UPEC
UNIVERSITÉ PARIS-EST CRÉTEIL
FACULTÉ DE MÉDECINE

CARMAS
CArdiovascular and Respiratory Manifestations of Acute lung injury and Sepsis

L'essai ART signe-t-il une défaite de l'open lung strategy ?

Oui, probablement

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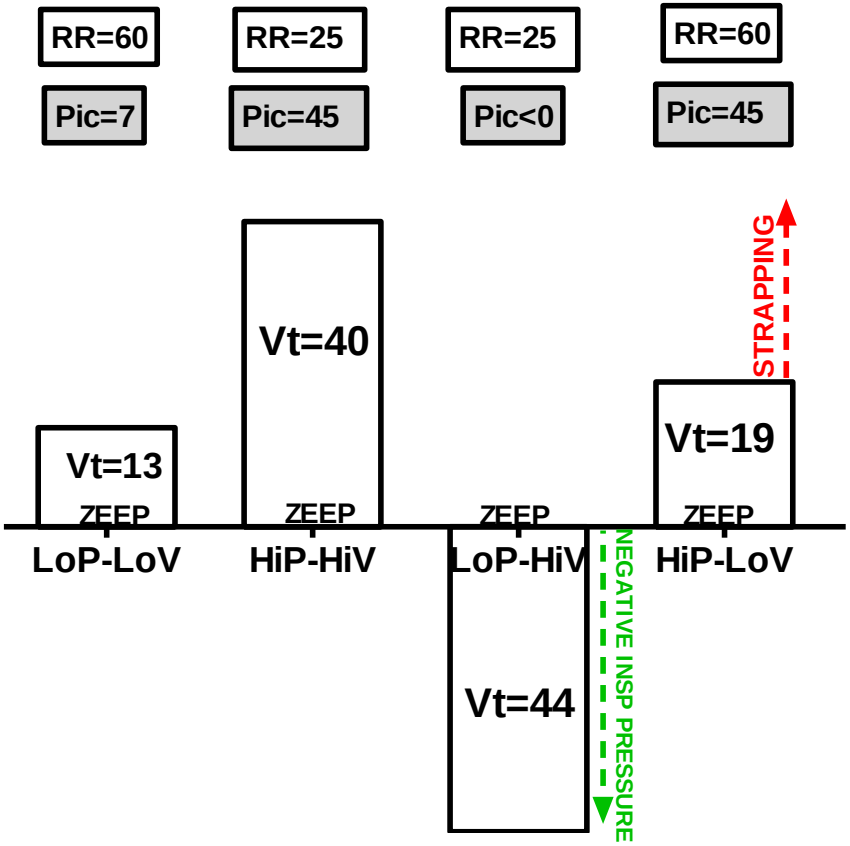
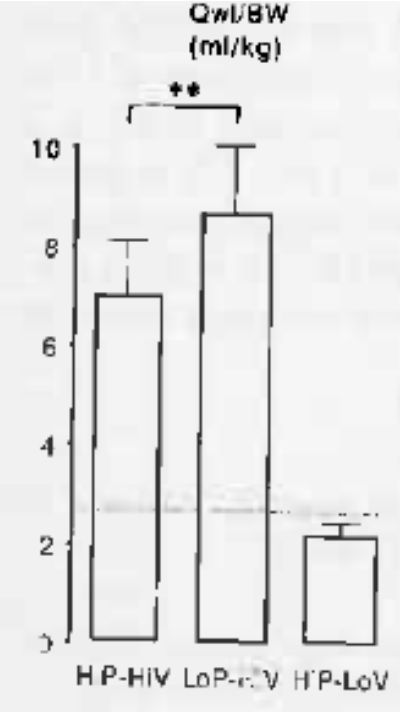
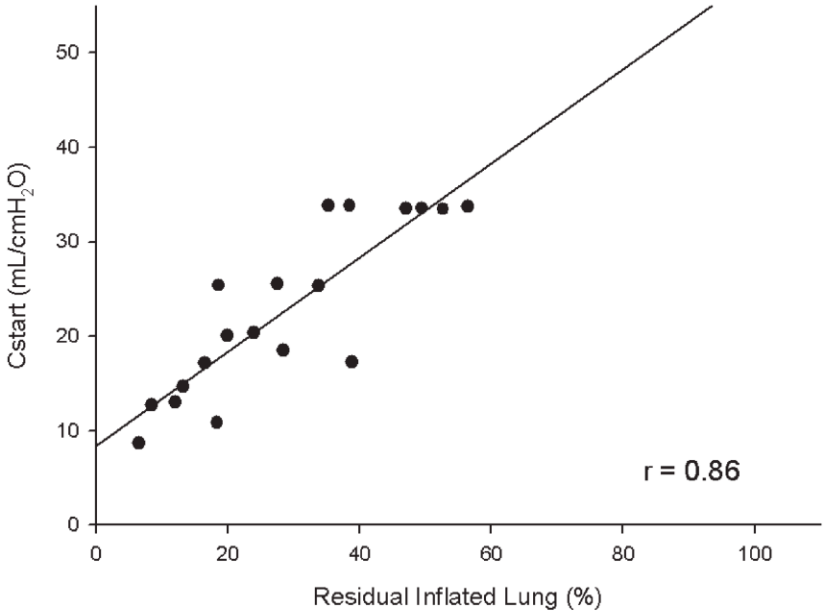
VILI: Volotrauma



Dreyfuss_ARRD 1988



Baby lung

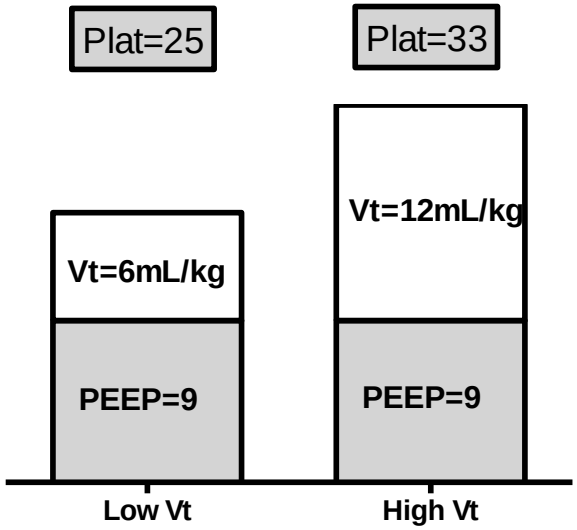


Gattinoni, ICM 2005

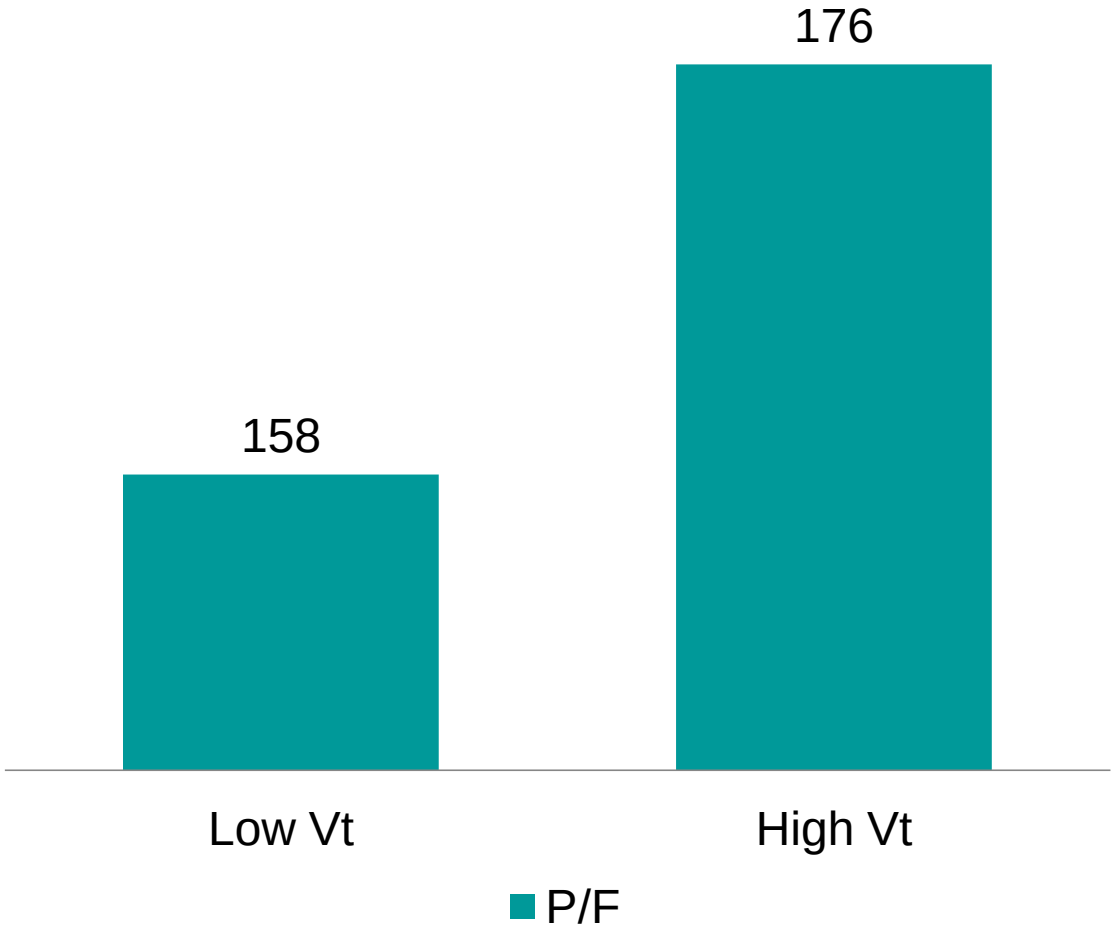
Ventilation protectrice

$\downarrow V_T$

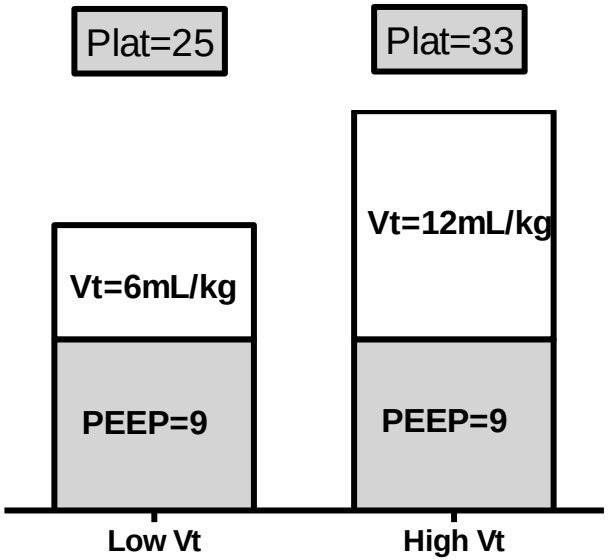
Effet du V_T sur l'oxygénation



ARDS Net_NEJM 2000



V_T et pronostic



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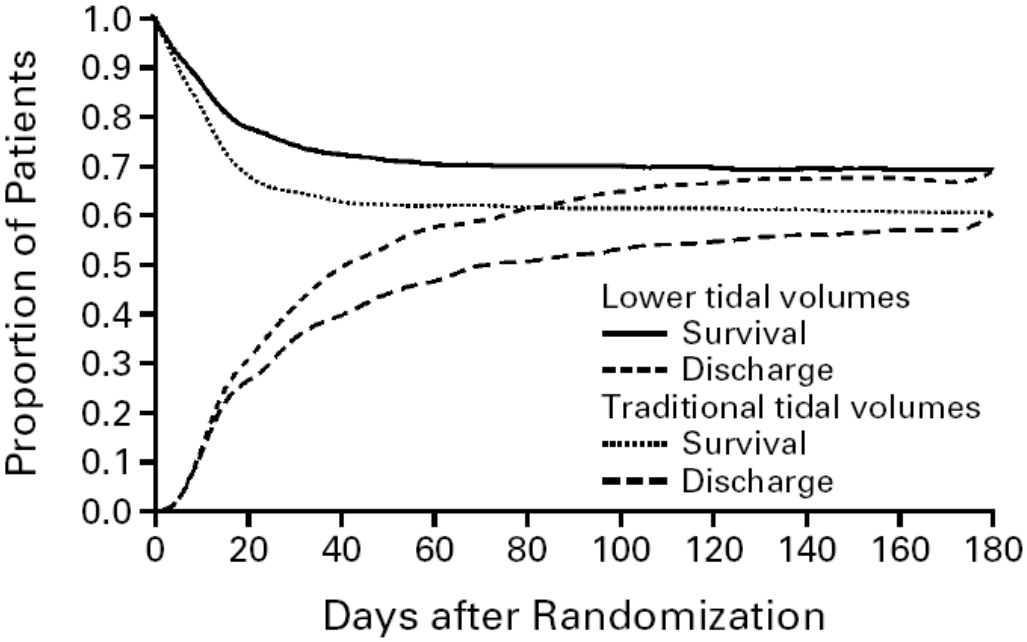
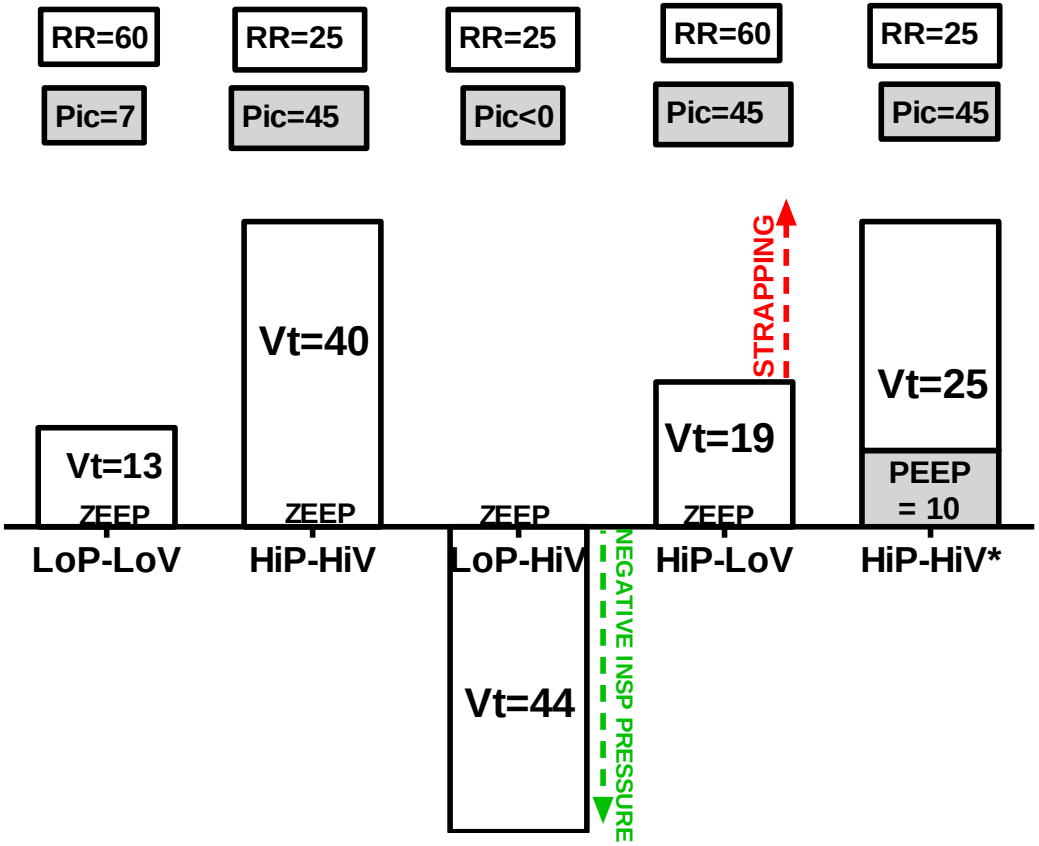
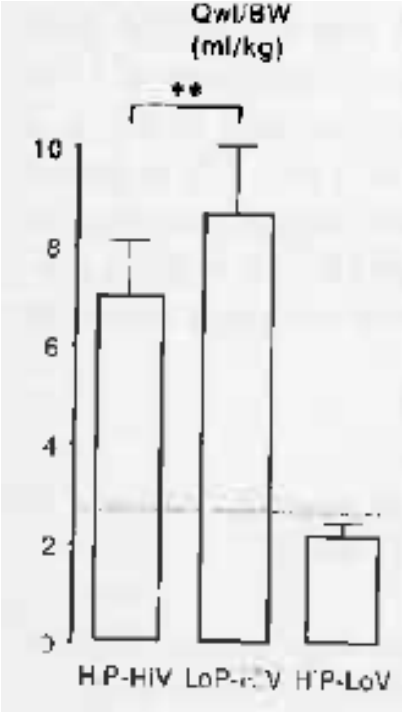
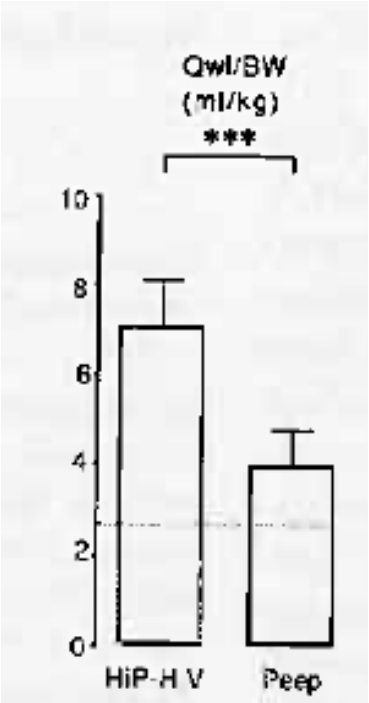


VILI: atelectrauma ?



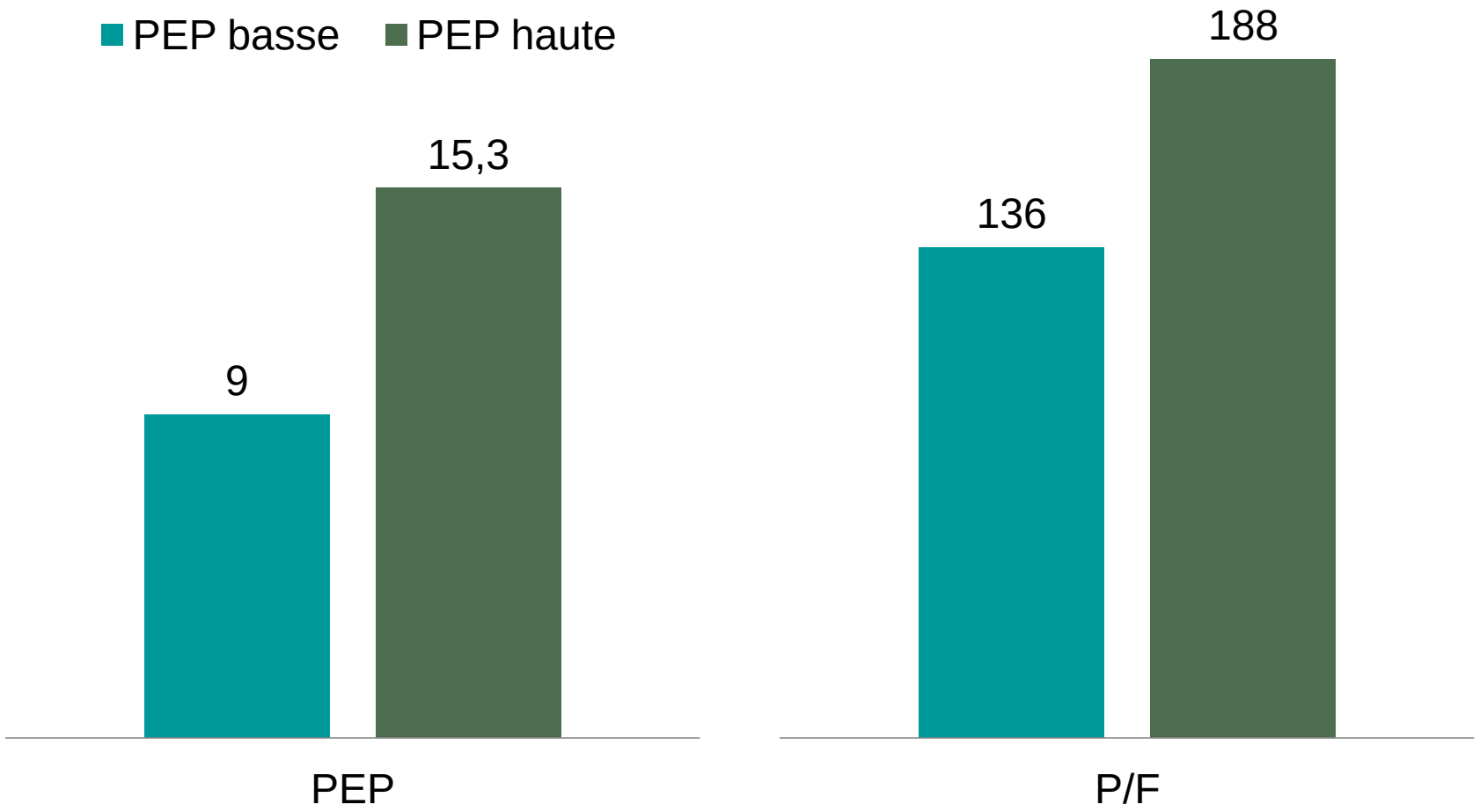
Dreyfuss_ARRD 1988



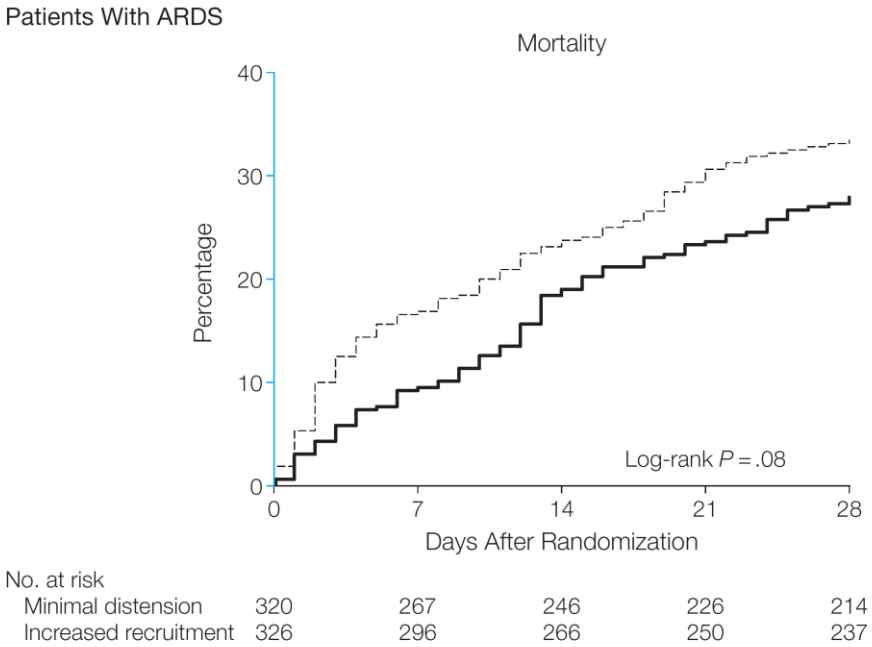


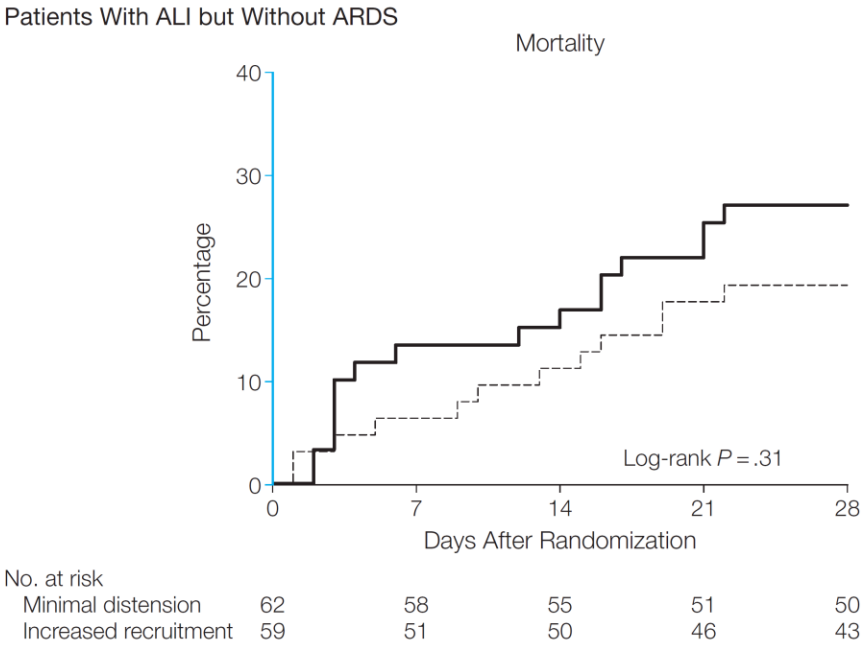
Ventilation protectrice	Poumon ouvert	
$\downarrow V_T$	REC.	$\uparrow$PEP

Effet de la PEP sur l'oxygénation



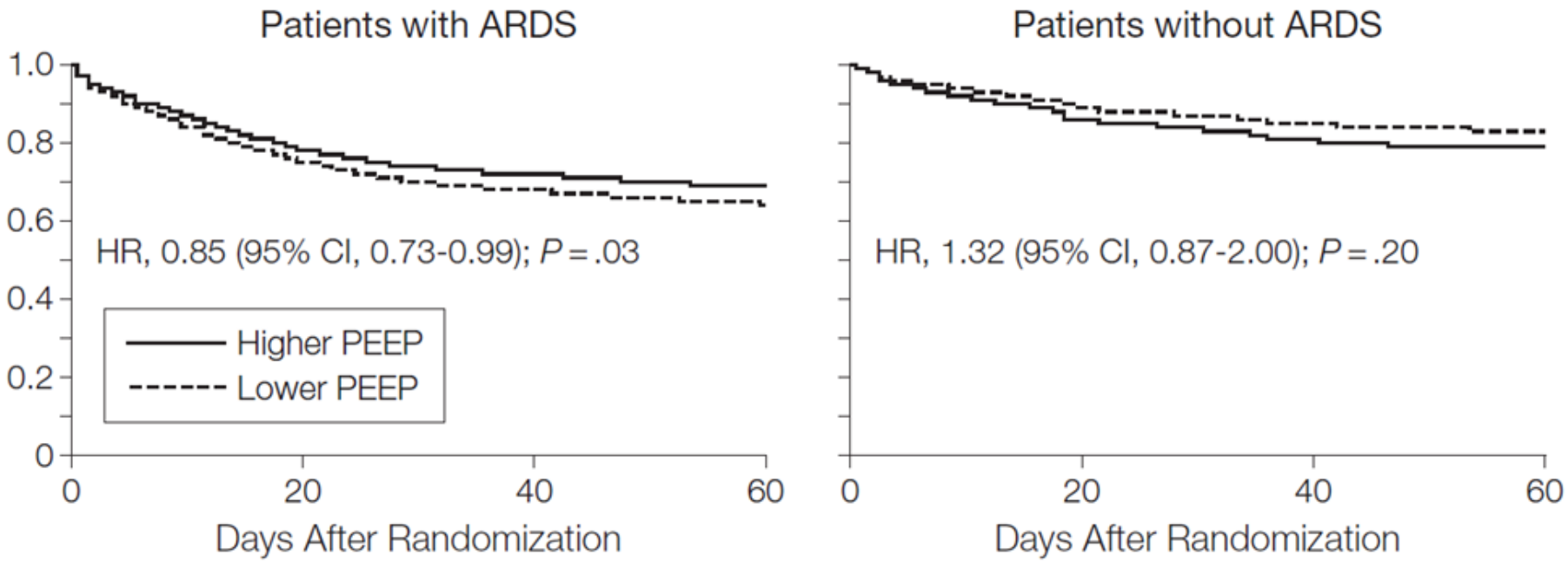
PEP augmentée et pronostic





Mercat, Jama 2008

Méta-analyse des essais



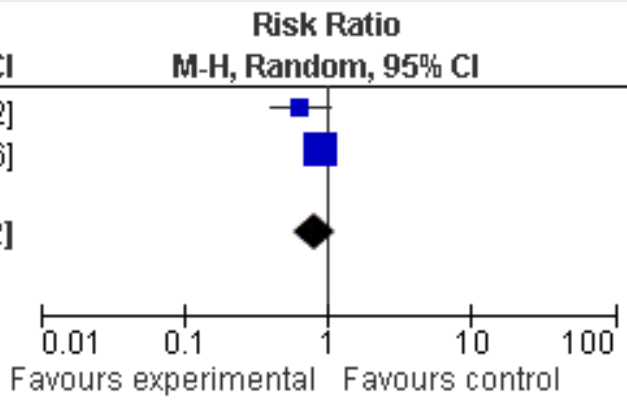
Briel, JAMA 2010

Essais avec manœuvres de recrutement

Study or Subgroup	Treatment Events	Treatment Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Amato 1998	13	29	17	24	29.1%	0.63 [0.39, 1.02]
Meade 2008	173	475	205	508	70.9%	0.90 [0.77, 1.06]
Total (95% CI)		**504**		**532**	**100.0%**	**0.81 [0.59, 1.12]**
Total events	186		222			

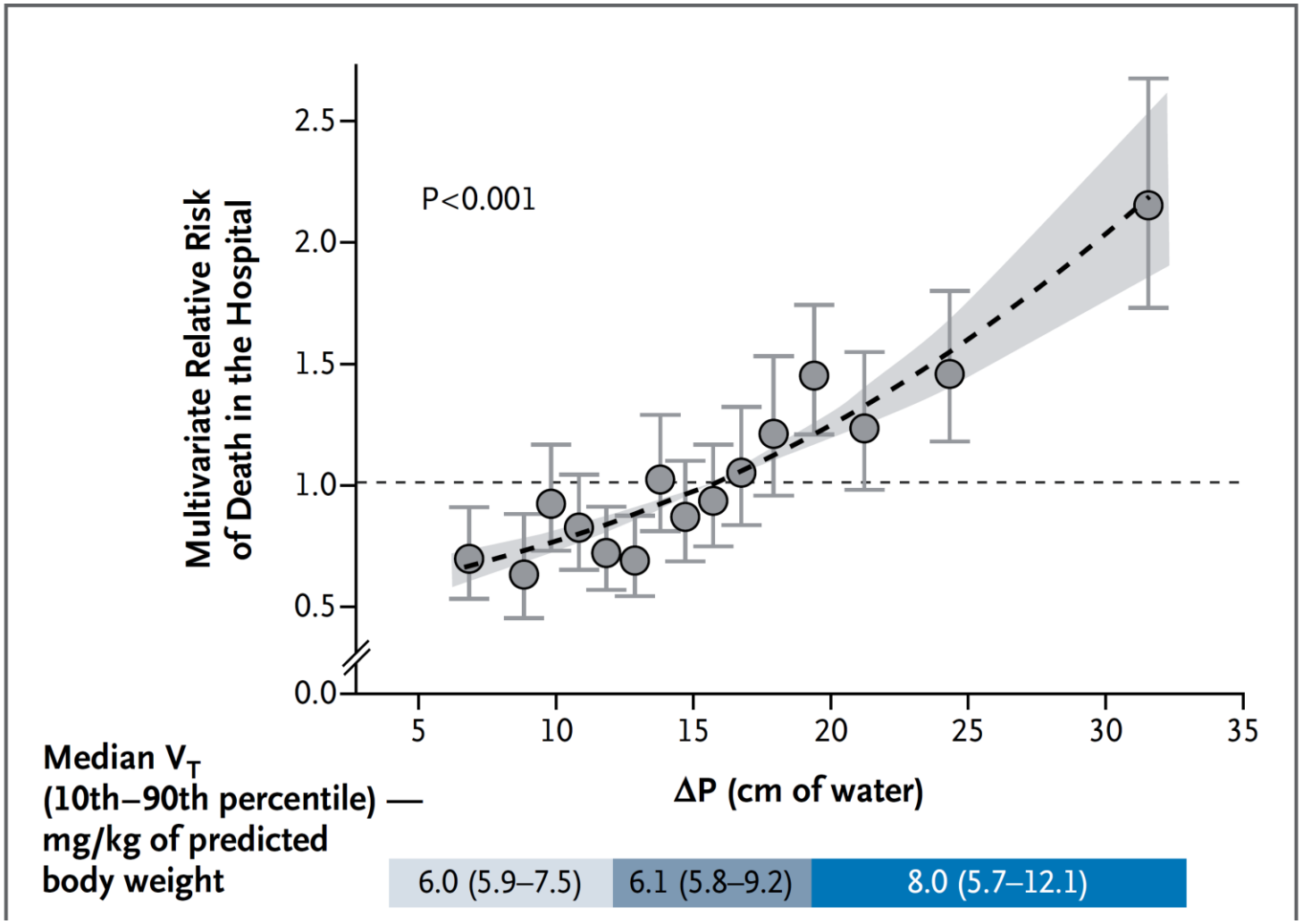
Heterogeneity: Tau² = 0.03; Chi² = 1.92, df = 1 (P = 0.17); I² = 48%

Test for overall effect: Z = 1.27 (P = 0.20)



Keating, Cochrane 2012

Driving pressure



Amato, NEJM 2015

Driving pressure

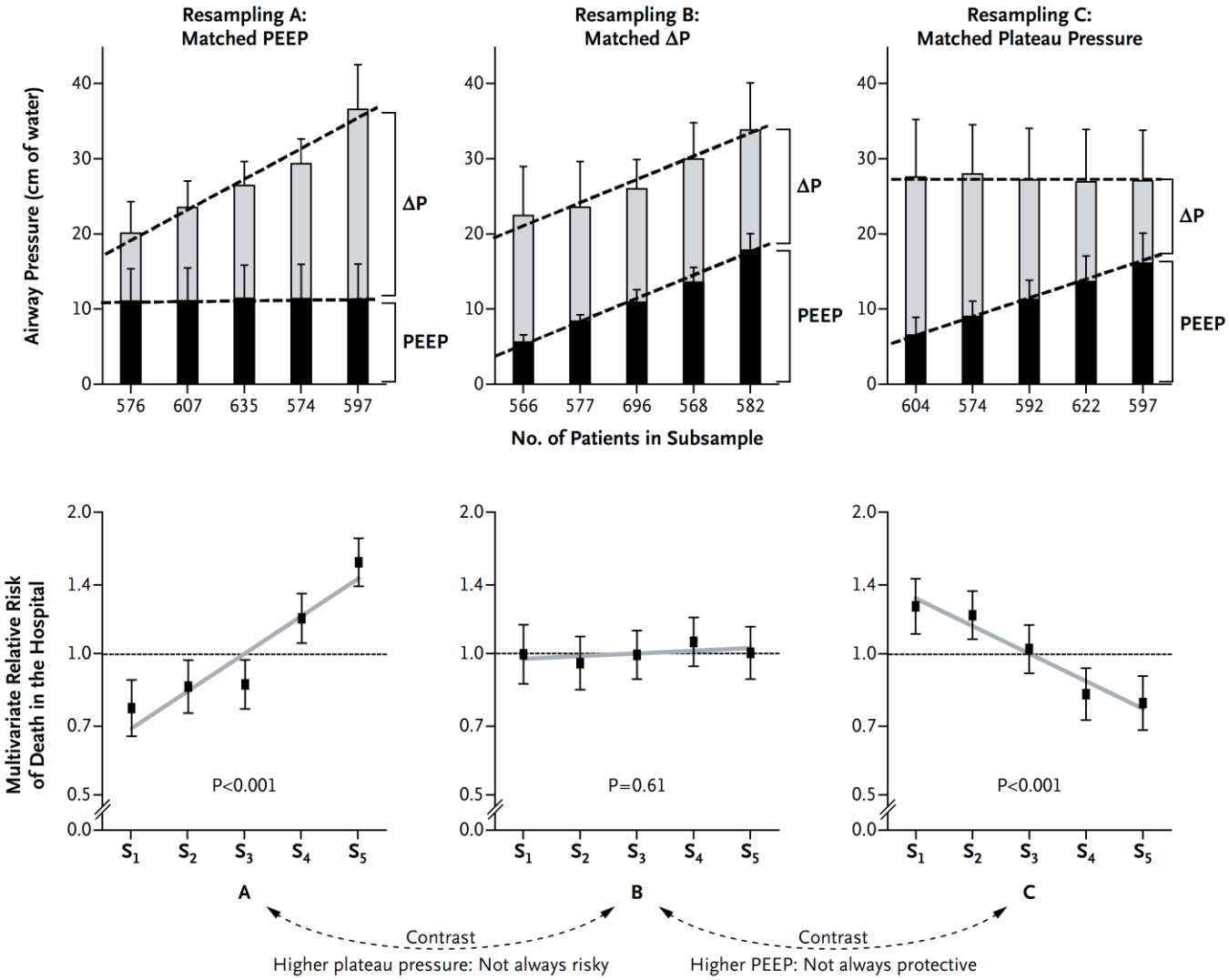


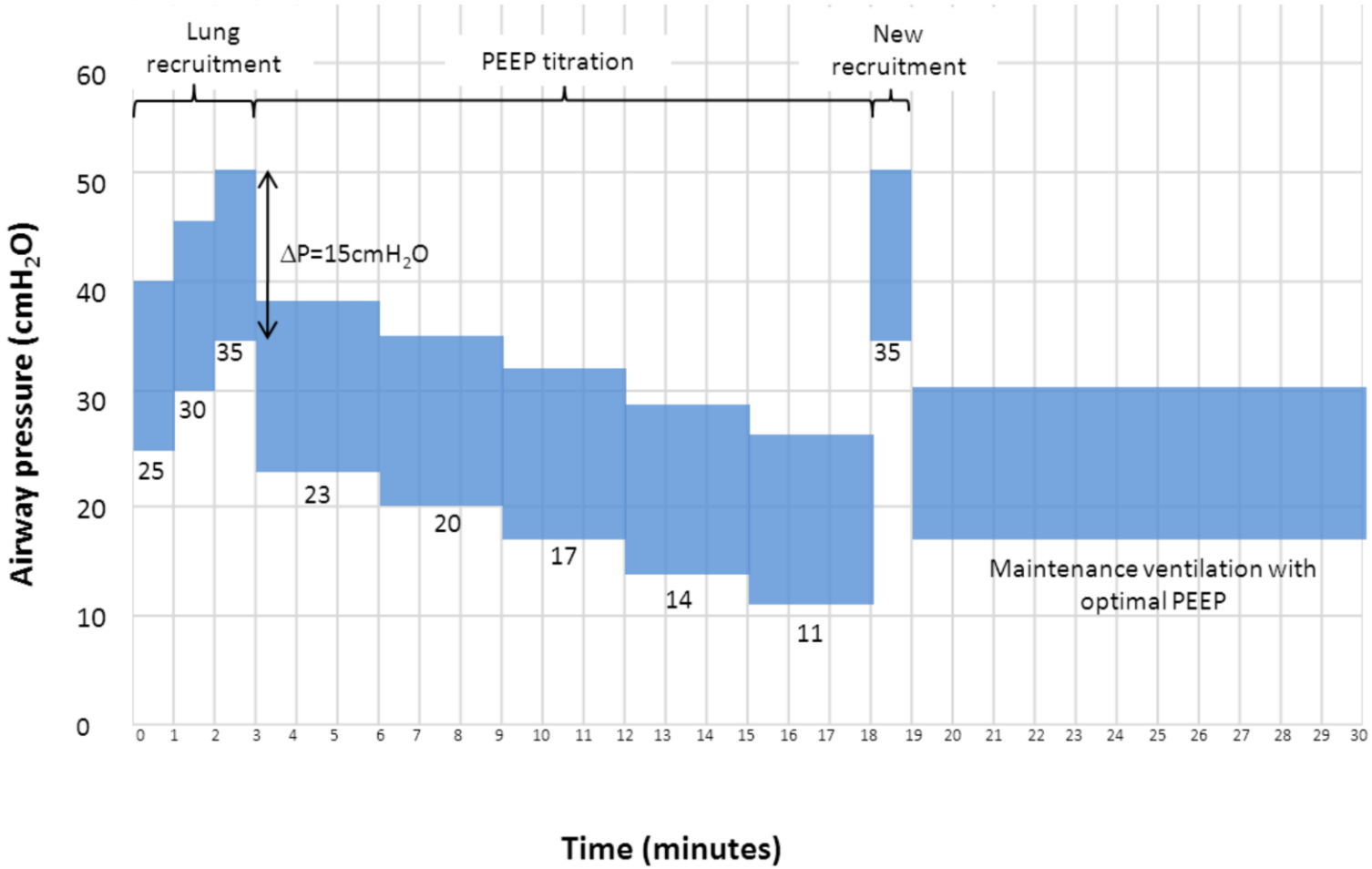
Figure 1. Relative Risk of Death in the Hospital across Relevant Subsamples after Multivariate Adjustment — Survival Effect of Ventilation Pressures.

Amato, NEJM 2015

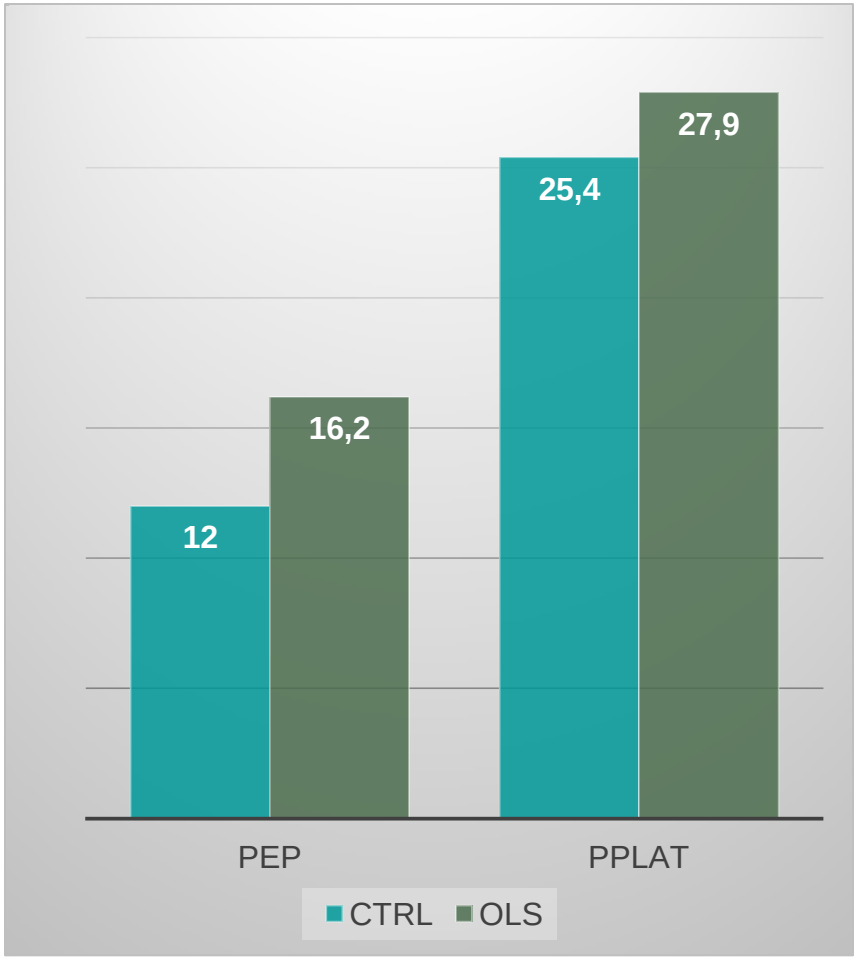
Etude ART

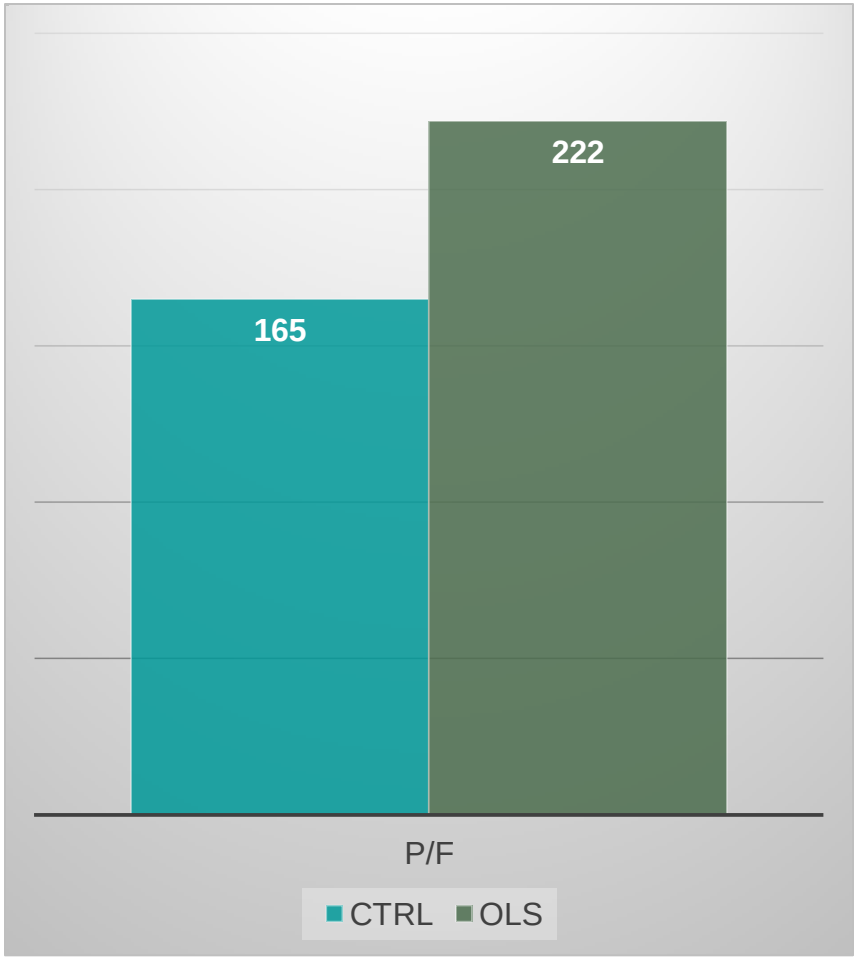
- Bolus de curare
- Remplissage vasculaire si signes d'hypovolémie
- Recrutement 1
  - PEP croissante (25 →35→45)
  - PEP décroissante (23→11); mesure Crs
- Recrutement 2
  - PEP 45
  - PEP décroissante (→ Best Crs+2)

- Bolus de curare
- Remplissage vasculaire si signes d'hypovolémie
- Recrutement 1
  - PEP croissante (25 →30→35)
  - PEP décroissante (23→11); mesure Crs
- Recrutement 2
  - PEP 35
  - PEP décroissante (→ Best Crs+2)

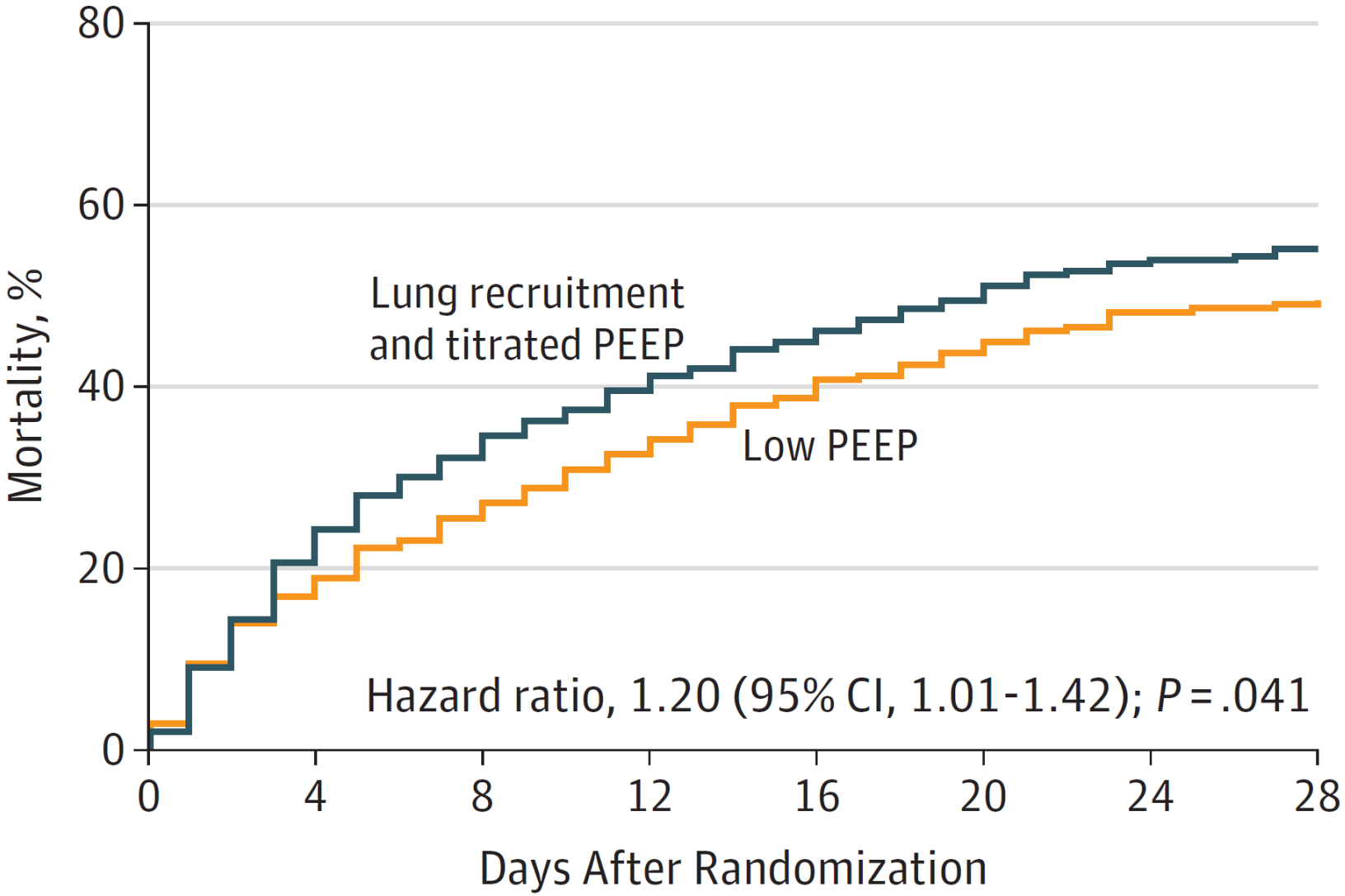

Lung recruitment
PEEP titration
New recruitment
ΔP=15cmH2O
Airway pressure (cmH2O)
Time (minutes)
25
30
35
23
20
17
14
11
35
Maintenance ventilation with optimal PEEP

Etude ART





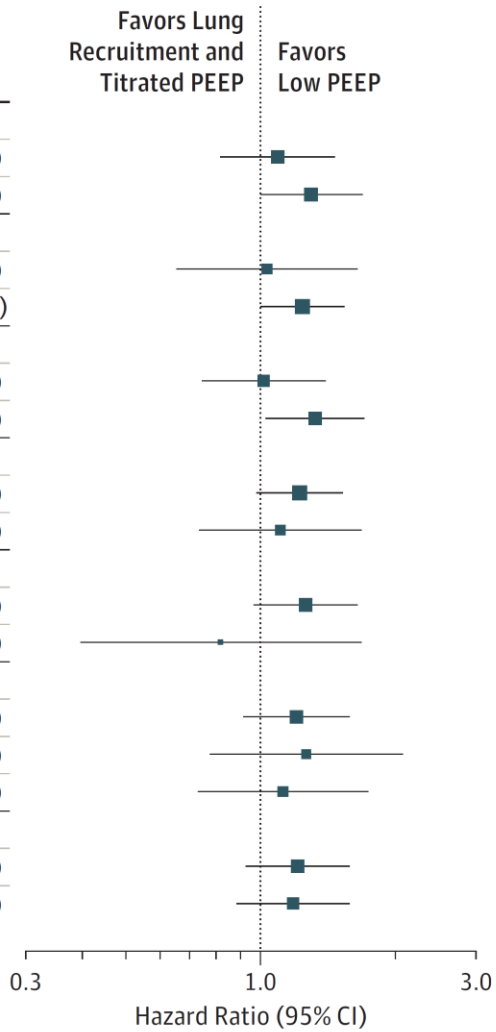
Poumon ouvert et pronostic



ART trial, NEJM 2017

Figure 3. Effects of the Lung Recruitment Maneuver With Titrated PEEP vs the Low-PEEP Group on Mortality According to Subgroups

Subgroup	No. of Deaths/Total No. (%)		Hazard Ratio (95% CI)	*P* Value for Interaction
	Lung Recruitment and Titrated PEEP (n = 501)	Low PEEP (n = 509)		
PaO_2: FIO_2				
≤100 mm Hg	117/197 (59.4)	120/214 (56.1)	1.09 (0.82-1.46)	.33
>100 mm Hg	160/304 (52.6)	131/295 (44.4)	1.30 (1.00-1.69)	
Simplified Acute Physiology Score 3				
<50	47/117 (40.2)	48/119 (40.3)	1.03 (0.65-1.64)	.42
≥50	230/384 (59.9)	203/390 (52.1)	1.24 (1.00 -1.54)	
Type of ARDS				
Extrapulmonary	98/188 (52.1)	102/196 (52)	1.02 (0.74-1.40)	.15
Pulmonary	179/313 (57.2)	149/313 (47.6)	1.32 (1.03-1.69)	
Duration of ARDS at randomization, h				
≤36	214/388 (55.2)	196/405 (48.4)	1.22 (0.98-1.52)	.63
>36 to <72	63/113 (55.8)	55/104 (52.9)	1.11 (0.73-1.67)	
Position 1 h after randomization				
Supine (dorsal decubitus) or lateral decubitus	153/274 (55.8)	132/273 (48.4)	1.26 (0.96-1.64)	.21
Prone	19/31 (61.3)	20/30 (66.7)	0.82 (0.40-1.67)	
Duration of mechanical ventilation before randomization, d				
0-2	160/297 (53.9)	152/320 (47.5)	1.20 (0.92-1.56)	.91
3-4	54/88 (61.4)	41/77 (53.2)	1.26 (0.77-2.07)	
≥5	63/116 (54.3)	58/112 (51.8)	1.12 (0.73-1.71)	
Protocol modification				
Before	151/273 (55.3)	138/280 (49.3)	1.21 (0.93-1.57)	.89
After	126/228 (55.3)	113/229 (49.3)	1.18 (0.88-1.58)	



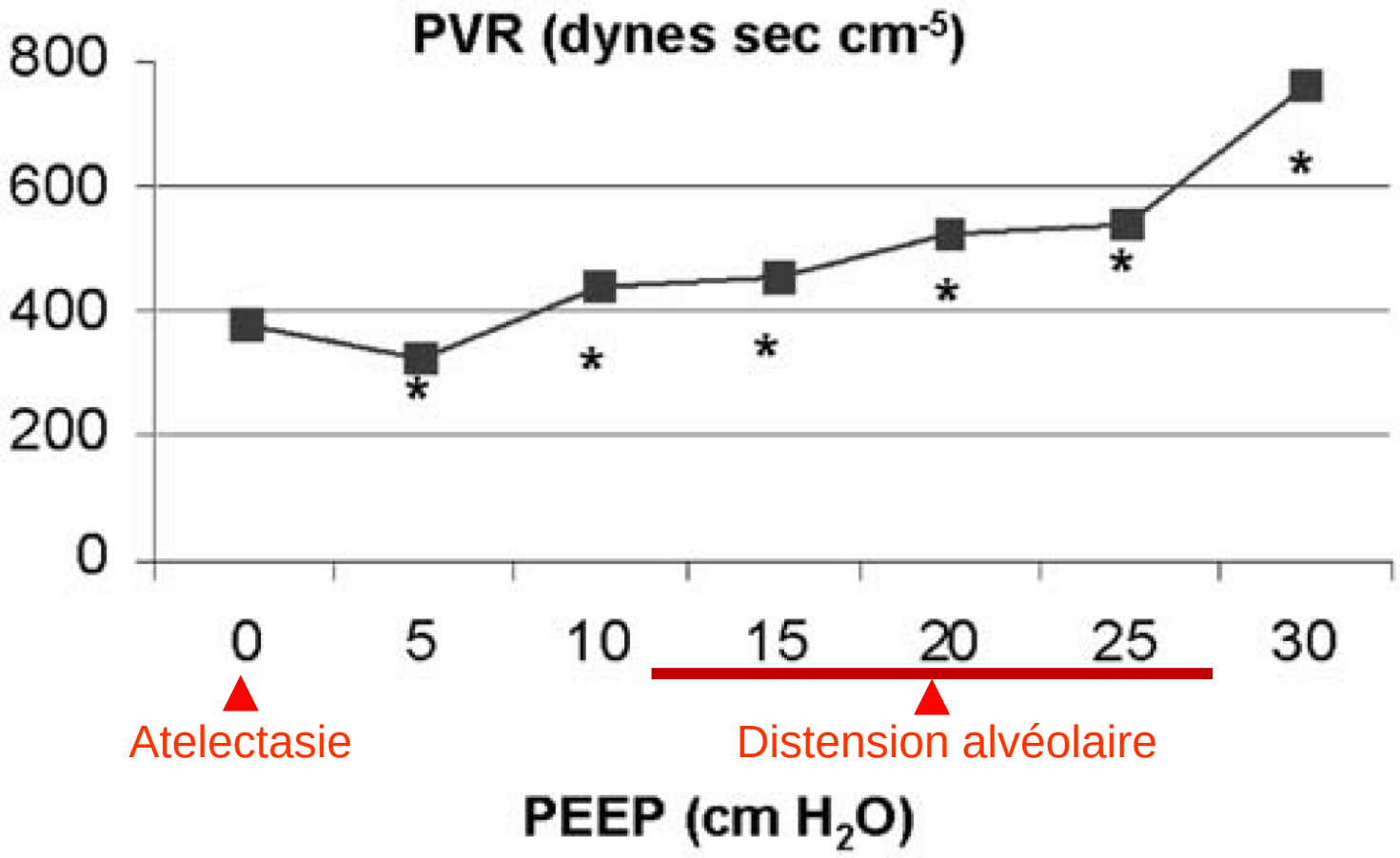
Intolérance hémodynamique

Volemia optimized before alveolar recruitment, No. of events (%) [a]	341 (89.7)
Reason for interrupting alveolar recruitment maneuver, No. of events (%)	
Heart rate <60bpm or >150bpm	2/78 (2.6)
Mean blood pressure <65mmHg or systolic blood pressure <90mmHg	57/78 (73.1)
SpO_2 <88% for longer than 30s	16/78 (20.5)

La mauvaise tolérance hémodynamique malgré un remplissage vasculaire préalable suggère un effet postcharge VD

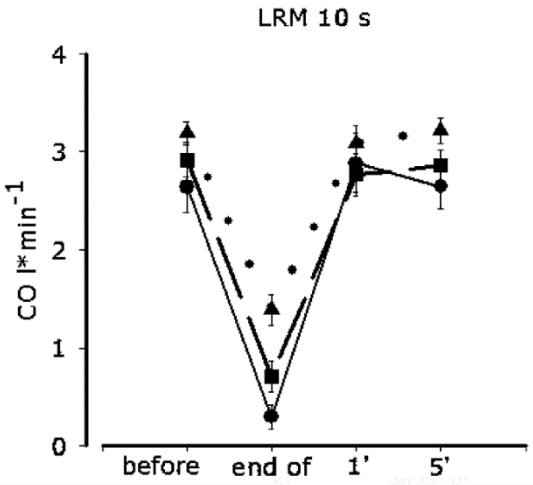
ART trial, NEJM 2017

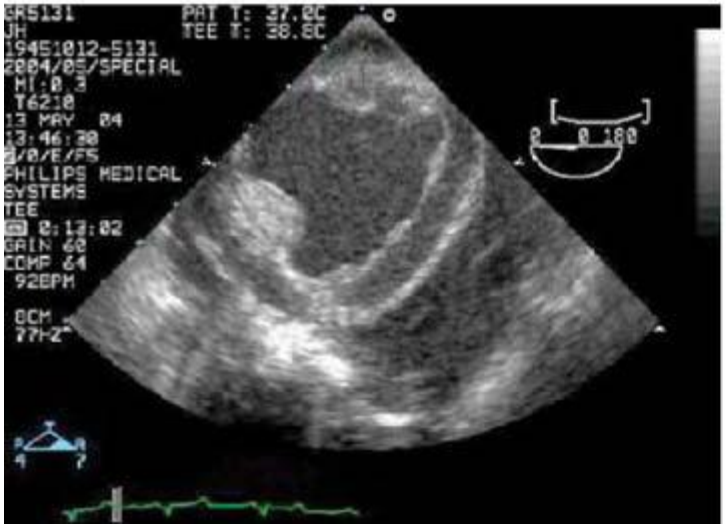
PEP et circulation pulmonaire

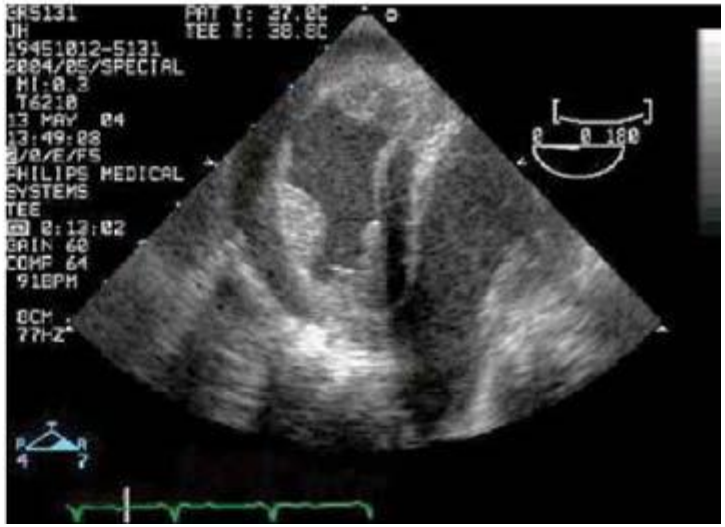


Jardin, ICM 2003

Postcharge VD et manœuvres de recrutement



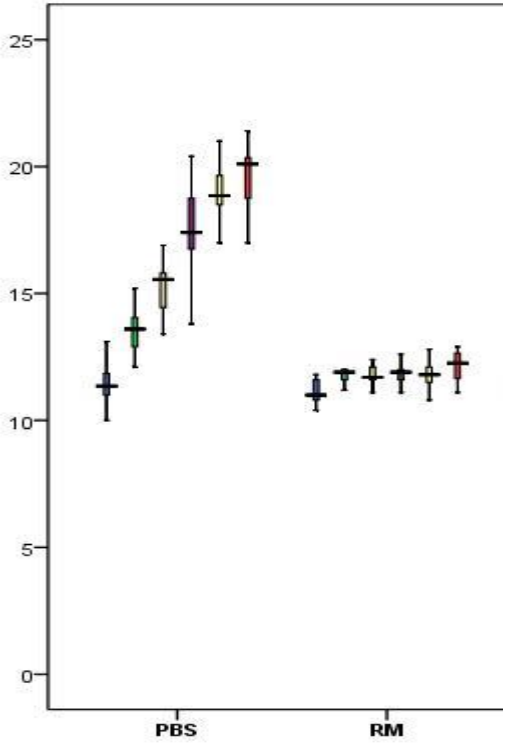




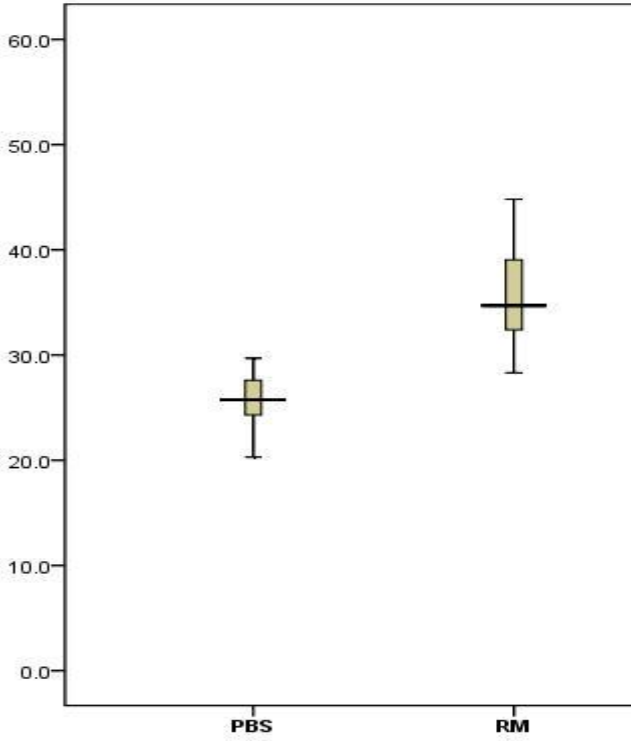
Nielsen, ICM 2006 (lavaged pig)

RM and lung vascular dysfunction

Paw

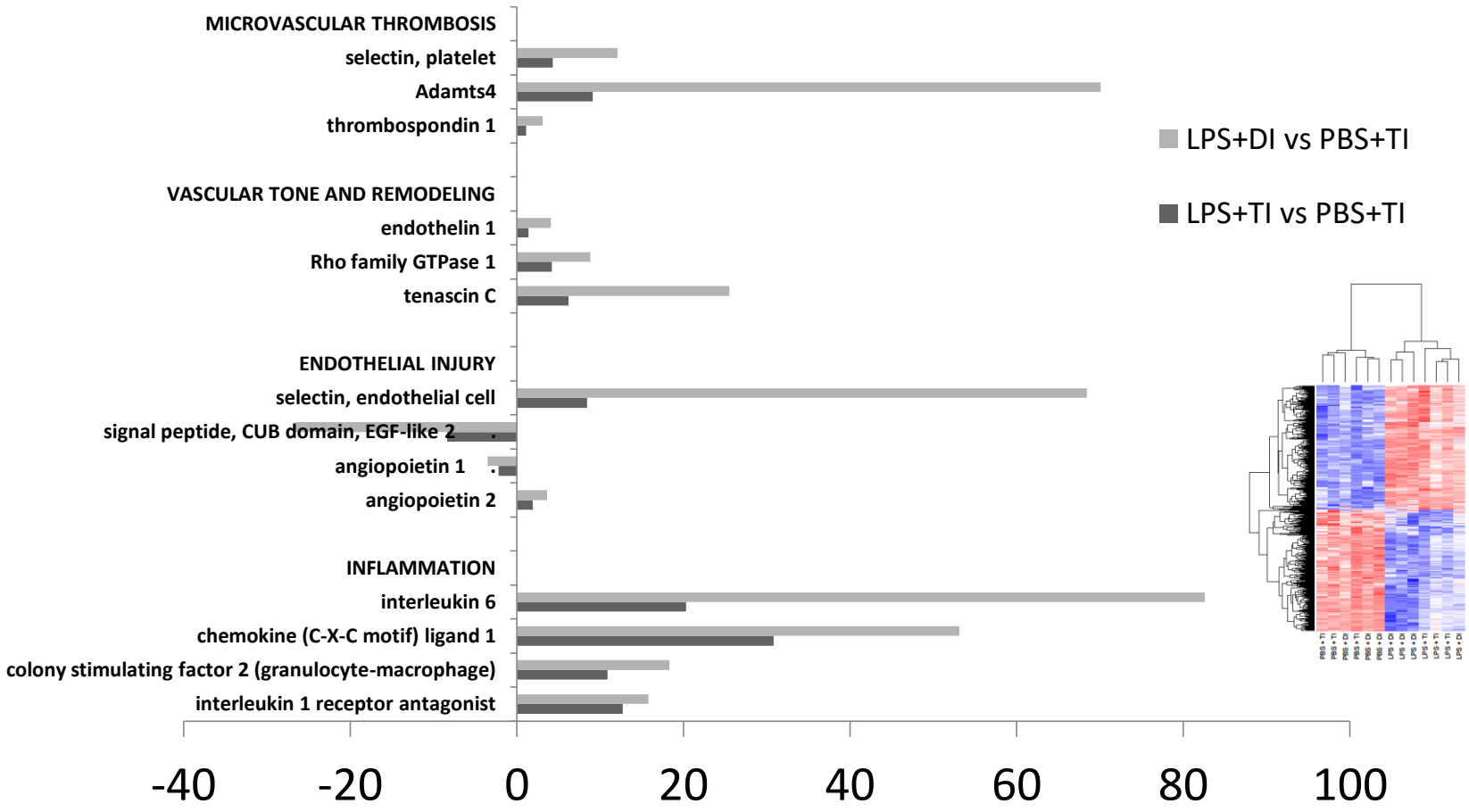


RV pressure



Mekontso Dessap, AJRCMB 2012

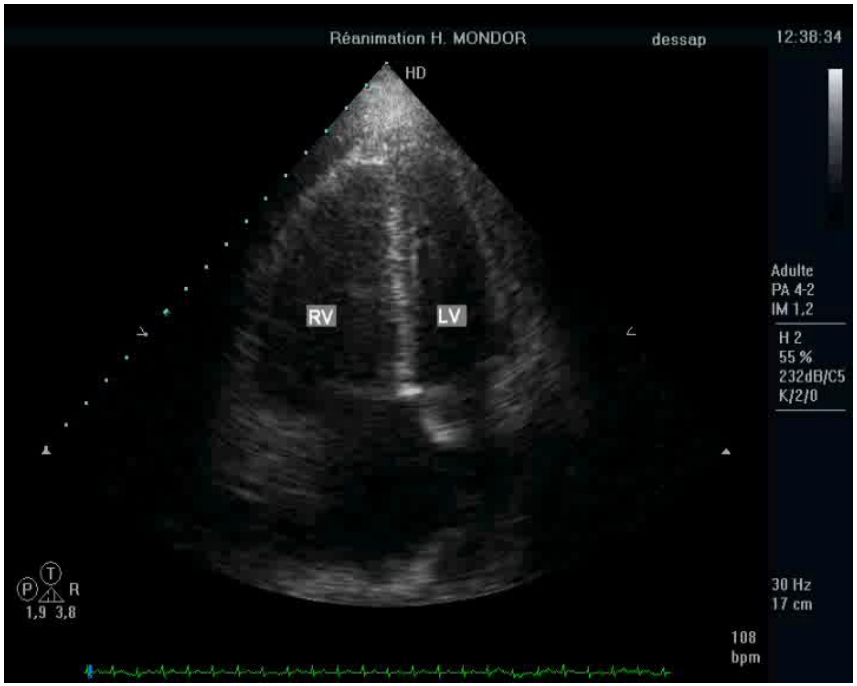
RM and lung vascular dysfunction
Lungs microarrays



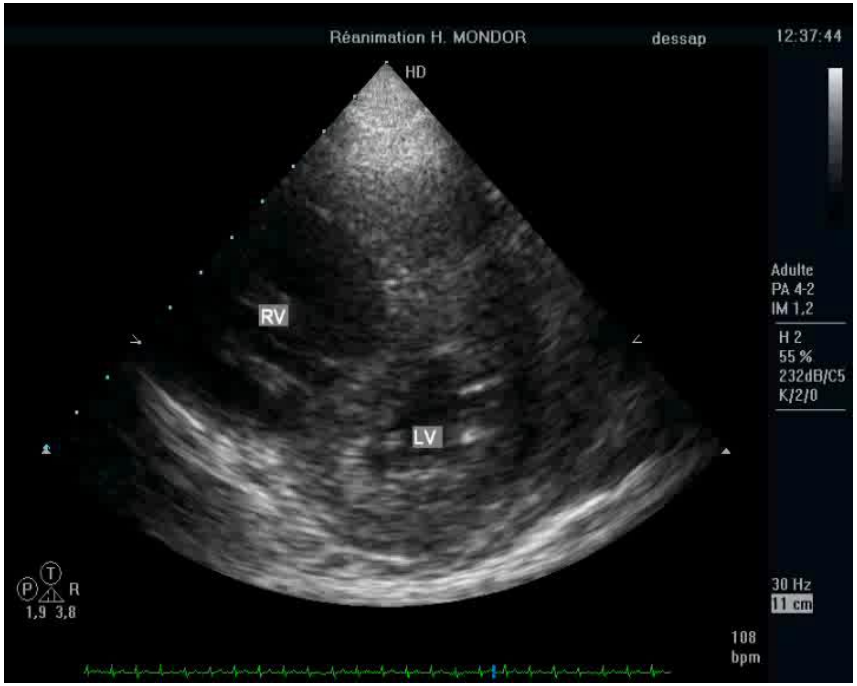
Mekontso Dessap, AJRCMB 2012

Coeur pulmonaire aigu

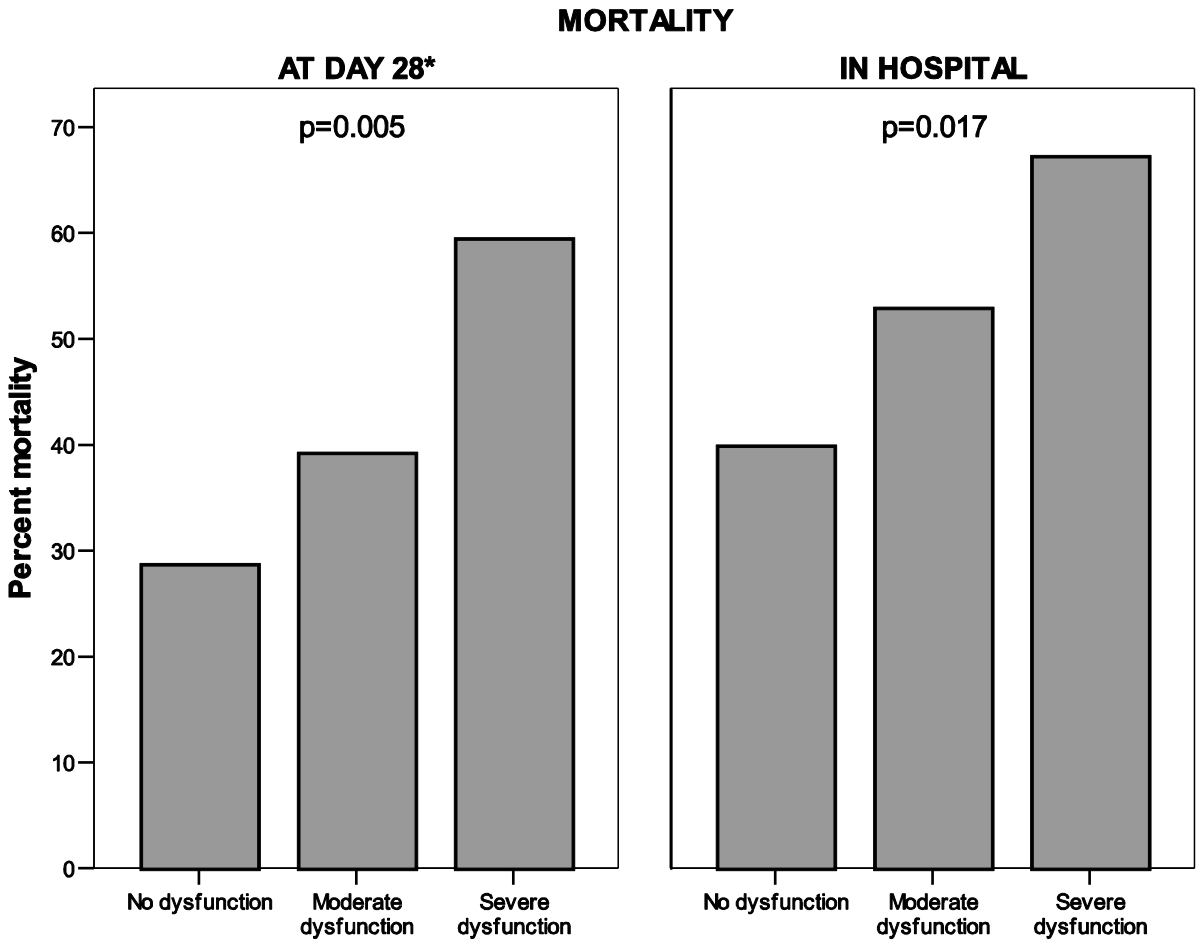
Dilatation VD



Septum paradoxal

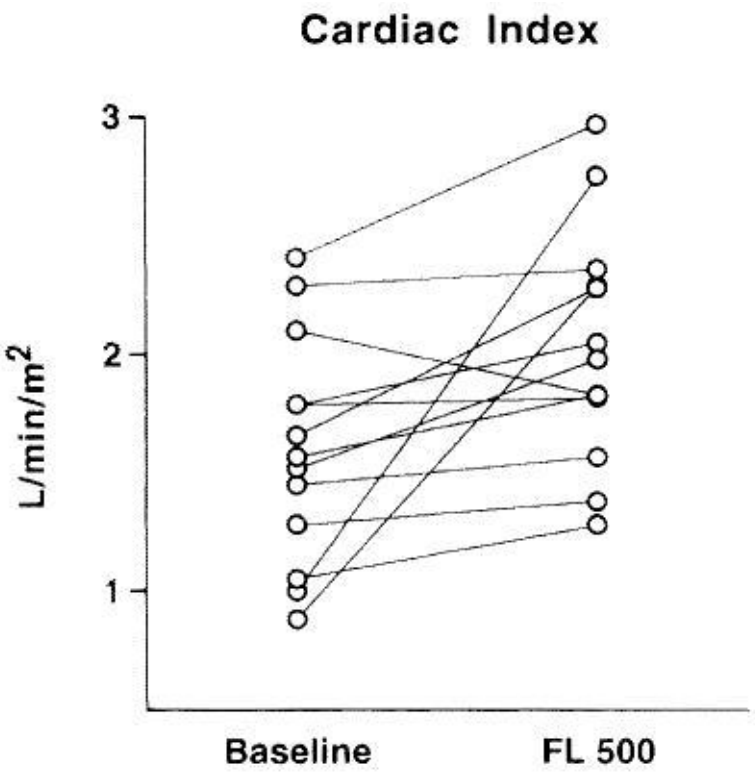


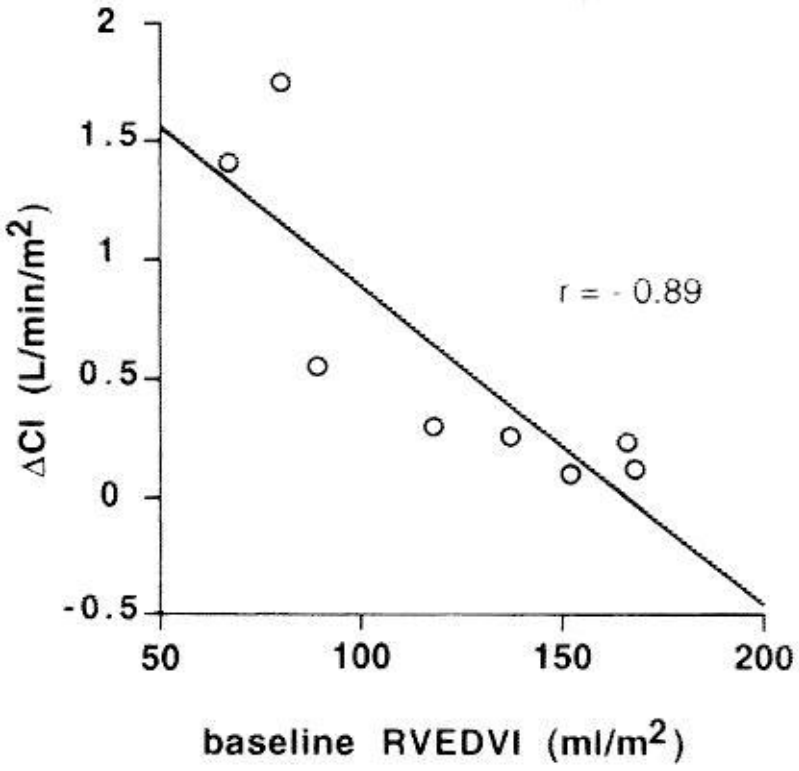
Dysfonction vasculaire pulmonaire et pronostic



Boissier, ICM 2013

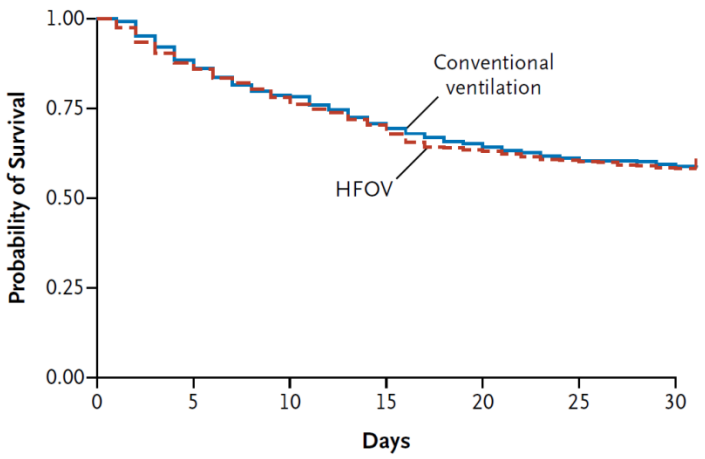
Postcharge VD et volémie



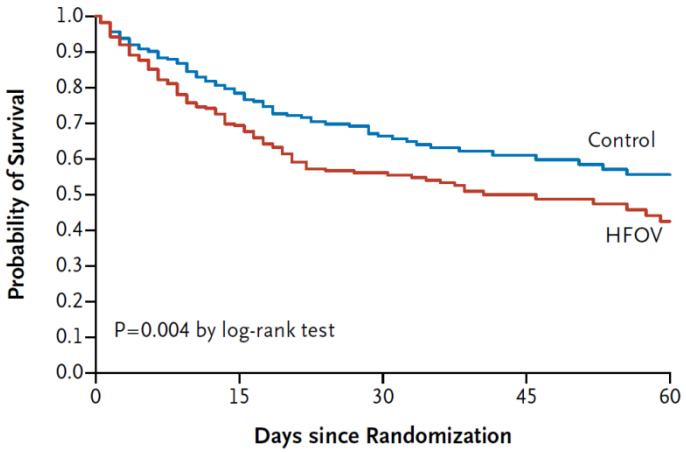


EP massive
Mercat, CCM 1999

HFO



No. at Risk							
Conventional ventilation	397	351	312	281	259	243	236
HFOV	398	349	311	280	253	241	233

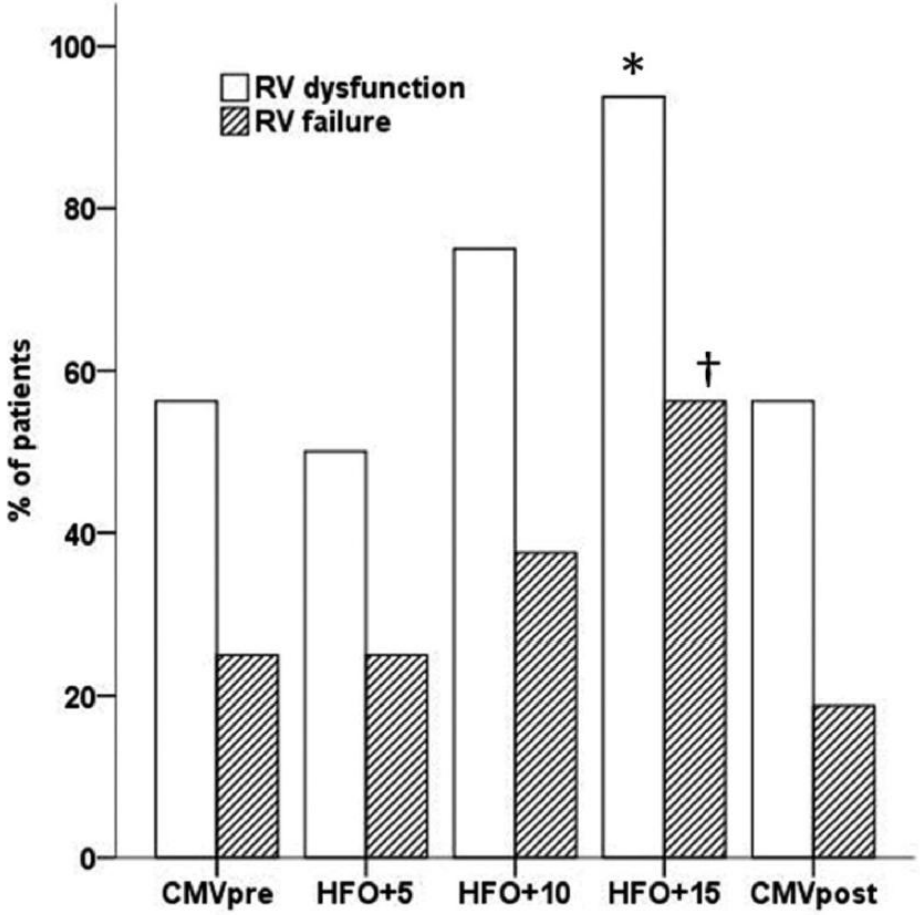


No. at Risk					
HFOV	275	169	98	54	26
Control	273	181	92	54	39

OSCAR, NEJM 2013

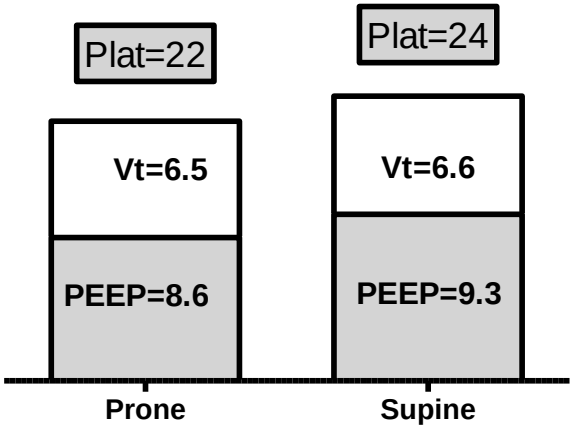
OSCILLATE, NEJM 2013

Tolérance hémodynamique HFO

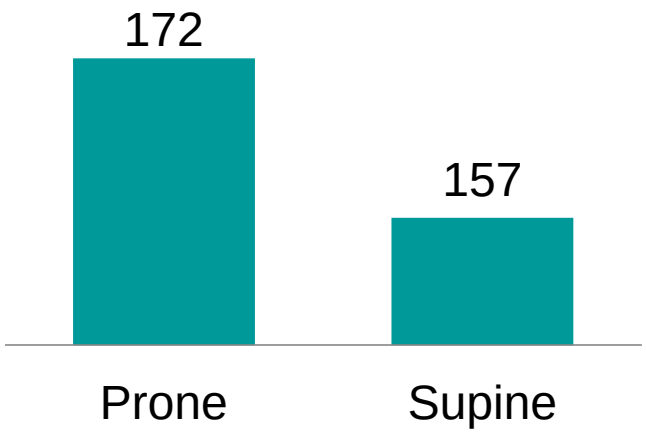


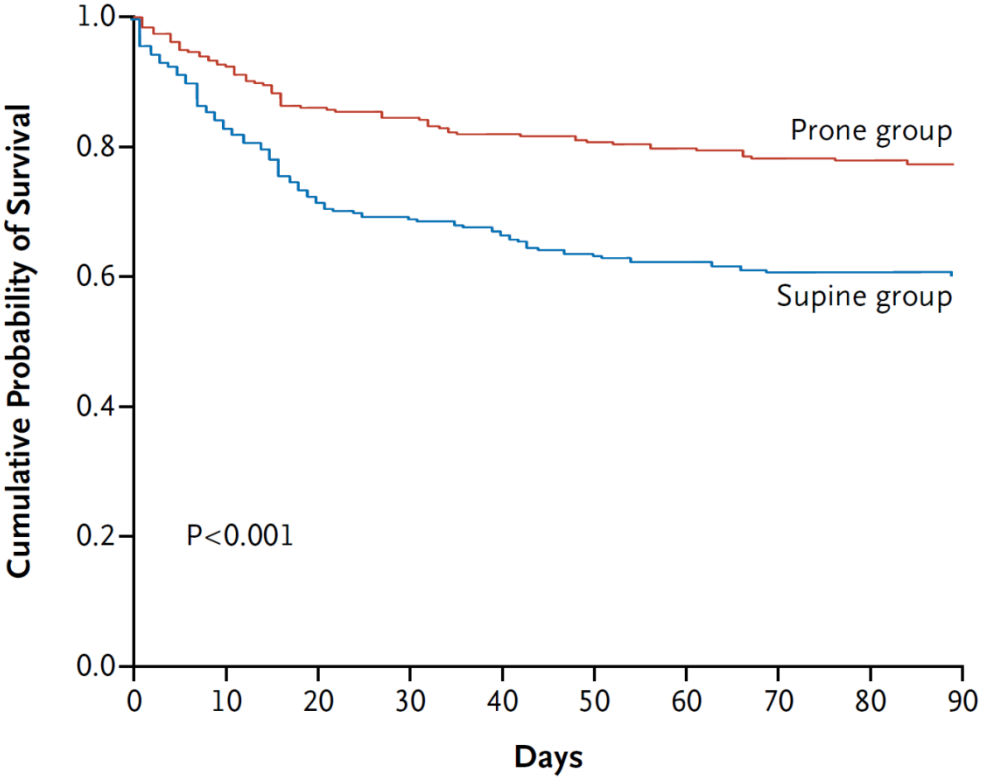
Guervilly, CCM 2012

DV

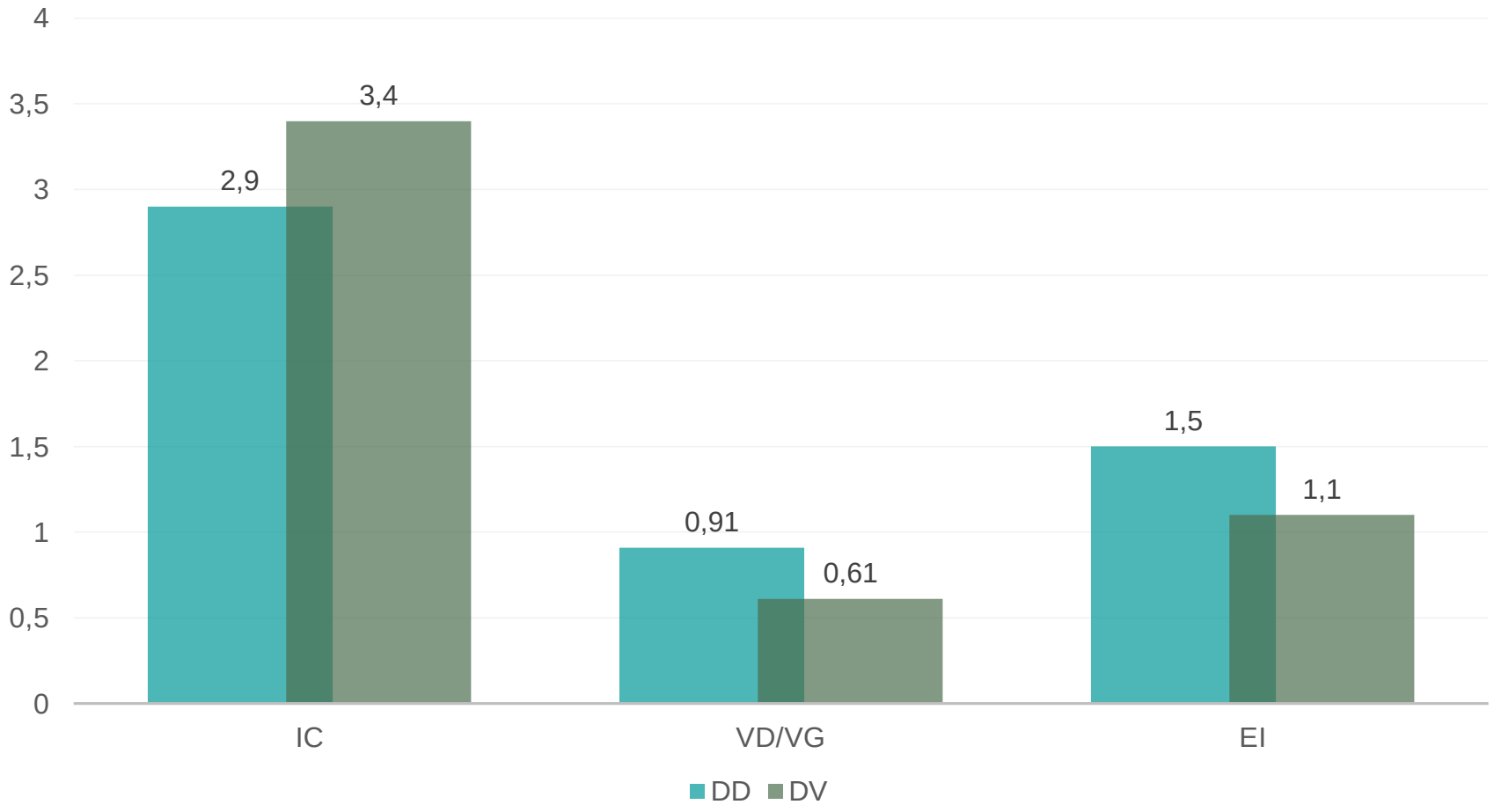


PROSEVA, NEJM 2013
(P/F<150)





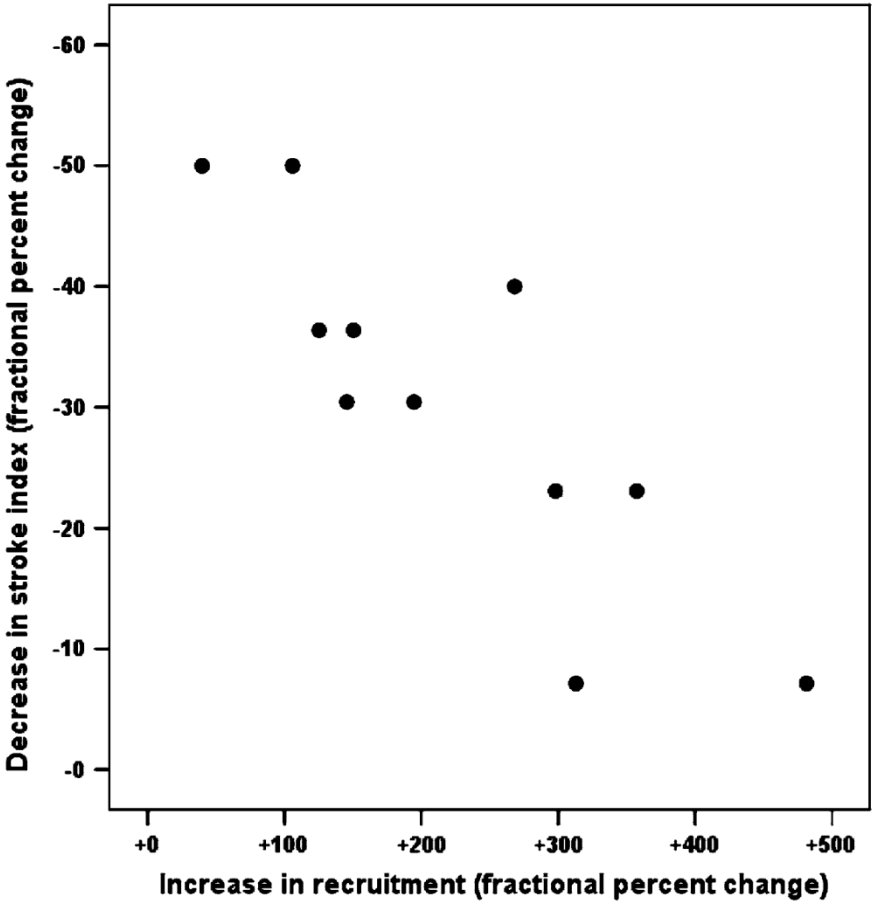
DV et circulation pulmonaire



Vieillard-Baron, Chest 2007

QUELLE SOLUTION ?

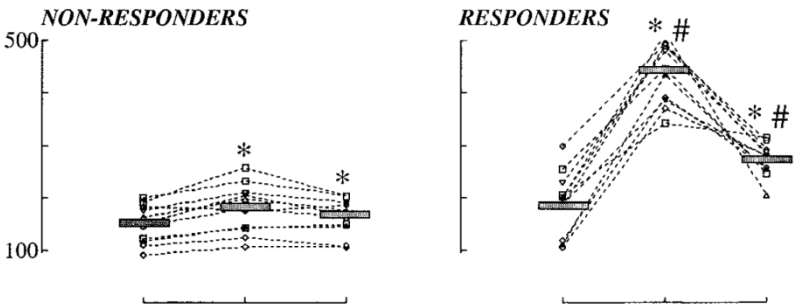
Recrutement alvéolaire et circulation pulmonaire



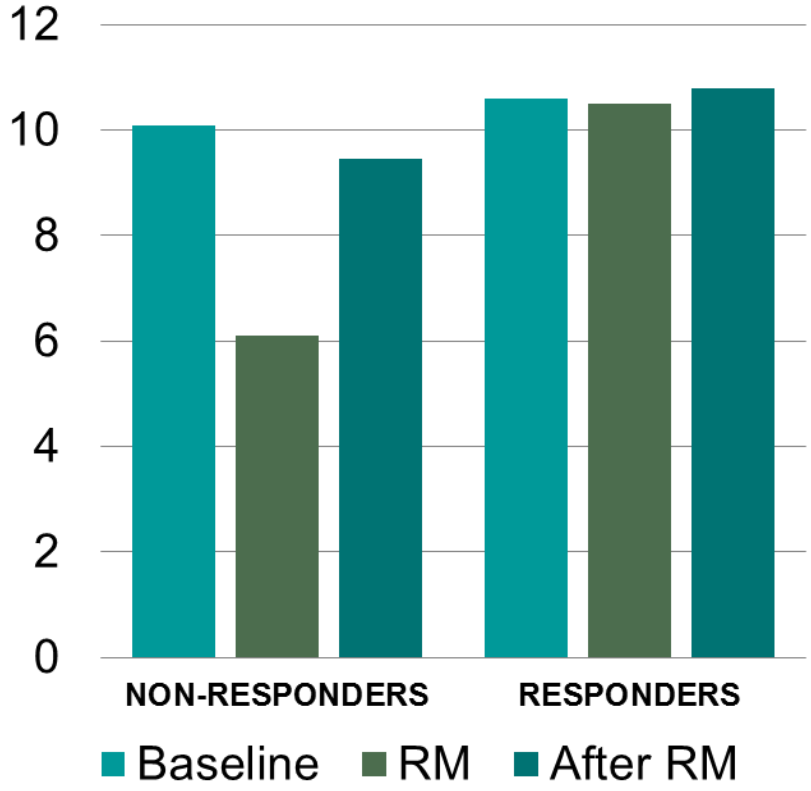
Mekontso Dessap, ICM 2008

Tolérance hémodynamique manœuvres de recrutement

P/F

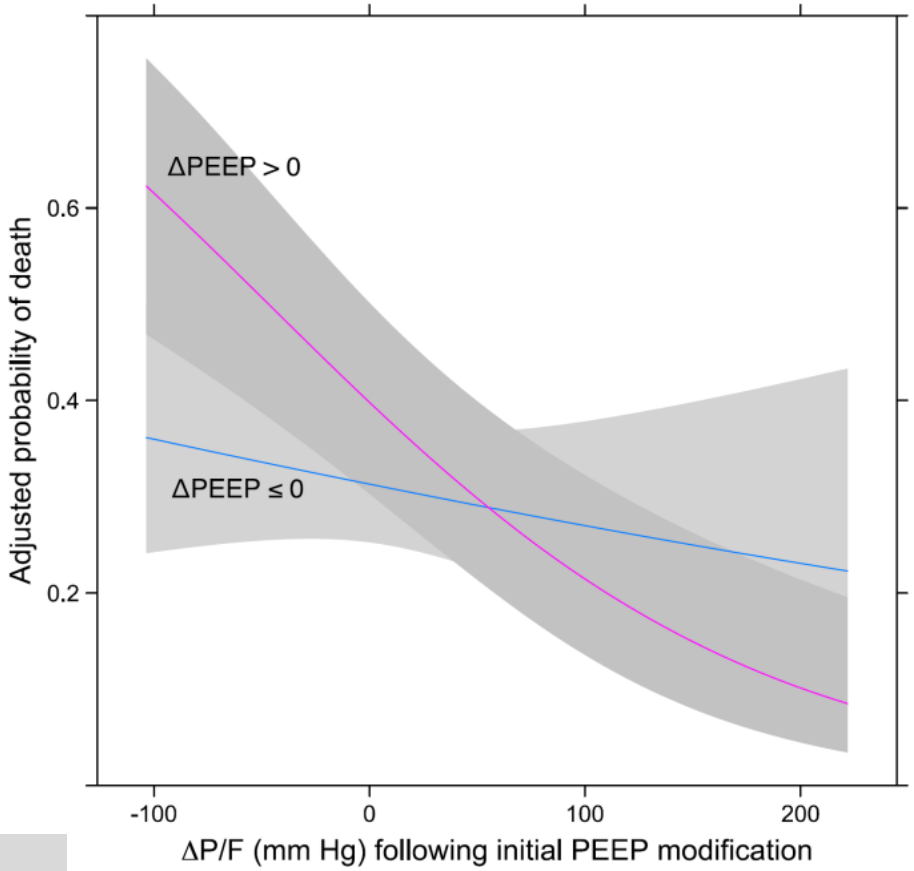


DC



Grasso, Anesthesiology 2002

Individualisation de la PEP ?



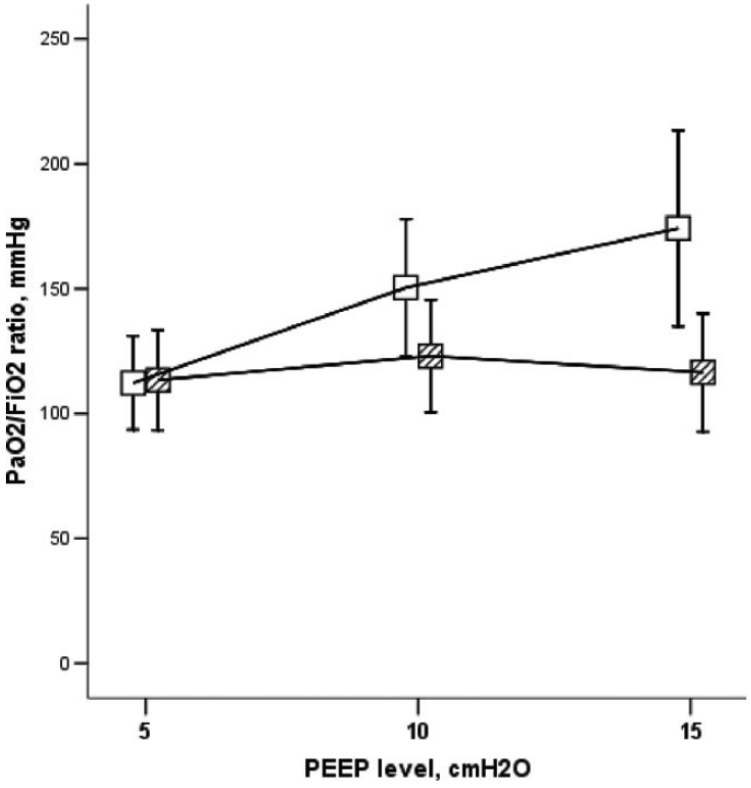
Goligher, AJRCCM 2014

Hypoxémie multifactorielle

- Shunt pulmonaire
- Basse PvO_2 (admission veineuse)
- Shunt intracardiaque (PFO)

Shunt intracardiaque

	No PFO (n=164)	PFO (n=39)	P value
RV/LV ratio	0.8 ± 0.3	1.0 ± 0.3	<0.01
PAPs	35 ± 18	43 ±17	0.04
ACP	18%	39%	<0.01



Mekontso Dessap, CCM 2010

Conclusion

Stratégie poumon ouvert

ALVEOLES OUVERTES

- Man[illegible] de recrut[illegible]nt
- HFO[illegible]
- PEP élevée