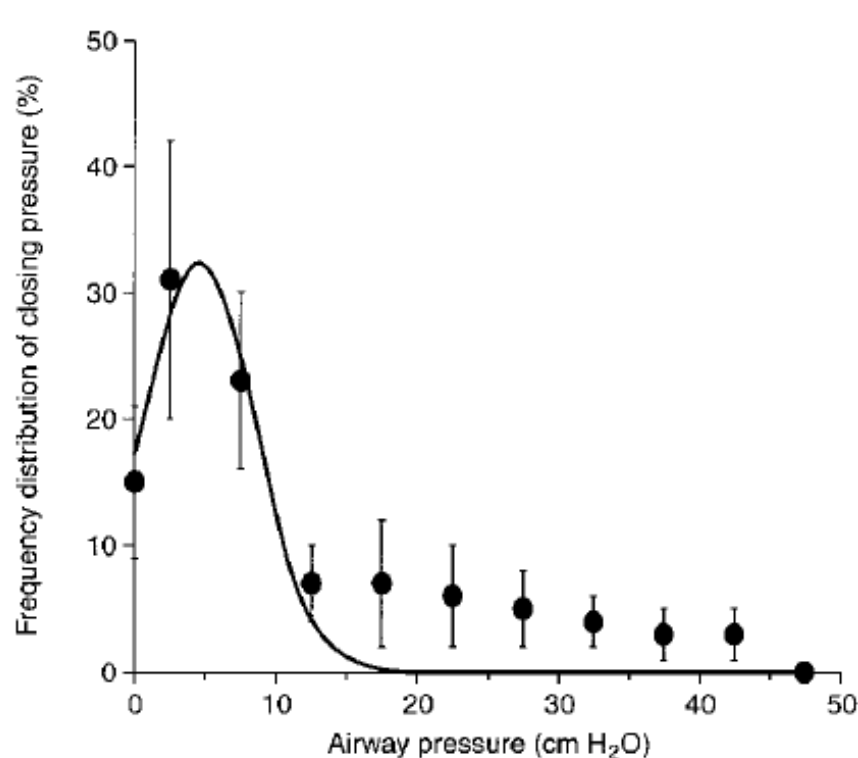
PEEP value of 16 cm of water was used.¹⁵ Recruiting maneuvers — aimed at reaerating alveolar units requiring very high opening pressures — were frequently used, especially after inadvertent disconnections from the ventilator. Continuous positive airway pressures of 35 to 40 cm of water were applied for 40 seconds, followed

Pressions d'ouverture > Pressions de fermeture

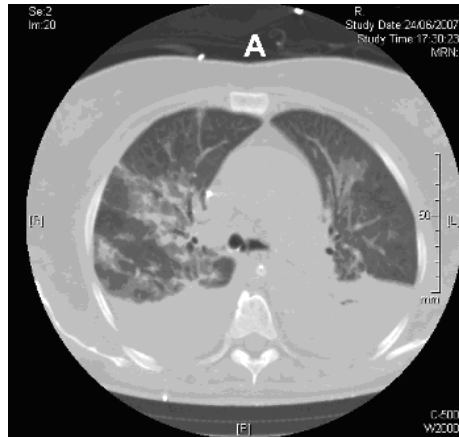
Recruitment and Derecruitment during Acute Respiratory Failure

A Clinical Study

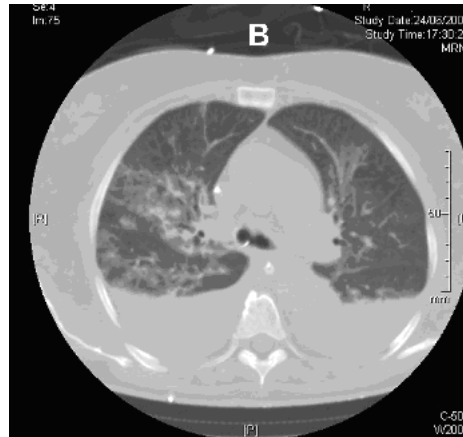
STEFANIA CROTTI, DANIELE MASCHERONI, PIETRO CAIRONI, PAOLO PELOSI, GIULIO RONZONI, MICHELE MONDINO, JOHN J. MARINI, and LUCIANO GATTINONI



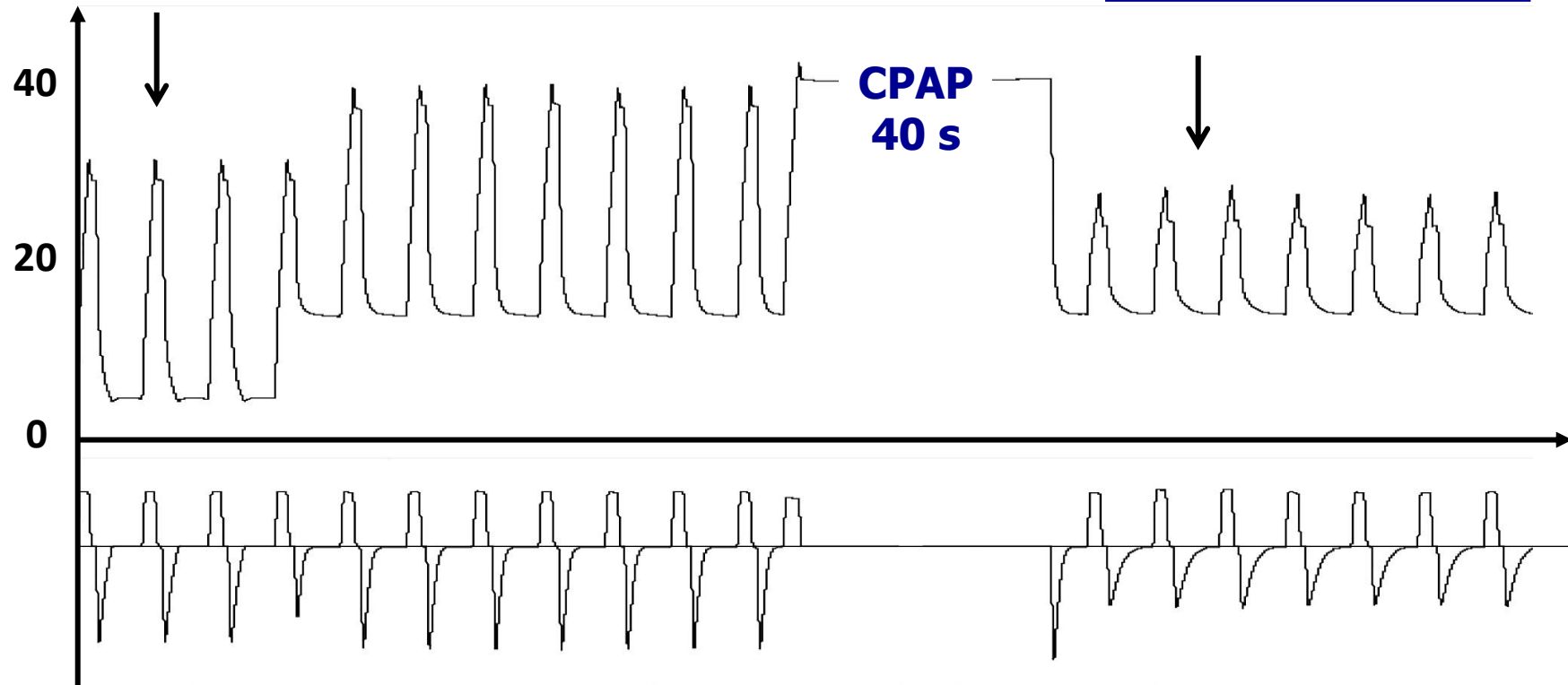
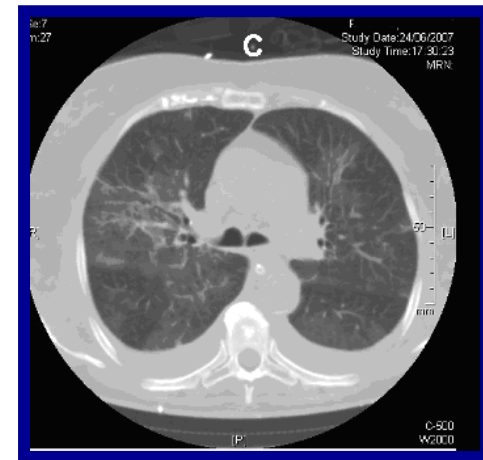
PaO₂= 88 mmHg



PaO₂= 135 mmHg



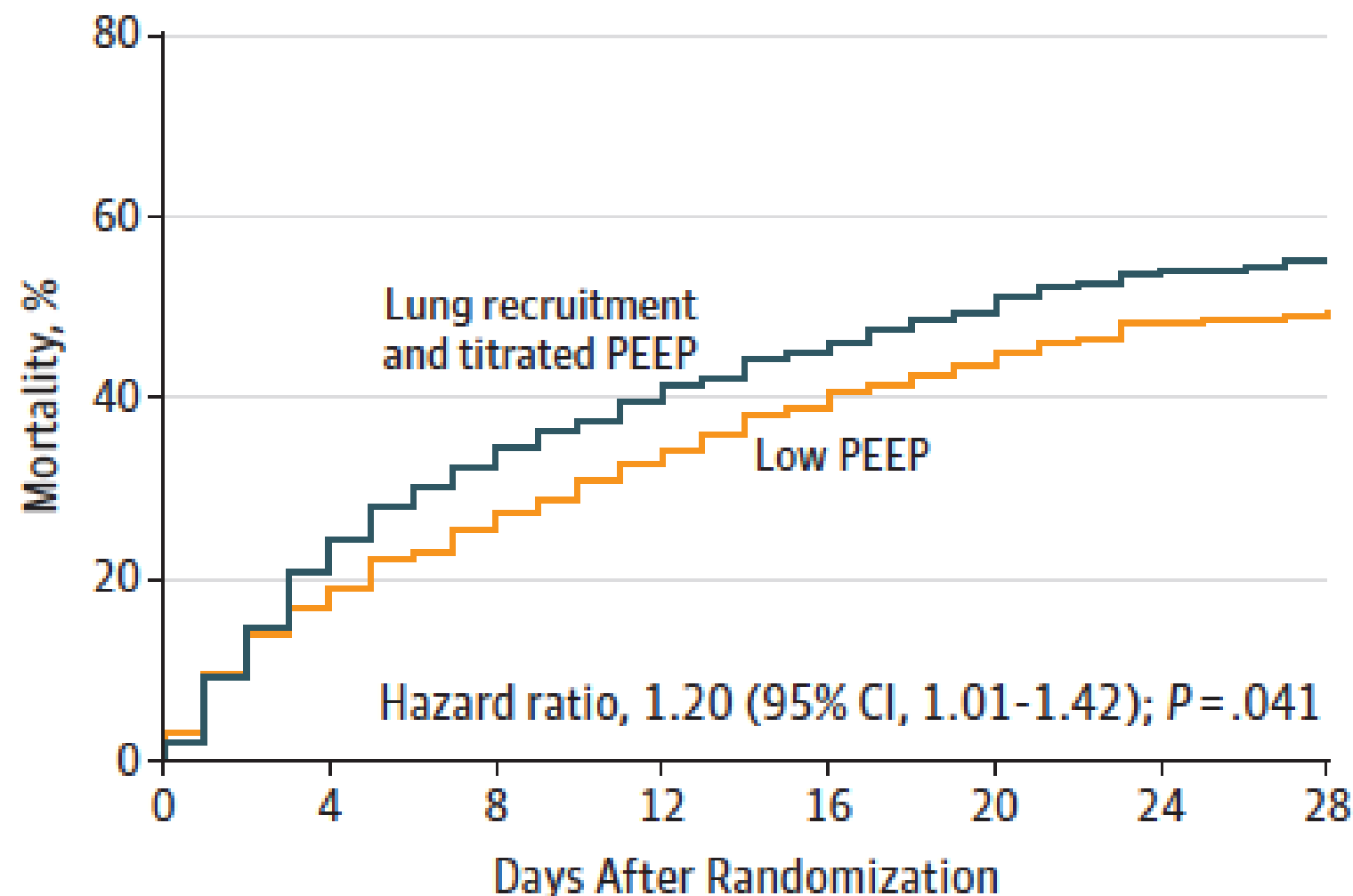
PaO₂= 365 mmHg



Effect of Lung Recruitment and Titrated Positive End-Expiratory Pressure (PEEP) vs Low PEEP on Mortality in Patients With Acute Respiratory Distress Syndrome

A Randomized Clinical Trial

JAMA. doi:[10.1001/jama.2017.14171](https://doi.org/10.1001/jama.2017.14171)
Published online September 27, 2017.

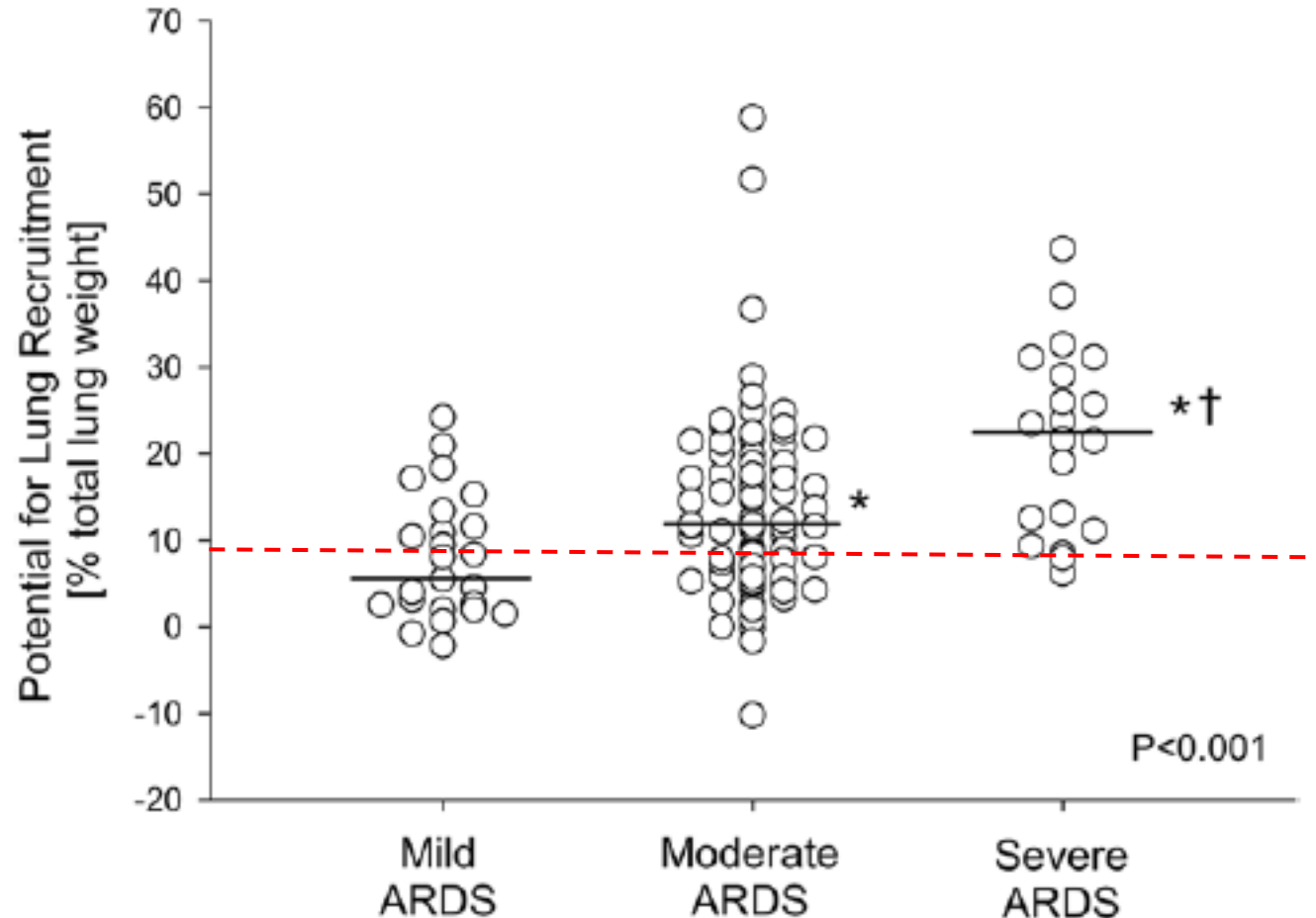


ART trial : Où est l'erreur ?

- Sélection des patients inappropriée à la démonstration d'un effet bénéfique du recrutement ?
- Pas de mesure objective du recrutement
- Inclusion : $\text{PaO}_2/\text{FiO}_2 < 200$ avec $\text{PEEP} \geq 10$ et FiO_2 100 %

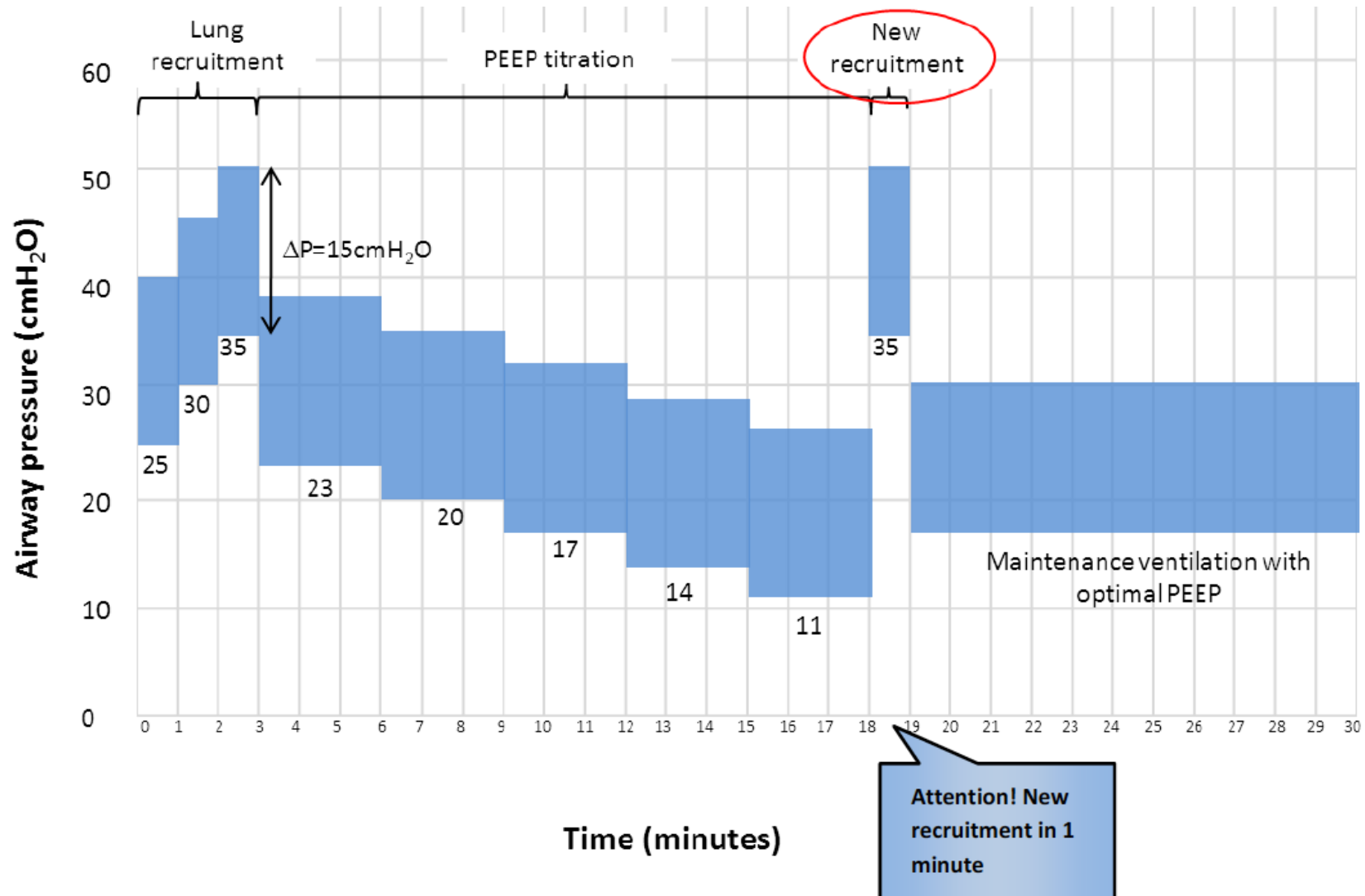
PaO₂/FiO₂ and recruitability

- 139 pts with mild or moderate or severe ARDS on PEEP 5



ART trial : Où est l'erreur ?

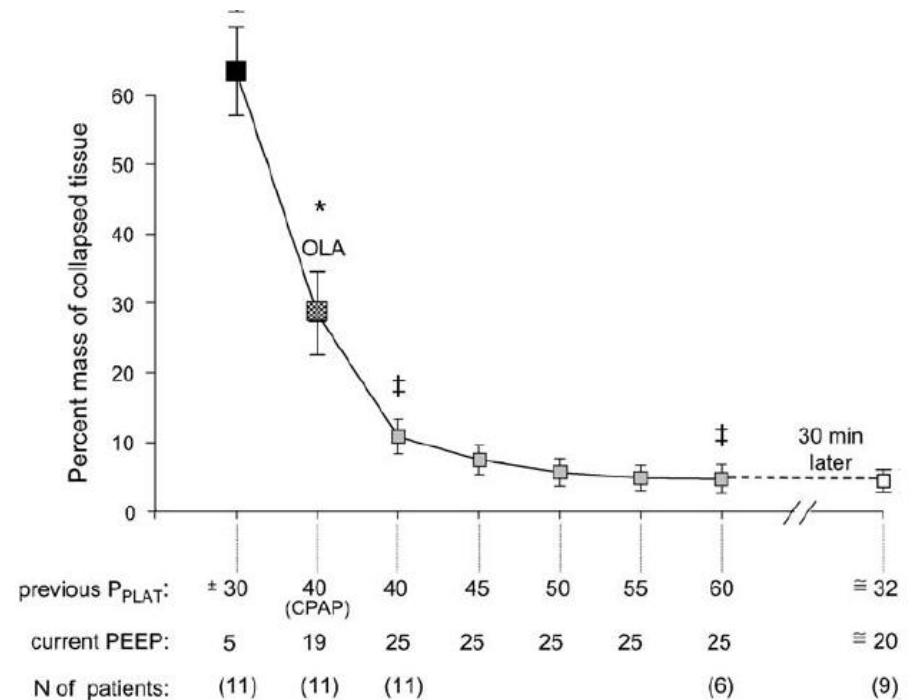
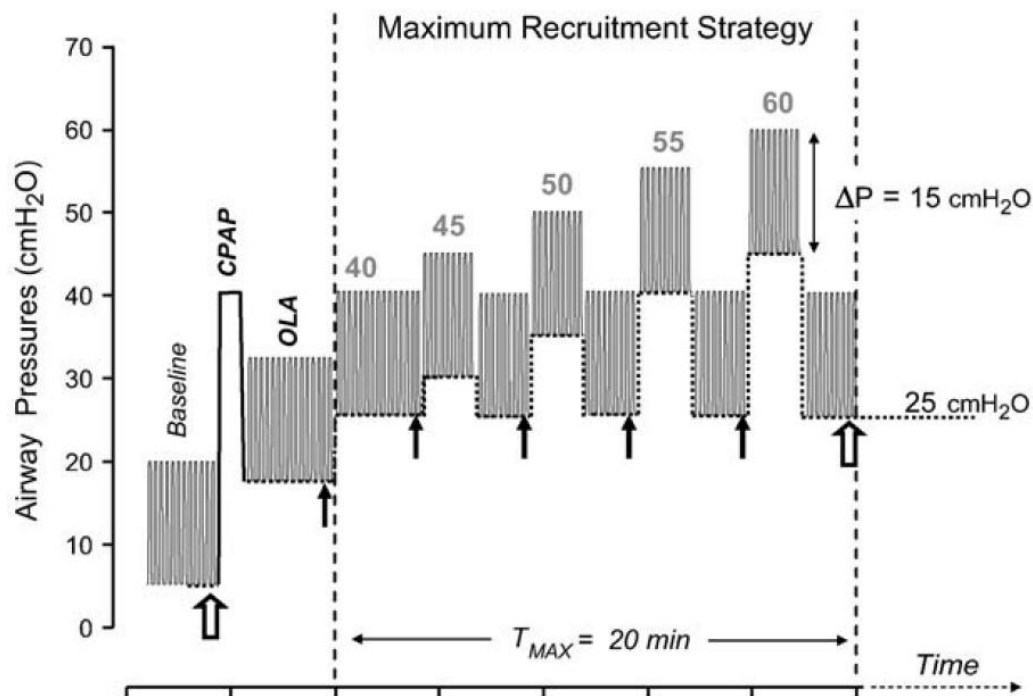
- Manœuvres de recrutement trop agressives ?



OLA : Stratégie de recrutement maximal

Reversibility of Lung Collapse and Hypoxemia in Early Acute Respiratory Distress Syndrome

João B. Borges, Valdelis N. Okamoto, Gustavo F. J. Matos, Maria P. R. Caraméz, Paula R. Arantes, Fabio Barros, Ciro E. Souza, Josué A. Victorino, Robert M. Kacmarek, Carmen S. V. Barbas, Carlos R. R. Carvalho, and Marcelo B. P. Amato



Stratégie de recrutement maximal

Reversibility of Lung Collapse and Hypoxemia in Early Acute Respiratory Distress Syndrome

João B. Borges, Valdelis N. Okamoto, Gustavo F. J. Matos, Maria P. R. Caraméz, Paula R. Arantes, Fabio Barros, Ciro E. Souza, Josué A. Victorino, Robert M. Kacmarek, Carmen S. V. Barbas, Carlos R. R. Carvalho, and Marcelo B. P. Amato

Situation	Baseline (n = 26)	OLA (n = 11)	Step 1 (n = 26)	Step 2 (n = 17)	Step 3 (n = 13)	Step 4 (n = 11)	Step 5 (n = 8)
Cardiac index, ml/min/m ² , mean (SD)	5.8 (± 1.9)	4.7 (± 1.4)	5.7 (± 1.7)	5.3 (± 1.8)	4.8 (± 1.8)	4.7 (± 1.7)	4.7 [§] (± 1.9)
Mean arterial pressure,* mm Hg, mean (SD)	84 (± 16)	NA	88 (± 13)	87 (± 11)	90 (± 14)	91 (± 14)	93 [†] (± 14)
Mixed venous saturation, %, mean (SD)	77 (± 16)	85 [†] (± 7)	86 [‡] (± 8)	85 (± 8)	87 (± 7)	87 (± 7)	88 [‡] (± 7)
Arterial pH, mean (SD)	7.15 (± 0.12)	7.11 [†] (± 0.11)	7.13 (± 0.13)	7.10 (± 0.14)	7.08 (± 0.15)	6.99 (± 0.11)	6.94 (± 0.11)
Arterial Pco ₂ , mm Hg, mean (SD)	64 (± 18)	75 [†] (± 19)	70 (± 25)	75 (± 27)	81 (± 30)	89 (± 31)	95 [‡] (± 34)
Ventilator settings during measurements							
PEEP, cm H ₂ O, mean	5	19	25	25	25	25	25
P _{PLAT} , cm H ₂ O, mean	30	31	40	40	40	40	40
Previous recruiting pressure, cm H ₂ O	—	40	40	45	50	55	60

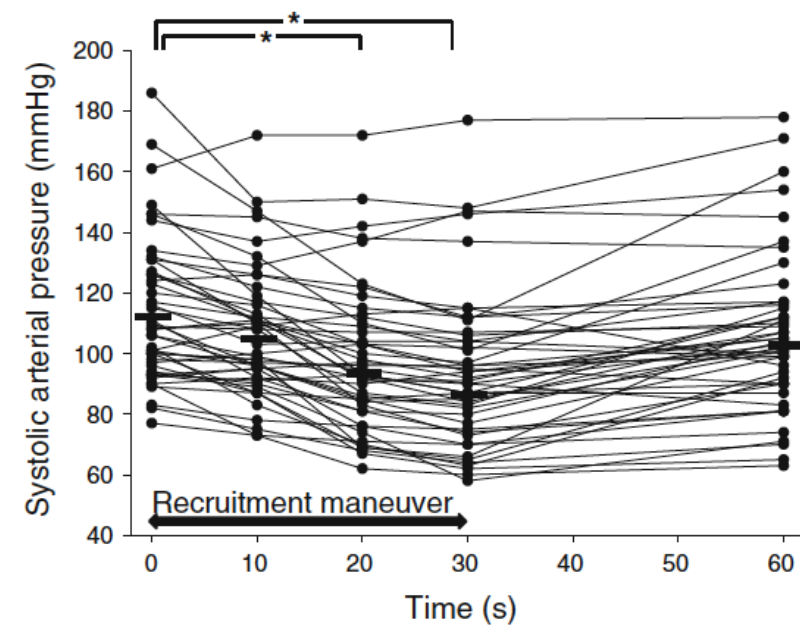
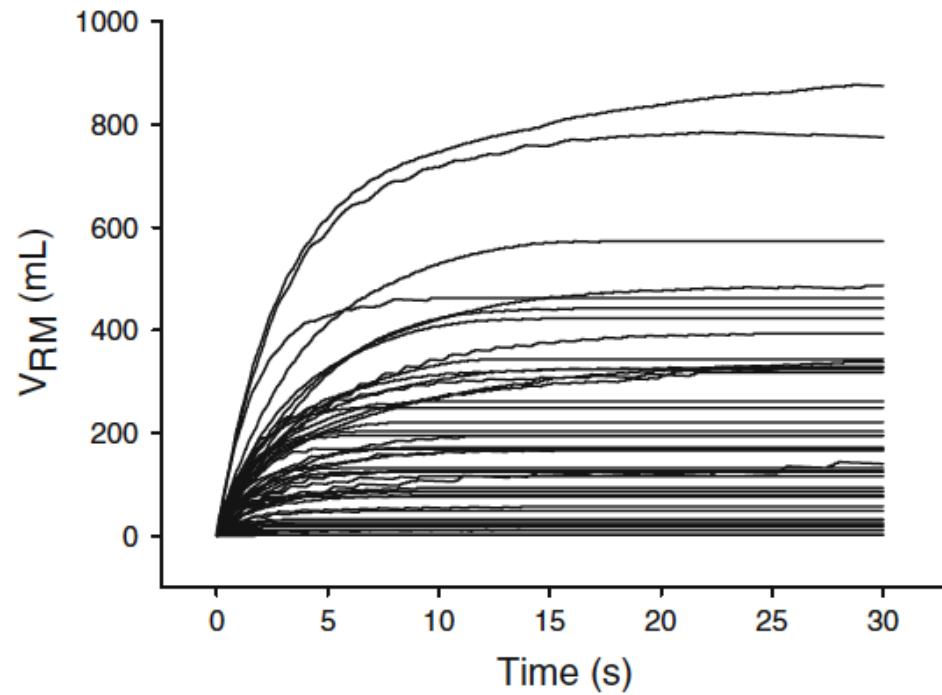
ART trial : Où est l'erreur ?

In June 2015, starting with the 556th patient, the steering committee, in consultation with the data monitoring committee, decided to modify the recruitment maneuver and PEEP titration strategy after 3 cases of resuscitated cardiac arrest possibly associated with the experimental group treatment were observed. During the recruitment maneuver, PEEP was increased to 25 cm H₂O, 30 cm H₂O, and then 35 cm H₂O, in steps of 1 minute. Maximum plateau pressure was 50 cm H₂O. Decremental PEEP trial was shorter, with each PEEP step lasting 3 minutes, followed by a new recruitment maneuver with PEEP of 35 cm H₂O.

Jean-Michel Arnal
J  r  mie Paquet
Marc Wysocki
Didier Demory
St  phane Donati
Isabelle Granier
Ga  lle Corno
Jacques Durand-Gasselin

Optimal duration of a sustained inflation recruitment maneuver in ARDS patients

Intensive Care Med (2011) 37:1588–1594



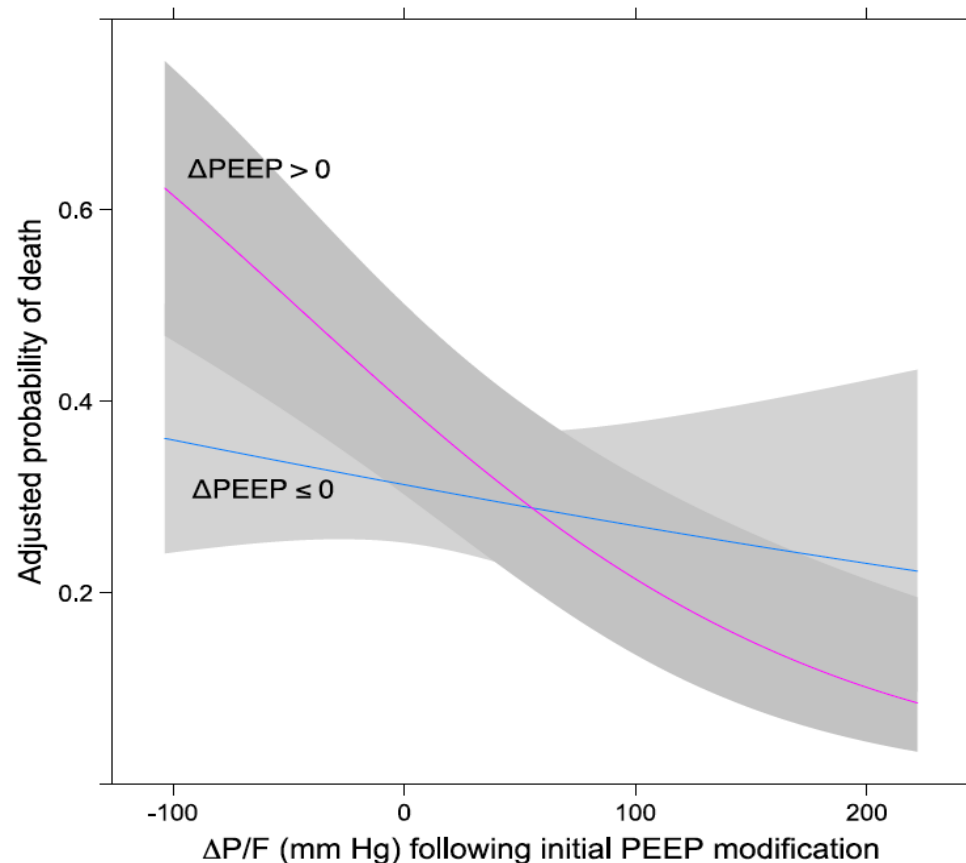
ART trial : Où est l'erreur ?

- Titration de la PEEP : « decremental PEEP trial »
- $PEEP = PEEP \text{ « meilleur compliance »} + 2 \text{ cmH}_2\text{O}$
- PEEP minimale 13 cmH₂O
- Relation recrutement / compliance ?
- Effets hémodynamiques ?
- Impact sur oxygénation ?

Oxygenation Response to Positive End-Expiratory Pressure Predicts Mortality in Acute Respiratory Distress Syndrome

A Secondary Analysis of the LOVS and ExPress Trials

Ewan C. Goligher^{1,2,3,4}, Brian P. Kavanagh^{1,5,6}, Gordon D. Rubenfeld^{1,2,7}, Neill K. J. Adhikari^{1,2,7}, Ruxandra Pinto⁷, Eddy Fan^{1,2,4}, Laurent J. Brochard^{1,2,8}, John T. Granton^{1,2,4}, Alain Mercat⁹, Jean-Christophe Marie Richard¹⁰, Jean-Marie Chretien¹¹, Graham L. Jones¹², Deborah J. Cook^{12,13}, Thomas E. Stewart^{1,2,4}, Arthur S. Slutsky^{1,2,4}, Maureen O. Meade^{12,13}, and Niall D. Ferguson^{1,2,3,4}



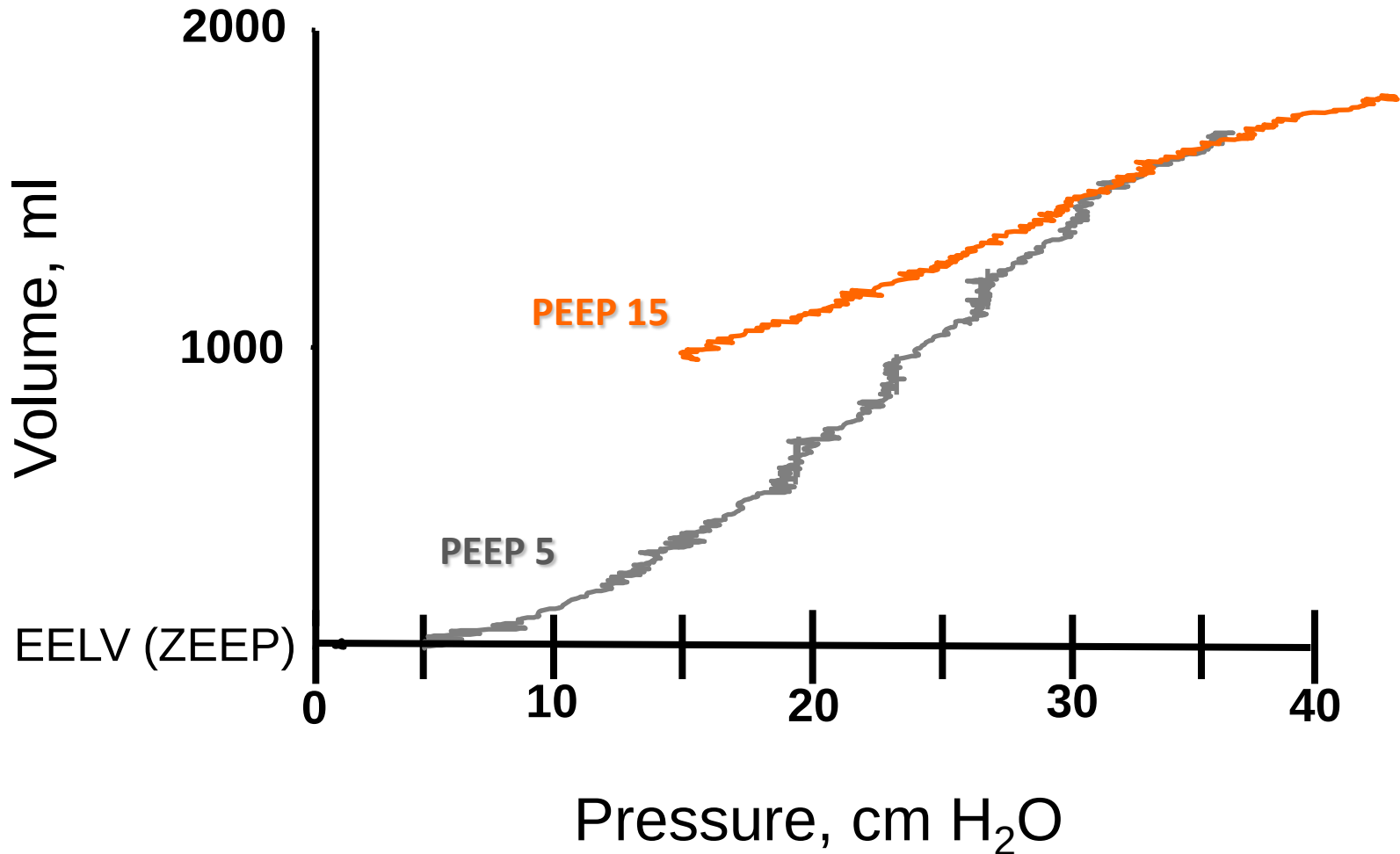
Compliance for individual PEEP titration

	Lower amount of potential recruitment ($\leq 9\%$) n = 34	Higher amount of potential recruitment ($> 9\%$) n = 34	P value
Crs in PEEP 5 (ml/cmH ₂ O)	51 $\pm$ 19	38 $\pm$ 15	.002
Crs in PEEP 15 (ml/cmH ₂ O)	46 $\pm$ 17	40 $\pm$ 16	.1
Δ Crs PEEP 5 to 15 (ml/cmH ₂ O)	- 5 $\pm$ 10	2 $\pm$ 9	.003

VT = 400 ml : Δ Crs 38 $\rightarrow$ 40 ml/cmH₂O

$\rightarrow$ Variation de Δ P de 0.5 cmH₂O !!

PEEP / Recruitment / Compliance





M, sexo masculino, 28 anos, Crohn
Evoluiu com IrPA e RNC após endoscopia
(Sub – oclusão) . IOT + UTI.

- P/F = 93
- TIE – RECRUTAMENTO 25 /40
- TIE TITULAÇÃO PEEP

Passo a passo

Passo da PEEP: 1



Hiperdistensão



Colapso cumulativo

PEEP: 26.0 cmH₂O
Hiperdistensão: 53.0%
Colapso: 0.0%
Complacência: 19.0 mL/cmH₂O

Passo da PEEP: 2



Hiperdistensão



Colapso cumulativo

PEEP: 24.1 cmH₂O
Hiperdistensão: 48.5%
Colapso: 0.0%
Complacência: 21.0 mL/cmH₂O

Passo da PEEP: 3



Hiperdistensão



Colapso cumulativo

PEEP: 22.1 cmH₂O
Hiperdistensão: 42.3%
Colapso: 0.0%
Complacência: 23.0 mL/cmH₂O

Passo da PEEP: 4



Hiperdistensão



Colapso cumulativo

PEEP: 20.1 cmH₂O
Hiperdistensão: 35.0%
Colapso: 0.0%
Complacência: 24.5 mL/cmH₂O

Passo da PEEP: 5



PEEP: 18.3 cmH₂O
Hiperdistensão: 27.3%
Colapso: 0.0%
Complacência: 26.2 mL/cmH₂O

Passo a passo (continuação'd)

Passo da PEEP: 6



Hiperdistensão



Colapso cumulativo

PEEP: 16.2 cm
Hiperdistensão: 21.1%
Colapso: 0.0%
Complacência: 27.5 mL

Passo da PEEP: 7



Hiperdistensão



Colapso cumulativo

PEEP: 14.2 cm
Hiperdistensão: 16.1%
Colapso: 0.1%
Complacência: 28.0 mL

Passo da PEEP: 8



Hiperdistensão



Colapso cumulativo

PEEP: 12.2 cm
Hiperdistensão: 8.9%
Colapso: 0.4%
Complacência: 28.6 mL

Passo da PEEP: 9



Hiperdistensão



Colapso cumulativo

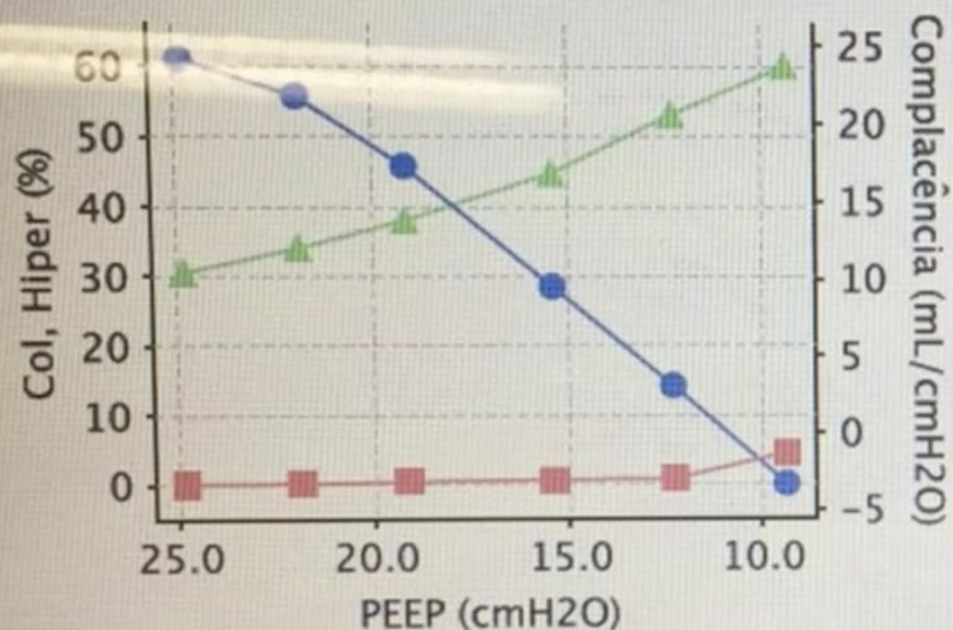
PEEP: 10.1 cm
Hiperdistensão: 3.6%
Colapso: 2.8%
Complacência: 28.1 mL

Passo da PEEP: 10



PEEP: 8.2 cm
Hiperdistensão: 0.0%
Colapso: 4.8%
Complacência: 27.8 mL

Resumo da Titulação da PEEP

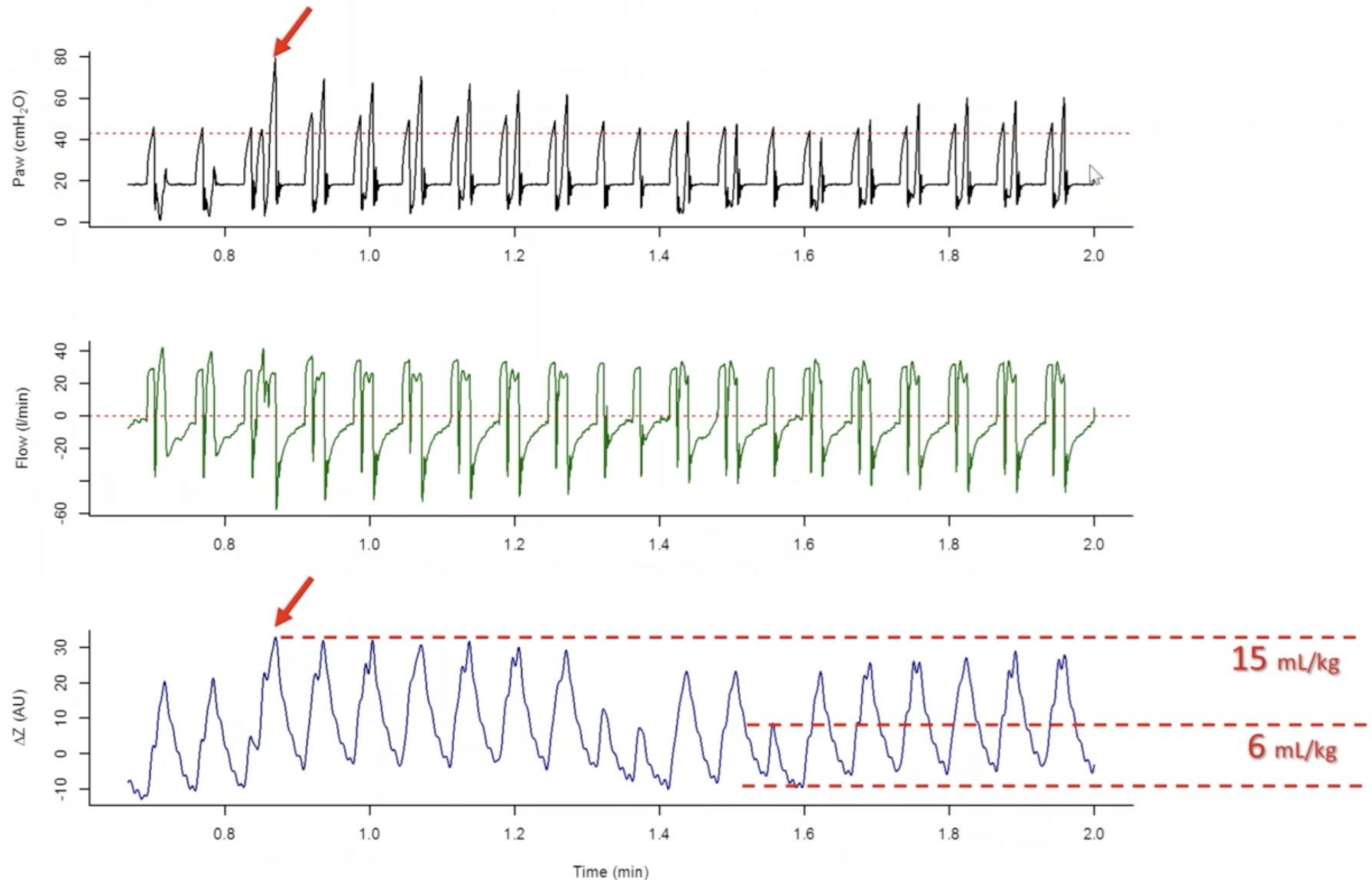


PEEP (cmH ₂ O)	Complacência (mL/cmH ₂ O)	Hiperdistensão (%)	Colapso (%)
24.8	10.4	61.0	0.0
21.9	12.0	55.8	0.1
19.2	13.8	45.8	0.4
15.4	16.8	28.5	0.6
12.3	20.6	14.2	0.7
9.4	23.7	0.0	4.5

■ Colapso ● Hiperdistensão ▲ Complacência

Patient ventilated with: $V_T = 6 \text{ mL/kg}$ – under High PEEP ($\sim 19 \text{ cmH}_2\text{O}$)

Breath stacked breaths generating $V_T = 15 \text{ mL/kg}$ and $P_{\text{PLAT}} = 45\text{-}50 \text{ cmH}_2\text{O}$ (Peak $\sim 70 \text{ cmH}_2\text{O}$)

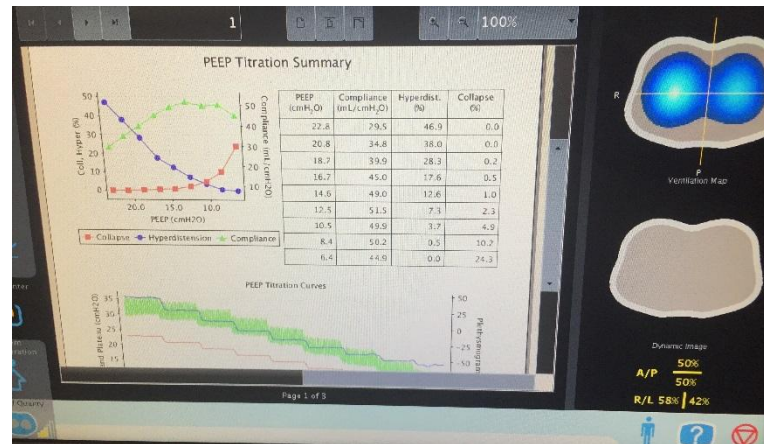


Quel avenir pour l'Open Lung Approach ?

- Manœuvres de recrutement plus prudentes (pression – durée)
- Titration de la PEEP personnalisée

→ Echanges gazeux + Mécanique + hémodynamique

→ Peso ? EIT ? EELV ?



- Vigilance vis à vis des asynchronies

ART trial : où est l'erreur ?

- PEEP plus élevée qu'attendue dans le bras « contrôle »
- Protocole : PEEP selon la table PEEP-FiO₂ de l'étude ARMA

FiO ₂	30	40	50	60	70	80	90	100						
PEEP	5	8	10		12	14		16	18	20	22	24		

For : PaO₂ : 55 - 80 mmHg ; SaO₂ 88 - 95 %

ART trial : où est l'erreur ?

Variable	1hour			Day 1		
	Lung Recruitment Maneuver with PEEP Titration Group	Control Group	P Value	Lung Recruitment Maneuver with PEEP Titration Group	Control Group	P Value
Tidal volume, mean (95% CI), mL/kg of predicted body weight	5.4 (5.3 to 5.5)	5.5 (5.5 to 5.6)	0.004	5.6 (5.5 to 5.7)	5.7 (5.7 to 5.8)	0.006
No. of patients	500	507		482	490	
Tidal volume > 6.5 mL/kg of predicted body weight, No. of events / total No. (%)	30/500 (6.0)	36/507 (7.1)	0.56	54/482 (11.2)	49/490 (10)	0.61
PEEP, mean (95% CI), cmH ₂ O	16.4 (16.0 to 16.7)	13.0 (12.7 to 13.3)	<0.001	16.2 (15.9 to 16.6)	12.0 (11.7 to 12.3)	<0.001
PaO ₂ :FIO ₂ , mean (95% CI)	184.1 (175.3 to 192.9)	142.3 (137.3 to 147.4)	<0.001	221.9 (213.5 to 230.4)	164.7 (158.5 to 170.9)	<0.001