



SDRA : Un cas clinique – 12 questions

Alain Mercat

alain.mercat@univ-angers.fr

Liens d'intérêts

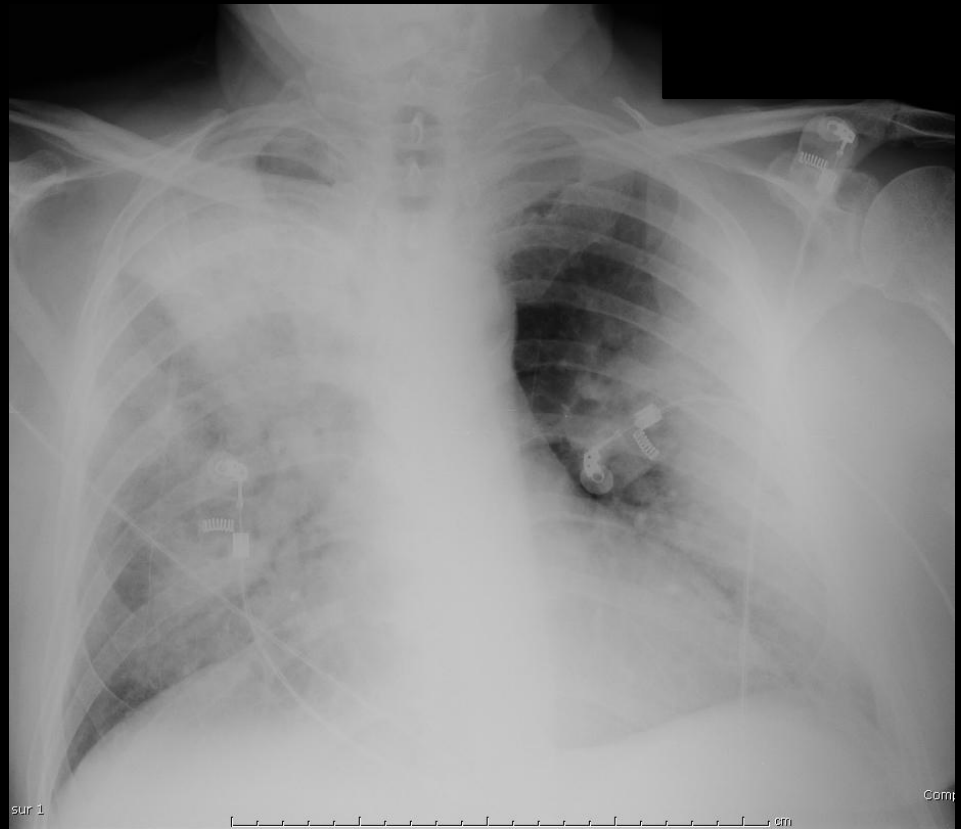
- Financement de travaux de recherche
 - Covidien (PAV+)
 - General Electric (CRF/SDRA)
 - Maquet (NAVA)
 - Fisher-Paykel (Optiflow)
- Brevet
 - General Electric (EELV/PEEP/recrutement)
- Exposés lors de congrès
 - Covidien
 - Alung technologies
- Activité d'expertise
 - Faron Pharmaceuticals
 - Air Liquide Medical Systems

Cas clinique

- Mr G, vigneron, 48 ans, 1.78 m – 97 kg
- Toux et fièvre depuis 4 jours, dyspnée croissante depuis 2 jours
- Aux urgences : T° 39° 2 C, FR 35/mn, dyspnée ++
- FC 110 bpm, PA 105/55 mmHg, pas de signe de choc, GCS 15/15
- GB 11 000/mm³, Hb 14 g/dl, plaquettes 89 000 /mm³
- Urée-créatinine : N, ASAT-ALAT : 3N, bili : N, TP : 85 %
- Ag urinaire *L. pneumophila* : Positif (→ levofloxacin)

Admission

- O₂ 15 L/mn (masque), FR = 35/mn, dyspnée ++
- pH 7.47 PaCO₂ 34 mmHg PaO₂ 61 mmHg SaO₂ 89 %
- Lactate 3.2 mmol/L



Q1 : Que proposez-vous ?

VNI

O2 nasale à haut débit

Intubation

VNI et IRA hypoxémique: Oxygénation

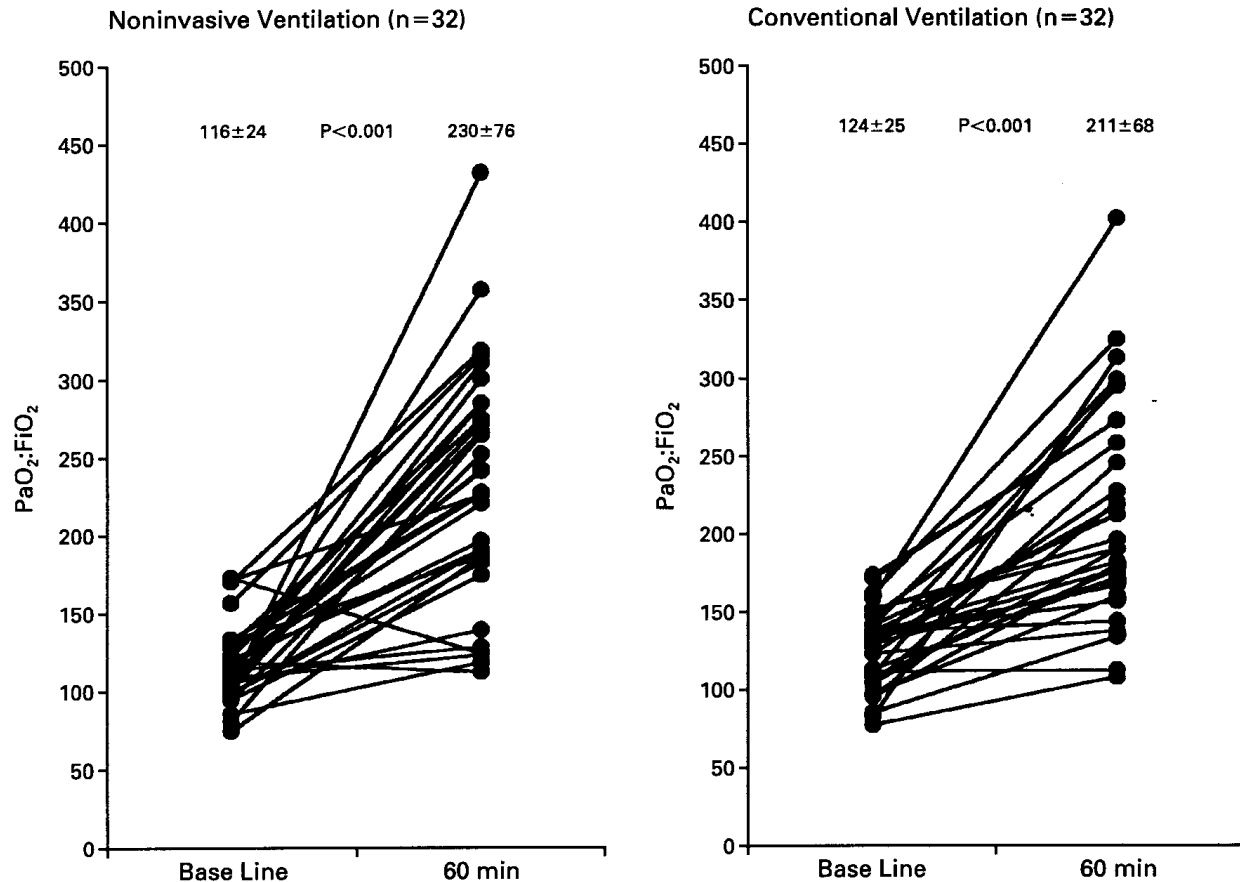


Figure 1. The Ratio of the Partial Pressure of Arterial Oxygen to the Fraction of Inspired Oxygen ($\text{PaO}_2:\text{FiO}_2$) at Base Line and after One Hour of Mechanical Ventilation in Patients with Acute Respiratory Failure in the Noninvasive-Ventilation and Conventional-Ventilation Groups.

A paired t-test was used for the statistical comparison. The degree of improvement in gas exchange after the start of mechanical ventilation was similar in the two groups. The values shown within the panels are means $\pm$ SD.

VNI et IRA hypoxémique

- Bénéfice sur la mortalité non démontré

(Keenan Crit Care Med 2004)

- Risque d'intubation en extrême urgence (ACR)

(Delclaux et al. JAMA 2000)

- Difficulté d'éviter des VTs élevés liés à une demande ventilatoire très élevée (SDRA)

- Possible augmentation de mortalité en cas d'échec

(Demoule et al. ICM 2006)

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D.,
Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D.,
Sébastien Perbet, M.D., Gwénael Prat, M.D., Thierry Boulain, M.D.,
Elise Morawiec, M.D., Alice Cottureau, M.D., Jérôme Devaquet, M.D.,
Saad Nseir, M.D., Ph.D., Keyvan Razazi, M.D., Jean-Paul Mira, M.D., Ph.D.,
Laurent Argaud, M.D., Ph.D., Jean-Charles Chakarian, M.D.,
Jean-Damien Ricard, M.D., Ph.D., Xavier Wittebole, M.D., Stéphanie Chevalier, M.D.,
Alexandre Herbland, M.D., Muriel Fartoukh, M.D., Ph.D.,
Jean-Michel Constantin, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Marc Pierrot, M.D.,
Armelle Mathonnet, M.D., Gaëtan Béduneau, M.D., Céline Delétage-Métreau, Ph.D.,
Jean-Christophe M. Richard, M.D., Ph.D., Laurent Brochard, M.D.,
and René Robert, M.D., Ph.D., for the FLORALI Study Group and the REVA Network*

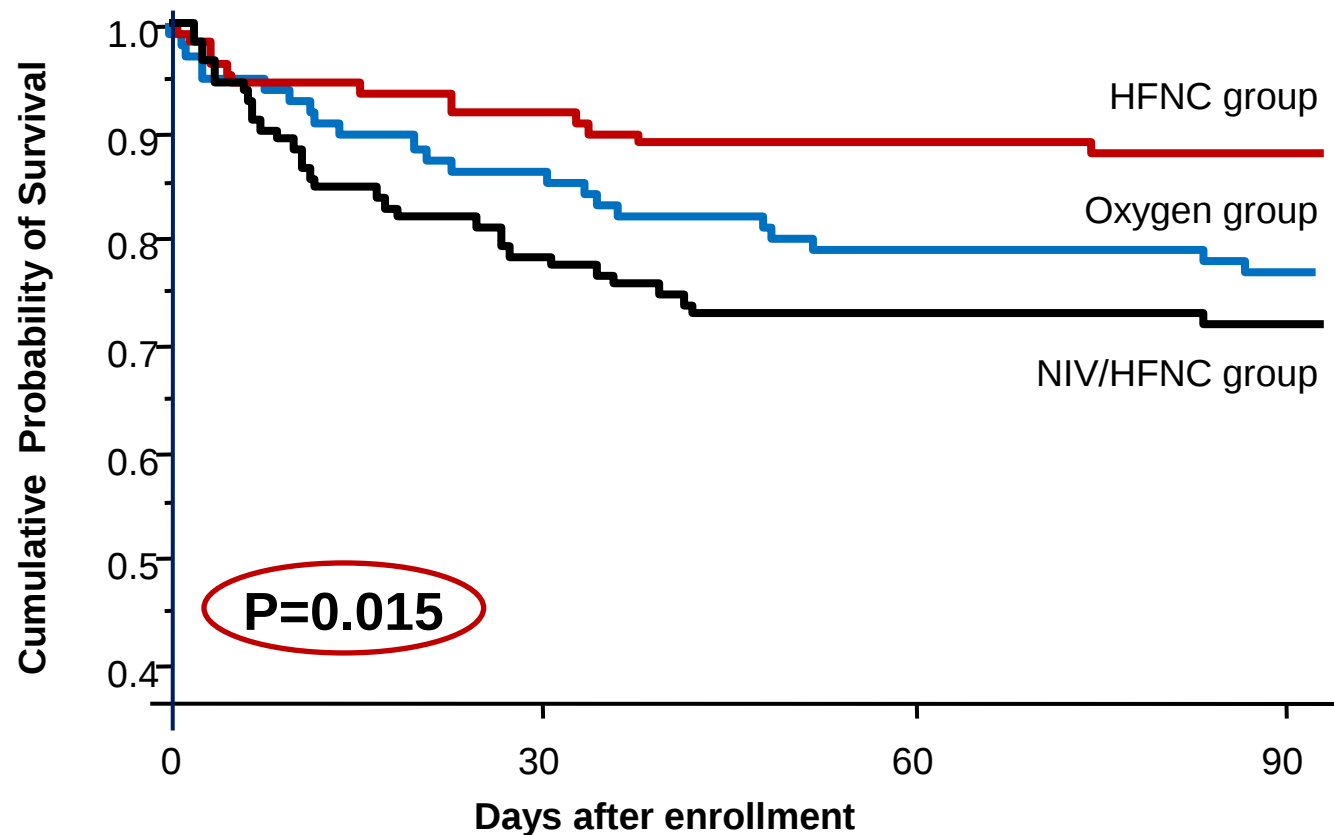


DOI: 10.1056/NEJMoa1503326



Secondary outcomes: in-ICU mortality, day 90 mortality, Day 28 VFD

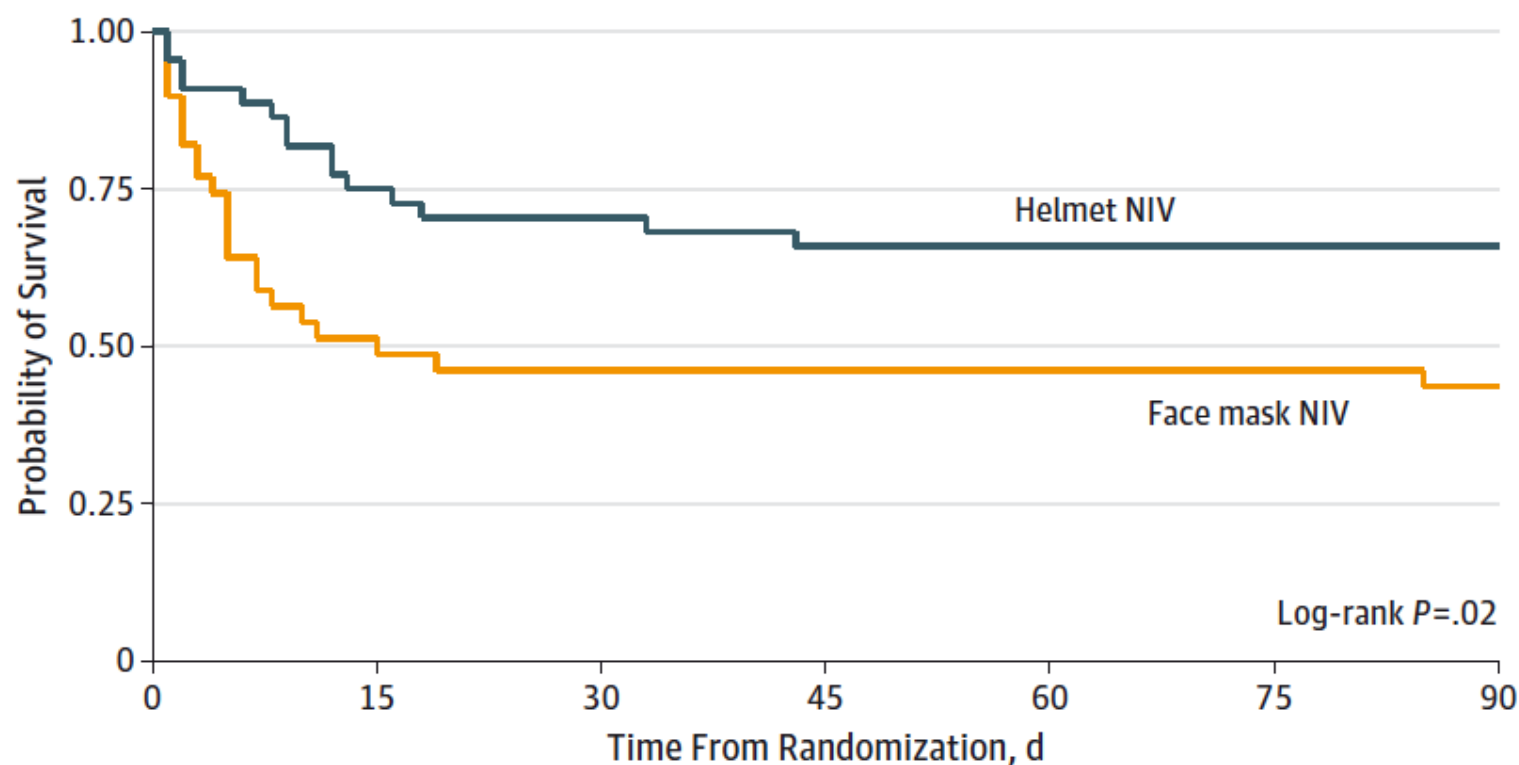
	Oxygen group (n=94)	HFNC group (n=106)	NIV/HFNC group (n=110)	P Value
ICU mortality – no. (%)	18 (19.1)	12 (11.3)	27 (24.5)	<0.05
Mortality at day 90– no. (%)	22 (23.4)	13 (12.3)	31 (28.2)	<0.05
Ventilator-free days at day 28 – day	22±10	24±8	19±12	<0.05





Effect of Noninvasive Ventilation Delivered by Helmet vs Face Mask on the Rate of Endotracheal Intubation in Patients With Acute Respiratory Distress Syndrome A Randomized Clinical Trial

Bhakti K. Patel, MD; Krysta S. Wolfe, MD; Anne S. Pohlman, MSN; Jesse B. Hall, MD; John P. Kress, MD



No. at risk

Face mask	39	20	18	18	18	18	17
Helmet	44	33	31	29	29	29	29

En VNI

- Masque facial, $\text{FiO}_2 = 1$, $\text{PEEP} = 8 \text{ cmH}_2\text{O}$, $\text{AI} = 12 \text{ cmH}_2\text{O}$
- $\text{FR } 30 / \text{mn}$, $V_T \text{ exp } 800 - 850 \text{ ml}$, $\text{SpO}_2 100 \%$
- Après 2 heures, passage O_2 au masque $\rightarrow \text{SpO}_2 81 \%$
- $\rightarrow$ Intubation
- Comment régler le ventilateur ?

Q2 : Mode ventilatoire?

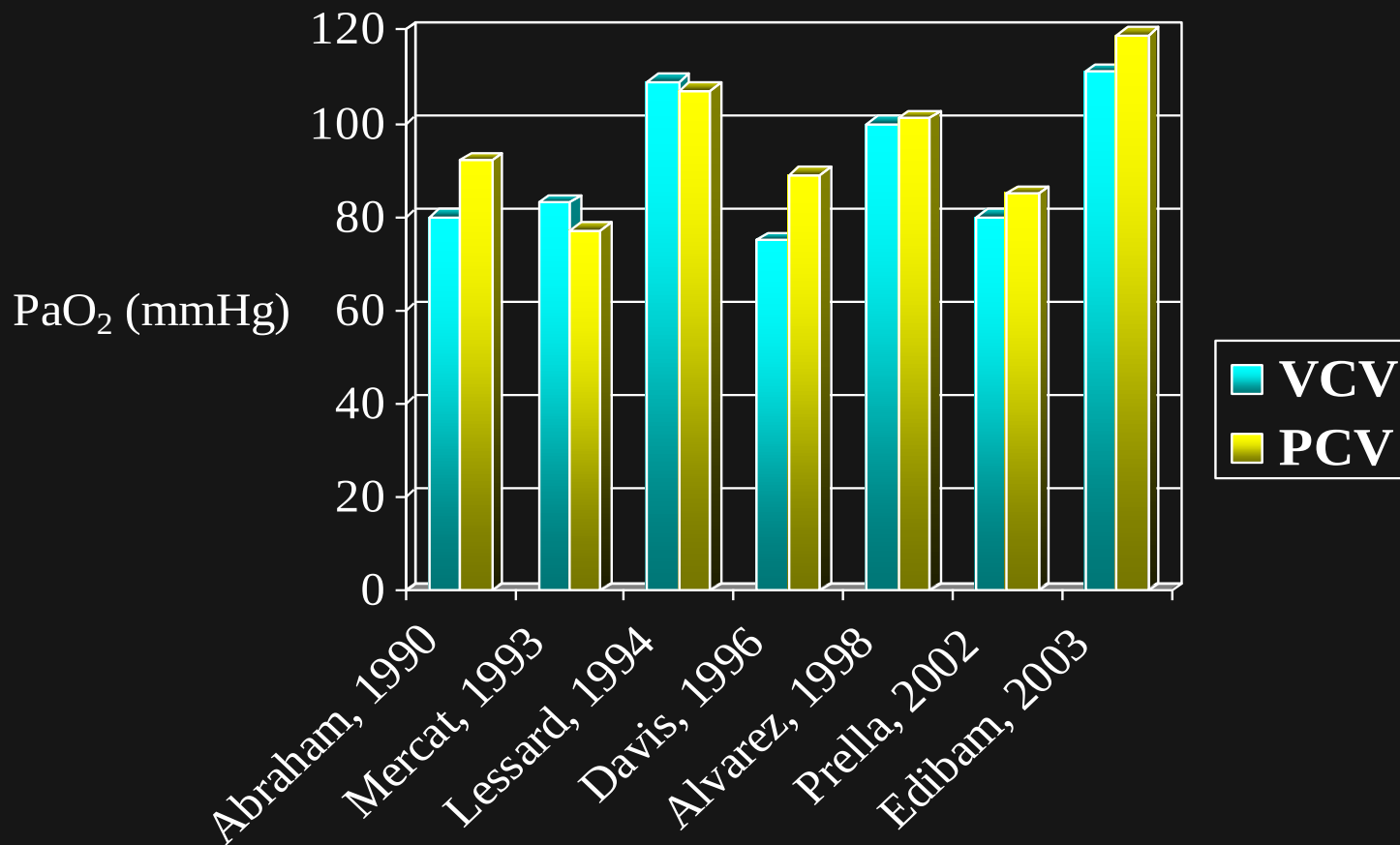
VAC en pression

VAC en volume

CPAP

PC vs VC : Oxygénation

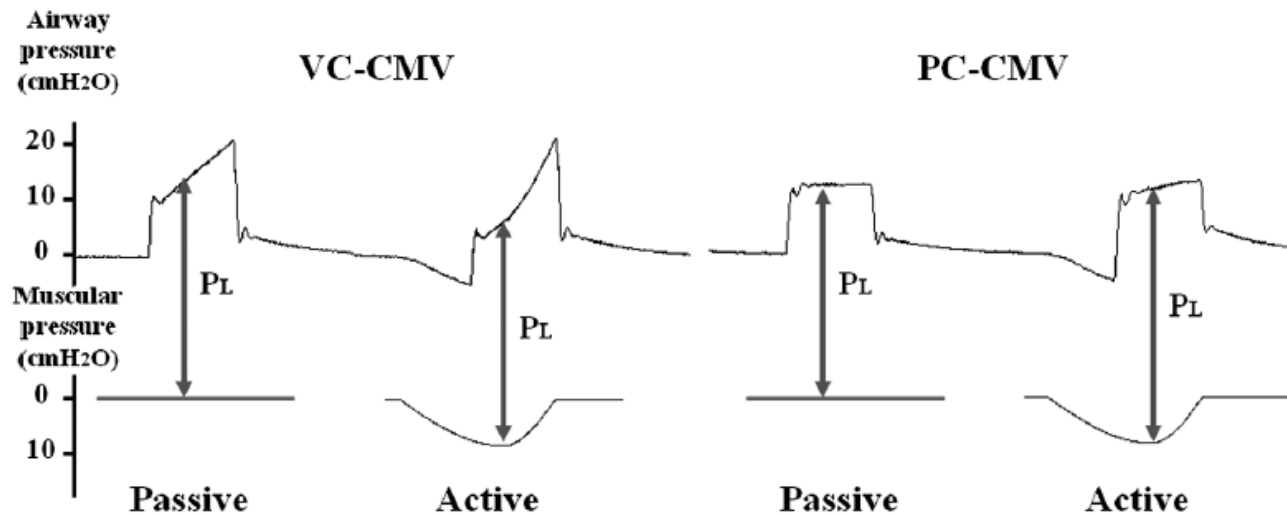
- Même VT, même PEEP, même FiO_2



Pressure-Controlled vs Volume-Controlled Ventilation in Acute Respiratory Failure

A Physiology-Based Narrative and Systematic Review

Nuttapol Rittayamai, MD; Christina M. Katsios, MD; François Beloncle, MD; Jan O. Friedrich, MD, PhD; Jordi Mancebo, MD; and Laurent Brochard, MD



CONCLUSION : The two modes have different working principles but clinical available data do not suggest any differences in the outcomes ...

CHEST 2015; 148(2):340-355

Q3 : Réglages du VT et de la FR ?

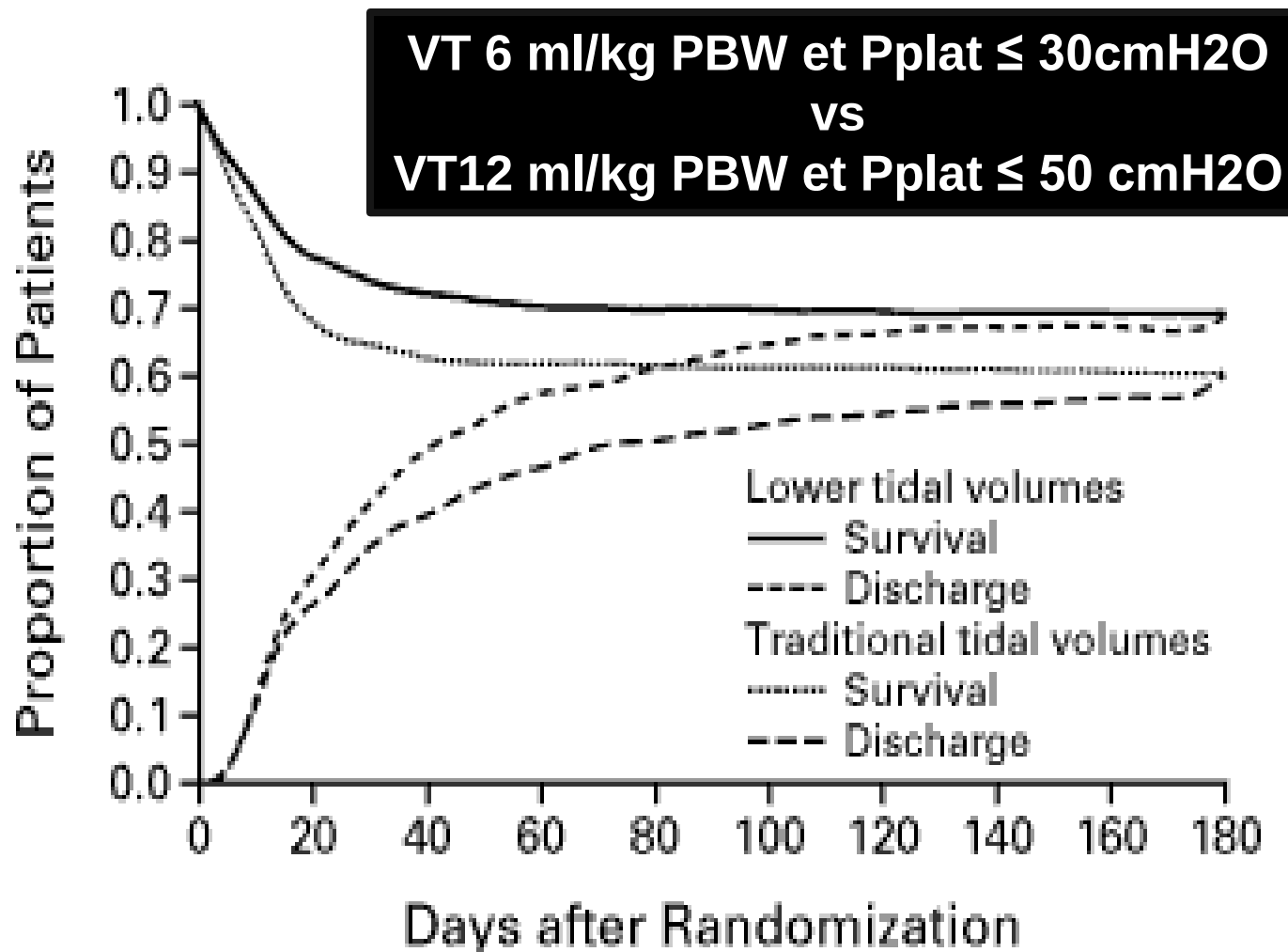
(1.78 m – 97 kg)

600 ml x 15

450 ml x 30

450 ml x 20

Essai « ARMA » (ARDS Network)



Réglage « individualisé » du volume courant

- En fonction de la pression de plateau
 - $P_{\text{plateau}} \leq 30 \text{ cm H}_2\text{O}$
- En fonction du poids prédit
 - 6 ml/kg PP
- En fonction de la pression motrice ($P_{\text{plat}} - \text{PEEP}_{\text{tot}}$)
 - $\Delta P < 14 \text{ cmH}_2\text{O}$

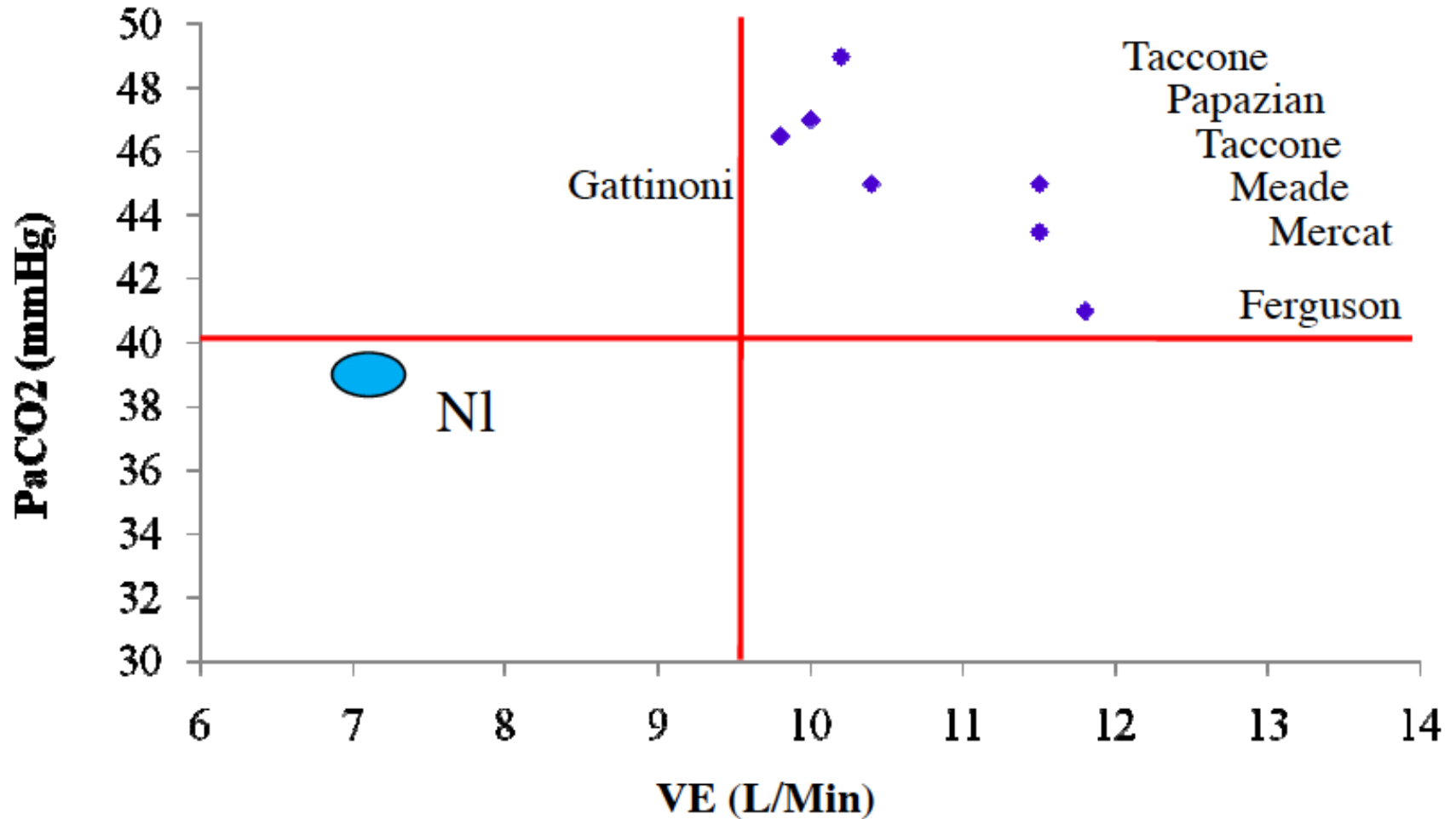
6 ml/kg PBW

TAILLE	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169
HOMME	281	287	292	298	303	309	314	320	325	331	336	341	347	352	358	363	369	374	380	385	391
FEMME	254	260	265	271	276	282	287	293	298	304	309	314	320	325	331	336	342	347	353	358	364

TAILLE	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
HOMME	396	402	407	412	418	423	429	434	440	445	451	456	462	467	473	478	483	489	494	500
FEMME	369	375	380	385	391	396	402	407	413	418	424	429	435	440	446	451	456	462	467	473

TAILLE	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209
HOMME	505	511	516	522	527	533	538	544	549	554	560	565	571	576	582	587	593	598	604	609
FEMME	478	484	489	495	500	506	511	517	522	527	533	538	544	549	555	560	566	571	577	582

SDRA : Besoins ventilatoires élevés



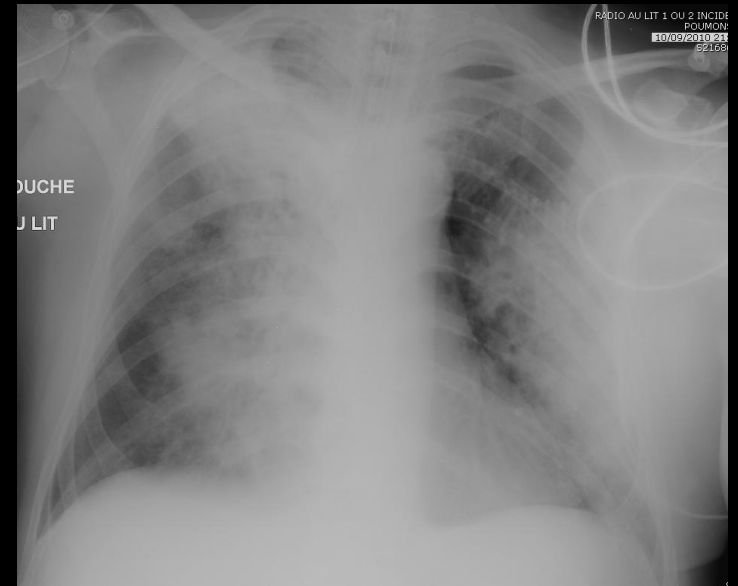
VT = 6 ml/kg PP → Quelle fréquence ?

- RR jusqu'à 35/mn ajustée pour : $7.30 \leq \text{pH} \leq 7.45$
- A J1 :

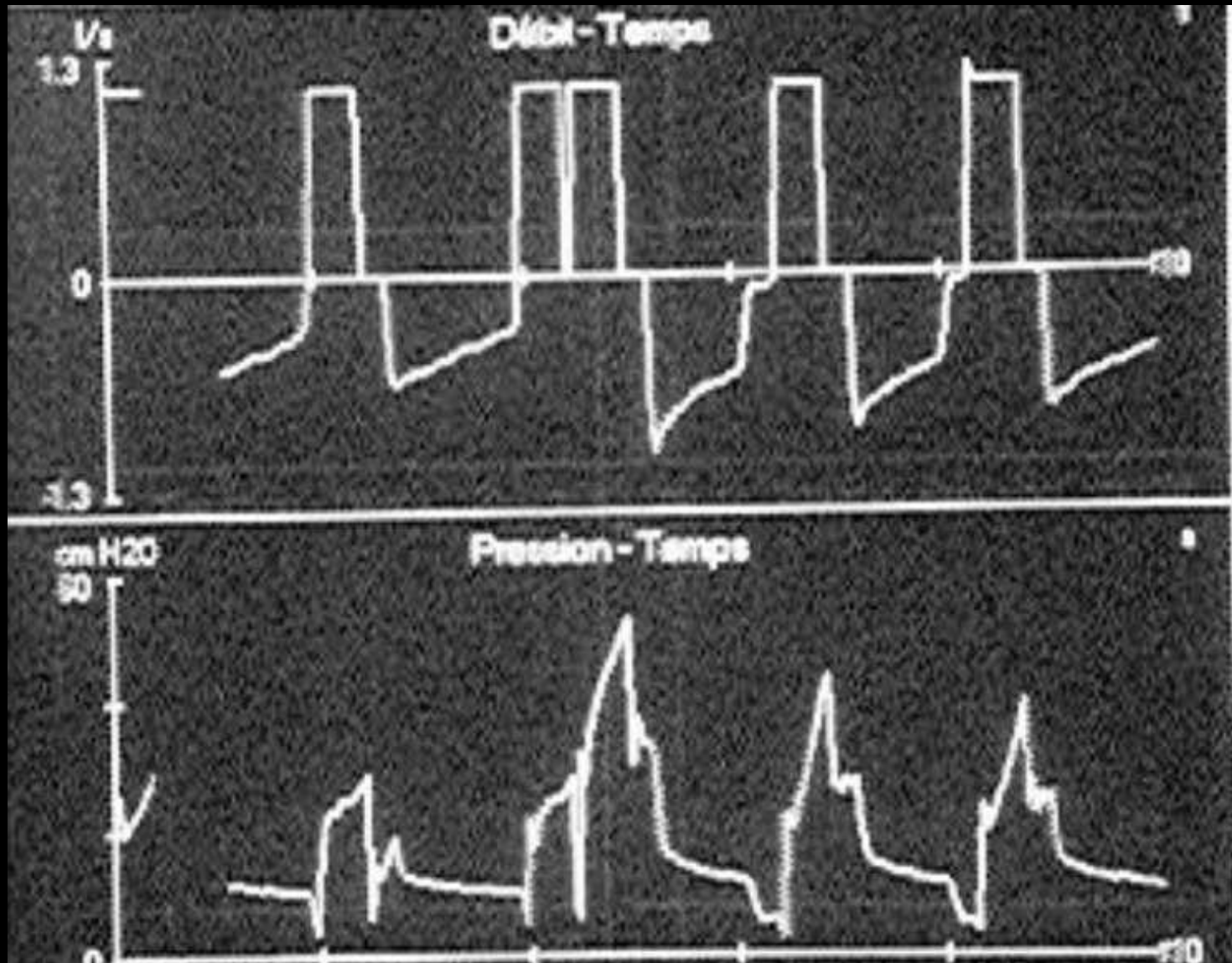
	mean VT (ml/kg PBW)	mean PaCO ₂ (mmHg)	mean pH	mean RR (/min)
ARMA	6.2	40	7.38	29
ALVEOLI	6.1	41	7.40	29
LOV	6.8	45	7.34	26
ExPress	6.1	44	7.35	28

Une heure après l'intubation

- VAC en volume : V_T 440 ml (6 ml/kg PBW), RR 28/mn, FiO_2 0.9, PEEP 10 cmH₂O
- Midazolam 5 mg/h, Fentanyl 100 µg/h → Ramsay 5
- CVC + arterial catheter
- Hypotension → 1 000 ml sérum salé



Ecran du ventilateur



Q4 : Que proposez-vous ?

Aucun changement

Passage en VAC en pression

Modifier réglage trigger

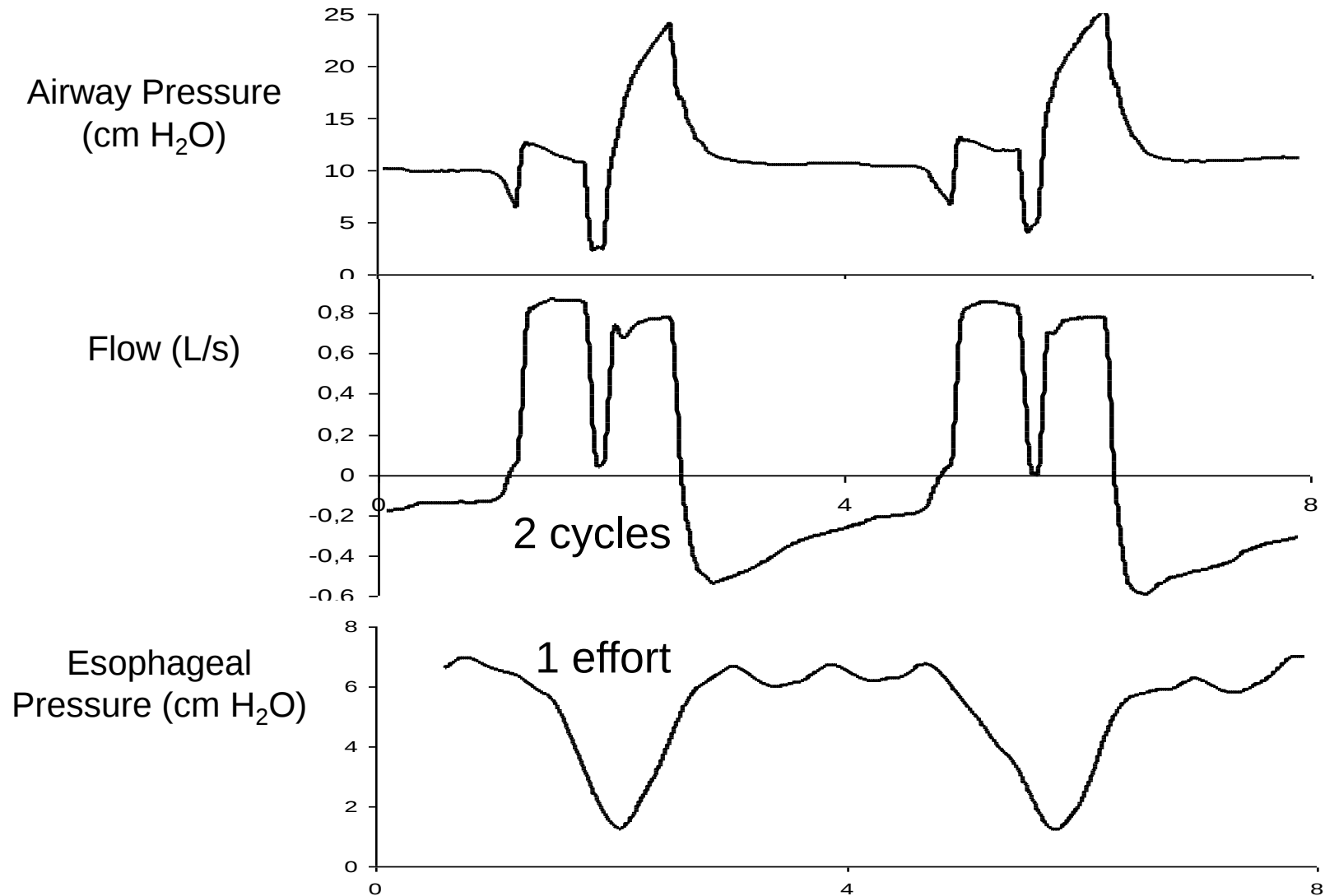
Autre décision

Efforts inspiratoires en VAC en volume



Double déclenchements

6 + 6 = 12 ml/kg PP !!



Curares au cours du SDRA : Acurasys trial

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

SEPTEMBER 16, 2010

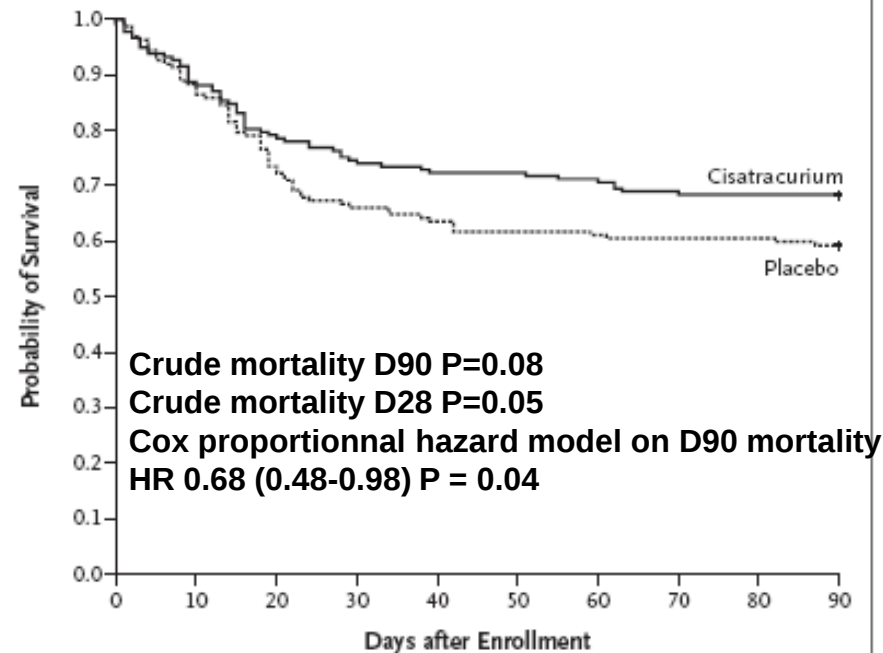
VOL. 363 NO. 12

Neuromuscular Blockers in Early Acute Respiratory Distress Syndrome

Laurent Papazian, M.D., Ph.D., Jean-Marie Forel, M.D., Arnaud Gacouin, M.D., Christine Penot-Ragon, Pharm.D., Gilles Perrin, M.D., Anderson Loundou, Ph.D., Samir Jaber, M.D., Ph.D., Jean-Michel Arnal, M.D., Didier Perez, M.D., Jean-Marie Seghboyan, M.D., Jean-Michel Constantin, M.D., Ph.D., Pierre Courant, M.D., Jean-Yves Lefrant, M.D., Ph.D., Claude Guérin, M.D., Ph.D., Gwenaél Prat, M.D., Sophie Morange, M.D., and Antoine Roch, M.D., Ph.D.,
for the ACURASYS Study Investigators*

- Curare pendant 48 hr →
 - Moins de pneumothorax (4% vs 12%)
 - Pas d'effet sur l'incidence des neuromyopathies
 - Meilleur devenir

- SDRA sévère ($PO_2/FiO_2 < 150$)
- Cisatracurium vs placebo pendant les 48 premières heures



15 mn plus tard

- VAC : V_T 440 ml, FR 28/mn, FiO_2 0.9, PEEP 10 cmH₂O
- midazolam 5 mg/h, fentanyl 100 µg/h, cisatracurium 5 mg/h
- P_{pic} 32 cmH₂O, $P_{plateau}$ 22 cmH₂O, $PEEP_{tot}$ 11 cmH₂O
- pH 7,34 $PaCO_2$ 48 mmHg PaO_2 72 mmHg SaO_2 90 %

Q5 : La compliance du système respiratoire est égale à ?

- VAC : V_T 440 ml, FR 28/mn, FiO_2 0.9, PEEP 10 cmH₂O
- P_{pic} 32 cmH₂O, $P_{plateau}$ 22 cmH₂O, $PEEP_{tot}$ 11 cmH₂O

20 ml/cmH₂O

44 ml/cmH₂O

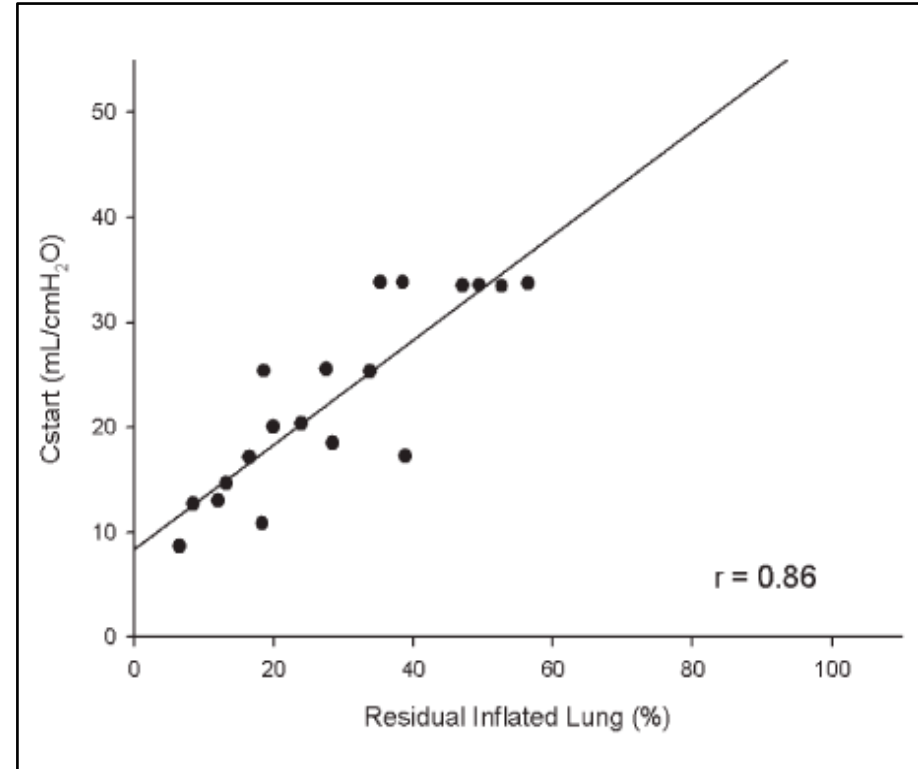
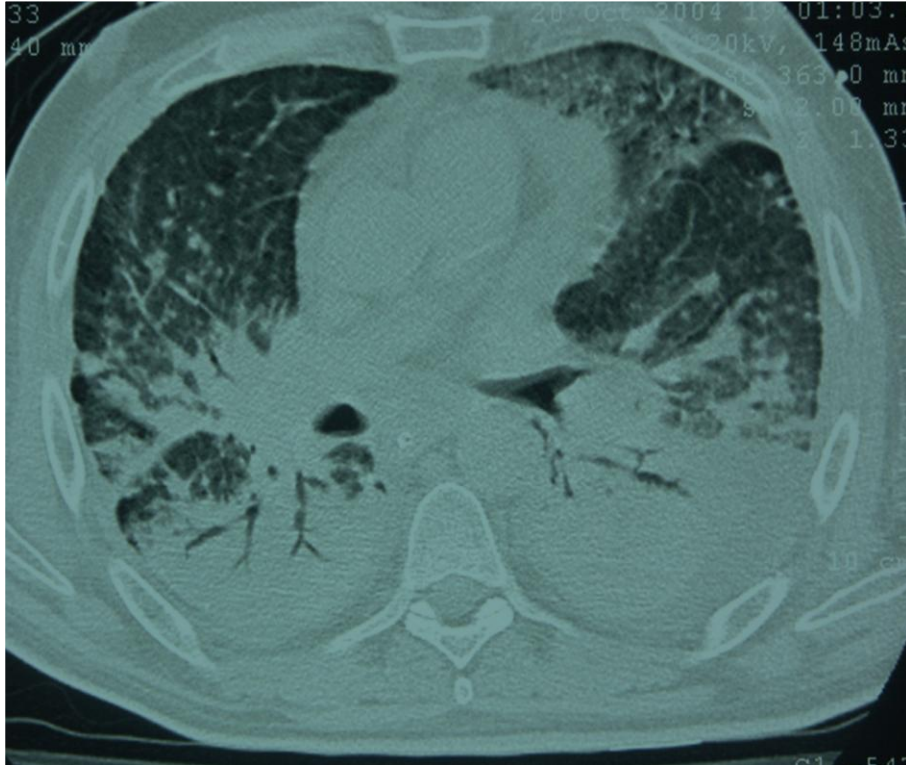
40 ml/cmH₂O

20 ml/cmH₂O

Compliance du système respiratoire

- $C_{rs} = V_T / (P_{plat} - PEEP_{tot})$
- « valeur normale » (adulte ventilé) : $\geq 50 \text{ ml/cmH}_2\text{O}$
- Déterminants :
 - Taille du poumon (taille du patient)
 - Taille du poumon aéré
 - Compliance de la paroi thoracique (pression intra-abdominale, position, épanchement pleural, ...)
 - Réglages du ventilateur (V_T , PEEP)

ARDS : “baby lung”



- Low compliance in ARDS : small lung not stiff lung

15 mn plus tard

- VAC : V_T 440 ml, FR 28/mn, FiO_2 0.9, PEEP 10 cmH₂O
- midazolam 5 mg/h, fentanyl 100 µg/h, cisatracurium 5 mg/h
- P_{pic} 32 cmH₂O, $P_{plateau}$ 22 cmH₂O, $PEEP_{tot}$ 11 cmH₂O
- pH 7,34 $PaCO_2$ 48 mmHg PaO_2 72 mmHg SaO_2 90 %

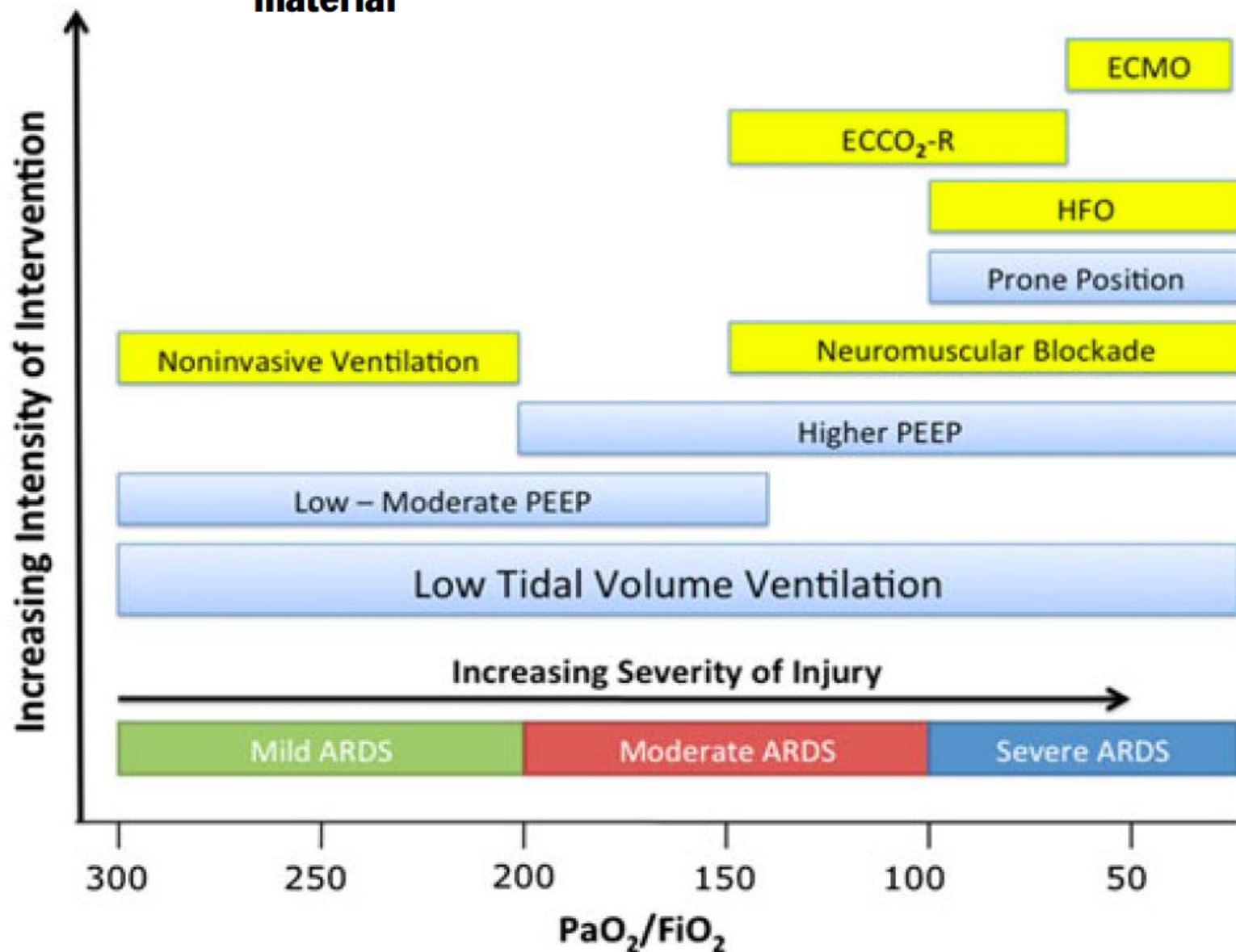
Q6 : Réglages conformes aux recommandations?

- VAC : V_T 440 ml, FR 28/mn, FiO_2 0.9, PEEP 10 cmH₂O
- P_{pic} 32 cmH₂O, $P_{plateau}$ 22 cmH₂O, $PEEP_{tot}$ 11 cmH₂O
- pH 7,34 $PaCO_2$ 48 mmHg PaO_2 72 mmHg SaO_2 90 %

A. Oui

A. Non

The Berlin definition of ARDS: an expanded rationale, justification, and supplementary material



Higher vs Lower Positive End-Expiratory Pressure in Patients With Acute Lung Injury and Acute Respiratory Distress Syndrome

Systematic Review and Meta-analysis

Matthias Briel, MD, MSc

Maureen Meade, MD, MSc

Alain Mercat, MD

Roy G. Brower, MD

Daniel Talmor, MD, MPH

Stephen D. Walter, PhD

Arthur S. Slutsky, MD

Eleanor Pullenayegum, PhD

Qi Zhou, PhD

Deborah Cook, MD, MSc

Laurent Brochard, MD

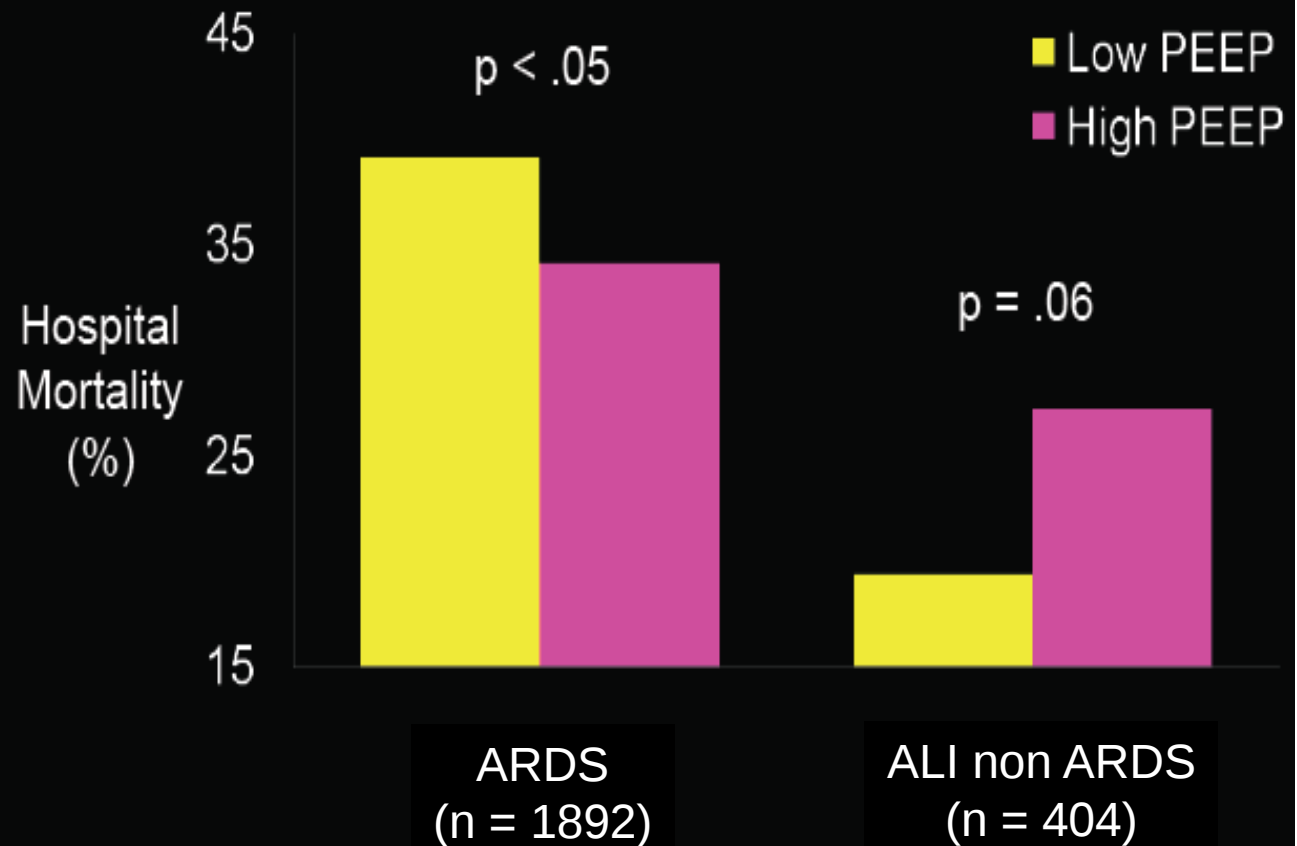
Jean-Christophe M. Richard, MD

Francois Lamontagne, MD

Neera Bhatnagar, MLIS

Thomas E. Stewart, MD

Gordon Guyatt, MD, MSc



High PEEP ?

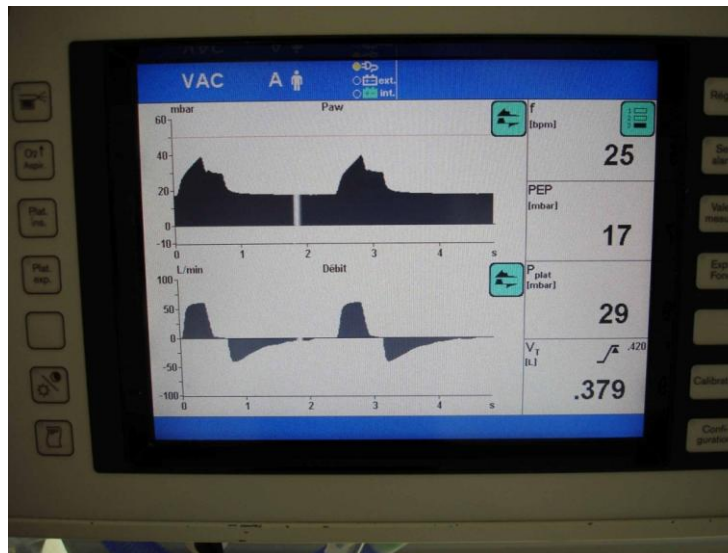
Day 1	
ALVEOLI	14.7 ± 3.5
LOV	15.6 ± 3.9
ExPress	15.8 ± 2.9

PEEP setting ?

- ALEOLI – LOV :

FiO2	30	40	40	40	40	40	50	50	60	70	80	80	90	100
PEEP	5-10	10	12	14	16	18	18	20	20	20	20	22	22	22-24

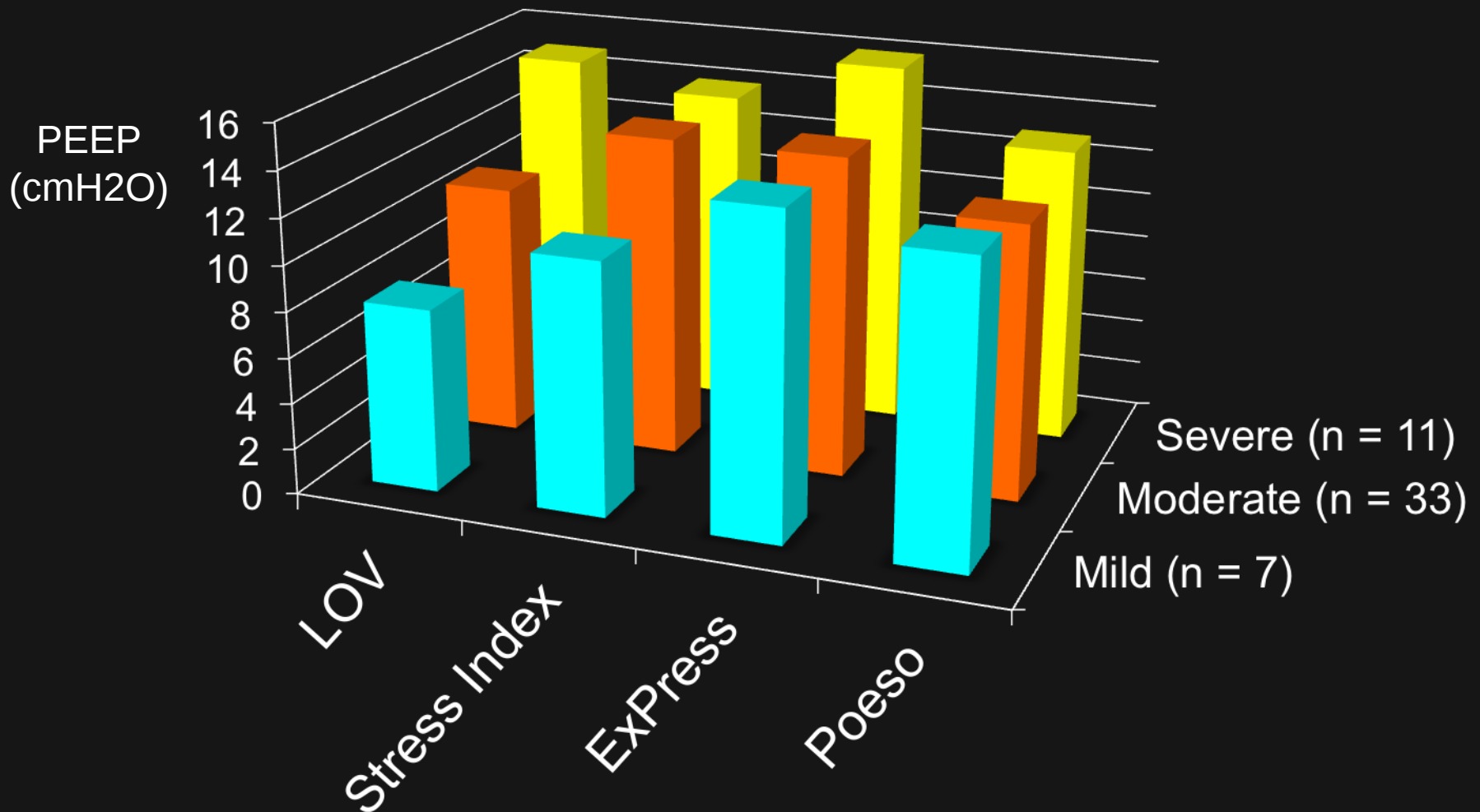
- ExPress : PEEP for : $28 \text{ cmH}_2\text{O} \leq P_{\text{plateau}} \leq 30 \text{ cmH}_2\text{O}$



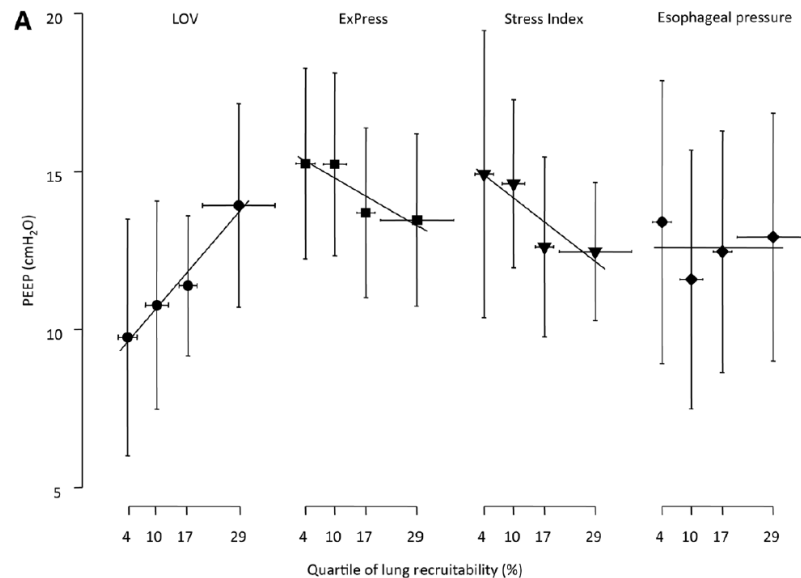
Réglage individualisé de la PEEP

- Echanges gazeux (PaO_2 , shunt, PaCO_2 , espace mort)
- Compliance du système respiratoire
- Hemodynamique (TaO_2)
- Courbe P-V en ZEEP (Pflex)
- Courbes P-V multiples
- Scanner thoracique
- Stress index
- Echocardiographie (fonction VD)
- Mesure du volume de fin d'expiration (N_2 washi-washout)
- Poeso (PTP) expiratoire, PTP inspiratoire
- Echographie pulmonaire
- Tomographie d'impédance électrique (EIT)

Bedside Selection of Positive End-Expiratory Pressure in Mild, Moderate, and Severe Acute Respiratory Distress Syndrome



Bedside Selection of Positive End-Expiratory Pressure in Mild, Moderate, and Severe Acute Respiratory Distress Syndrome



Respiratory Mechanics Variables

Severe ARDS
(*n* = 11)

Positive end-expiratory pressure (cm H₂O)

LOV	15 ± 3
ExPress	16 ± 3
Stress index	14 ± 3
Esophageal pressure	13 ± 4

Chiumello et al. Crit Care Med 2013

SDRA : proposition pour le réglage de la PEEP

- $\text{PaO}_2/\text{FiO}_2$ on PEEP 5 → ARDS severity
- Mild ARDS → Moderate PEEP (5 to 10)
- Moderate ARDS → PEEP 15 test (ABG, Crs, hemodynamics)
 - High PEEP if better PaO_2 without alteration of Crs, PaCO_2 and hemodynamics
- Severe ARDS → High PEEP
PEEP for Pplat 28 – 30 (VT 6 ml/kg PBW)
If PEEP < 14 → check Ccw (Peso)

Une heure plus tard

- VAC: V_T 440 ml, FR 30/mn, FiO_2 0.7, PEEP 16 cmH₂O
- midazolam 5 mg/h, fentanyl 100 µg/, cisatracurium 5 mg/h
- P_{pic} 41 cmH₂O, P_{plateau} 28 cmH₂O, PEEP_{tot} 17 cmH₂O
- pH 7.35 PaCO₂ 44 mmHg PaO₂ 88 mmHg SaO₂ 93 %

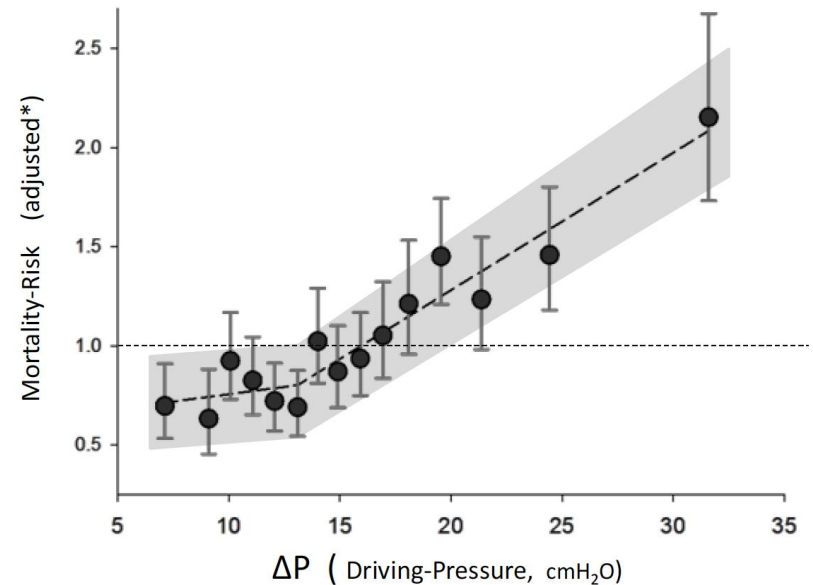
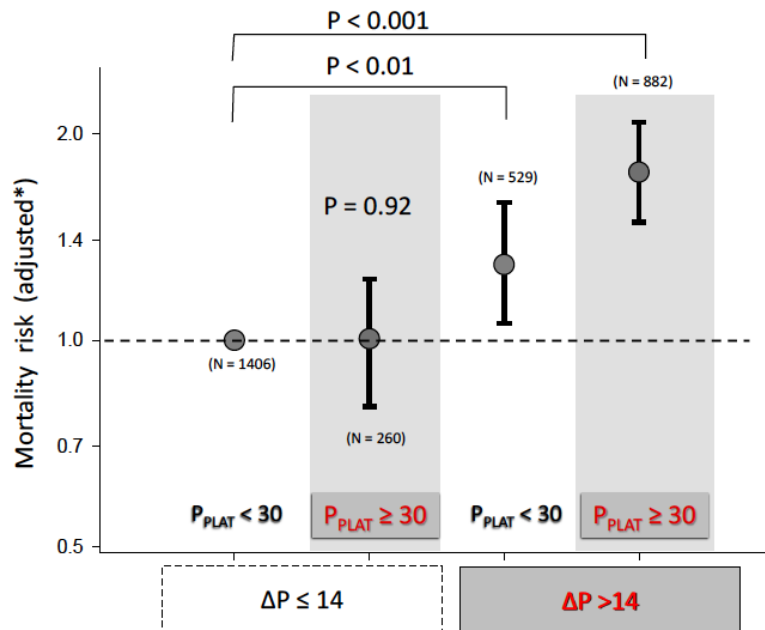
Q7 : Le niveau de pression motrice est inférieur
au seuil associé à une surmortalité.
(Pplat 28, PEEP 16, PEEPTot 17)

Vrai

Faux

Pression motrice = Driving pressure = $P_{plat} - P_{EEPtot}$

- Analyse *a posteriori* des données individuelles de 9 RCT (Brochard, Brower, Stewart, Amato, ARMA, ALVEOLI, LOV, EXPRESS, Talmor) (n=3080)



6 heures après l'intubation

- VAC : V_T 440 ml, FR 35/mn, FiO_2 0.7, PEEP 16 cmH₂O
- midazolam 5 mg/h, fentanyl 100 µg/, cisatracurium 5 mg/h
- 2000 ml sérum salé, noradrénaline 0.3 µg/kg/mn
- PA 105/60, FR 115/mn, T° 39.7 ° C
- P_{pic} 46 cmH₂O, P_{plateau} 30 cmH₂O, PEEP_{tot} 18 cmH₂O
- pH 7.28 PaCO₂ 54 mmHg PaO₂ 62 mmHg SaO₂ 89 %

Lactate 1.8 mmol/L

Q8 : Quelle(s) première(s) mesure(s)
pour diminuer la PaCO_2 ?

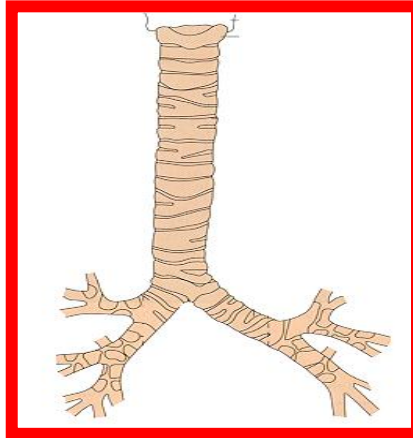
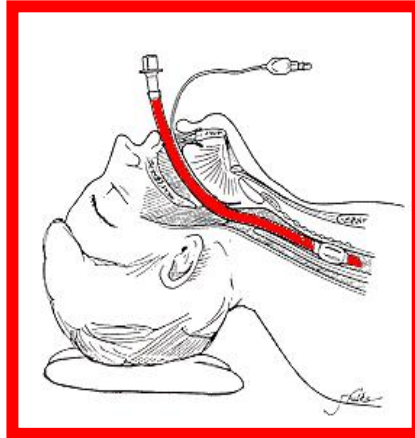
Rempacer le FECH par un HC

Augmenter VT et/ou FR

Diminuer la température corporelle

Epuration extra-corporelle de CO_2

Espace mort



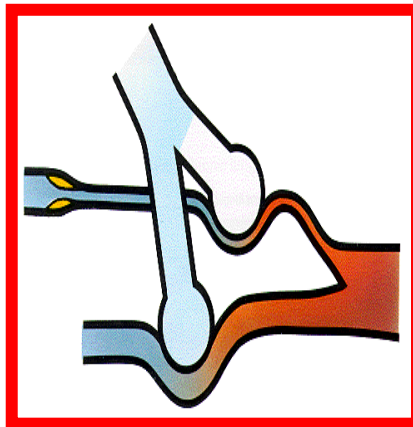
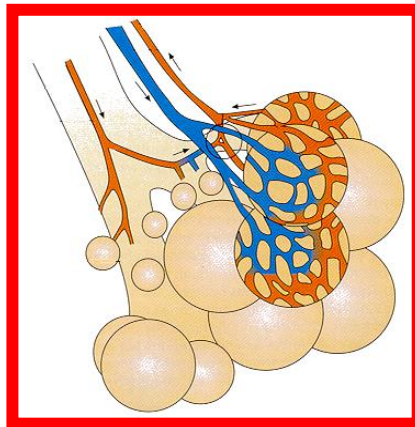
V_d anat



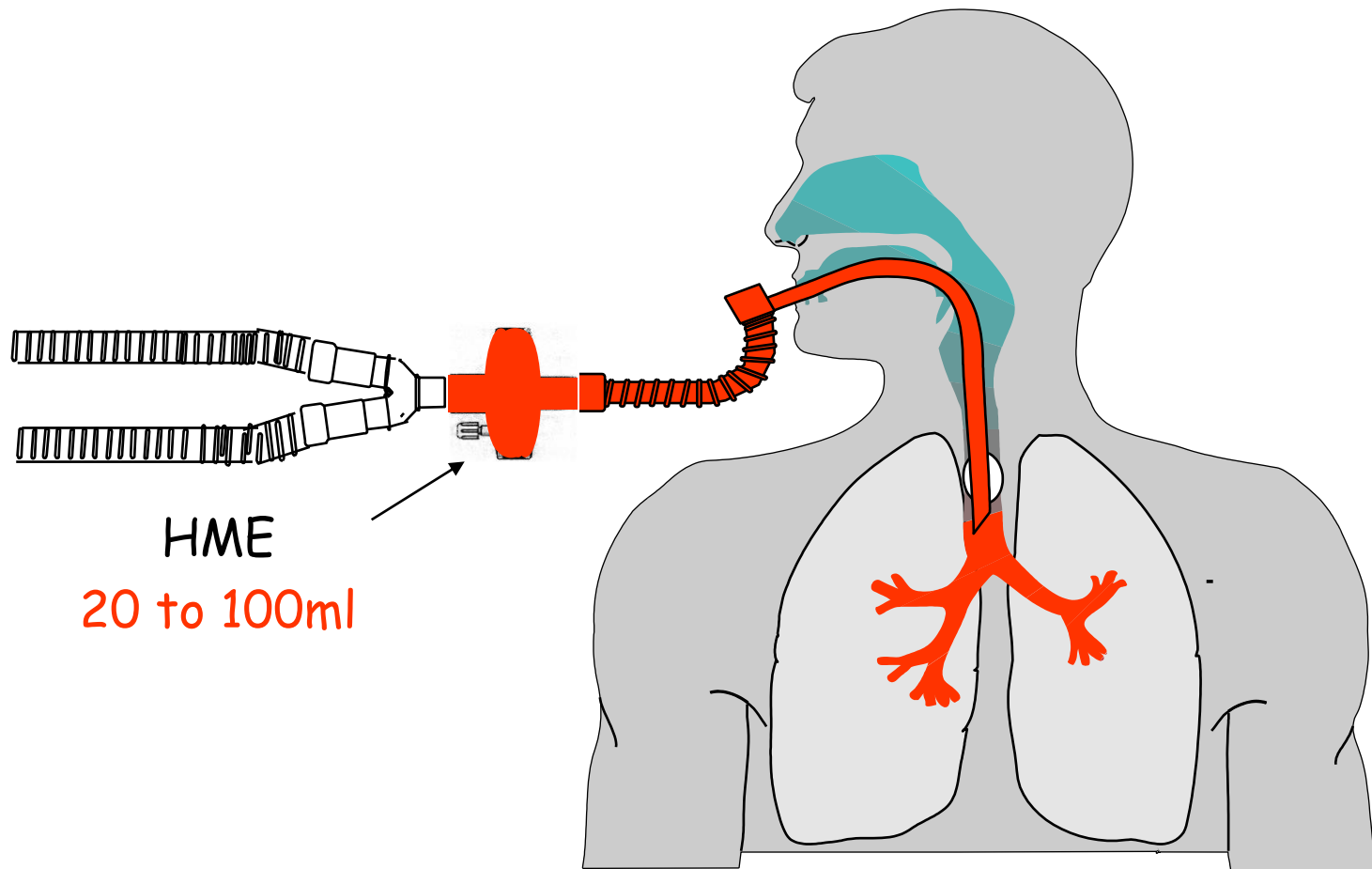
V_d phys



V_d alv

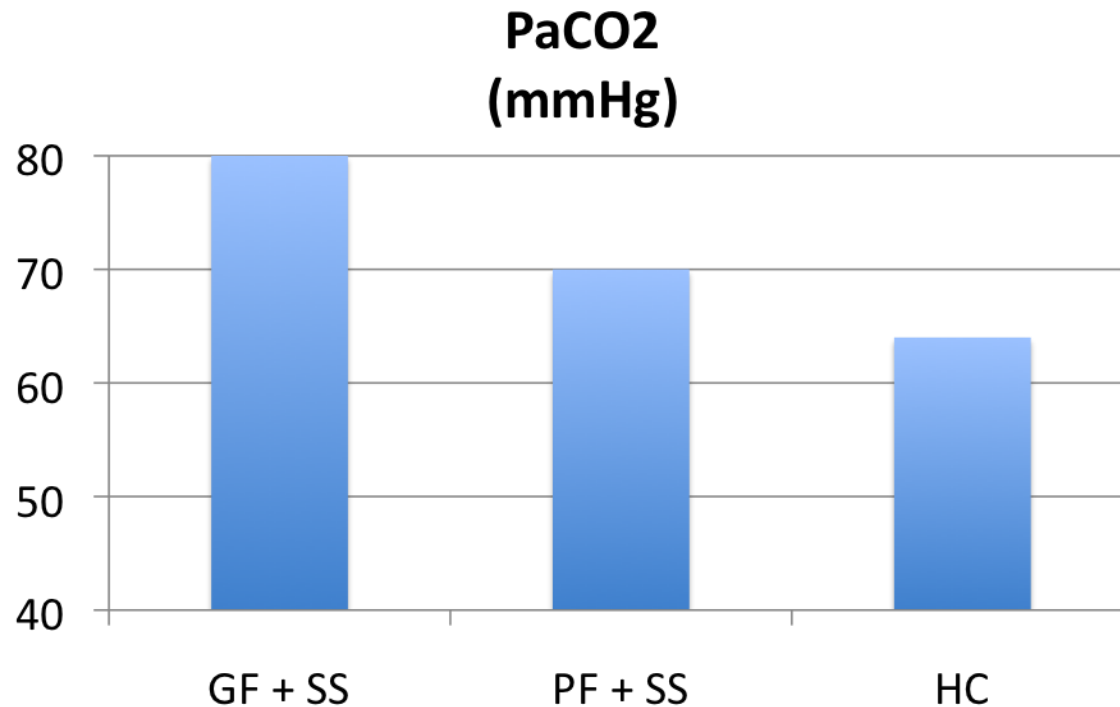


Instrumental dead space



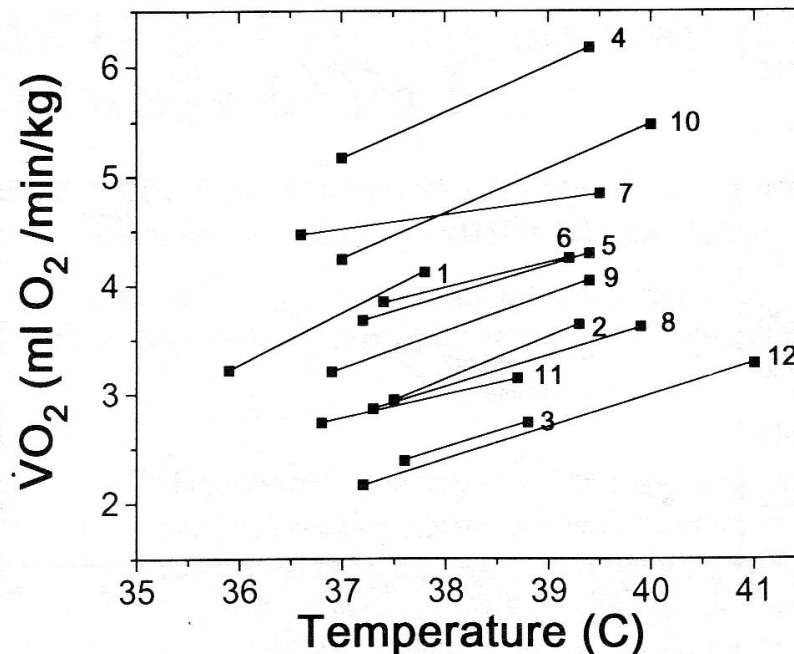
Espace mort instrumental

- 10 patients with ARDS, VC
- FiO₂, PEEP, VT (6.9 ml/kg) and RR (20/mn) constant
- Decrease in instrumental dead space



$VO_2 - VCO_2 \rightarrow PaCO_2$

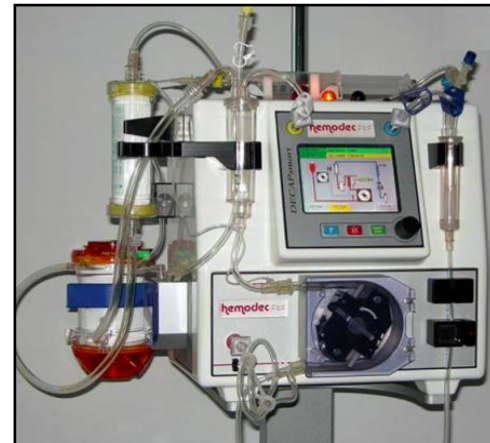
- Diminution de la température chez des patients fébriles
→ Diminution de VO_2 et VCO_2 → - Diminution des besoins en O_2
- Diminution du besoin ventilatoire



Manthous, AJRCCM 1995

ECCO₂R in ADRS

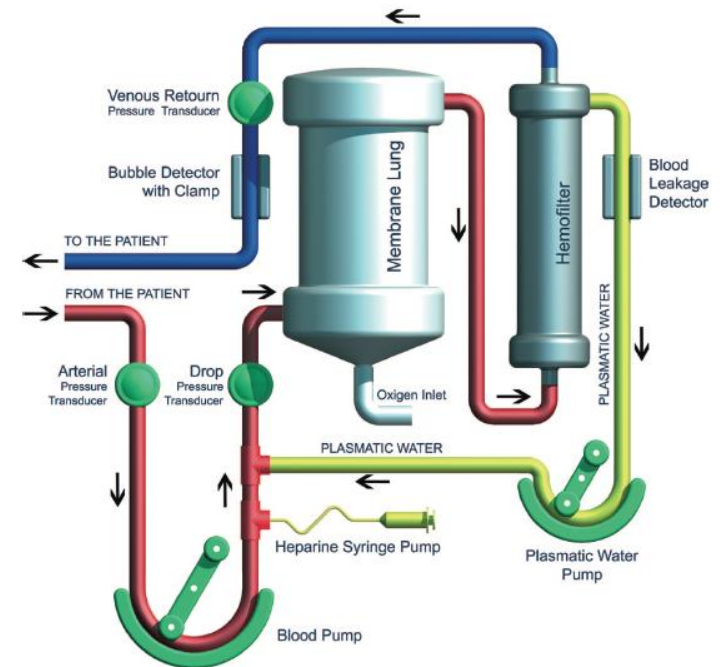
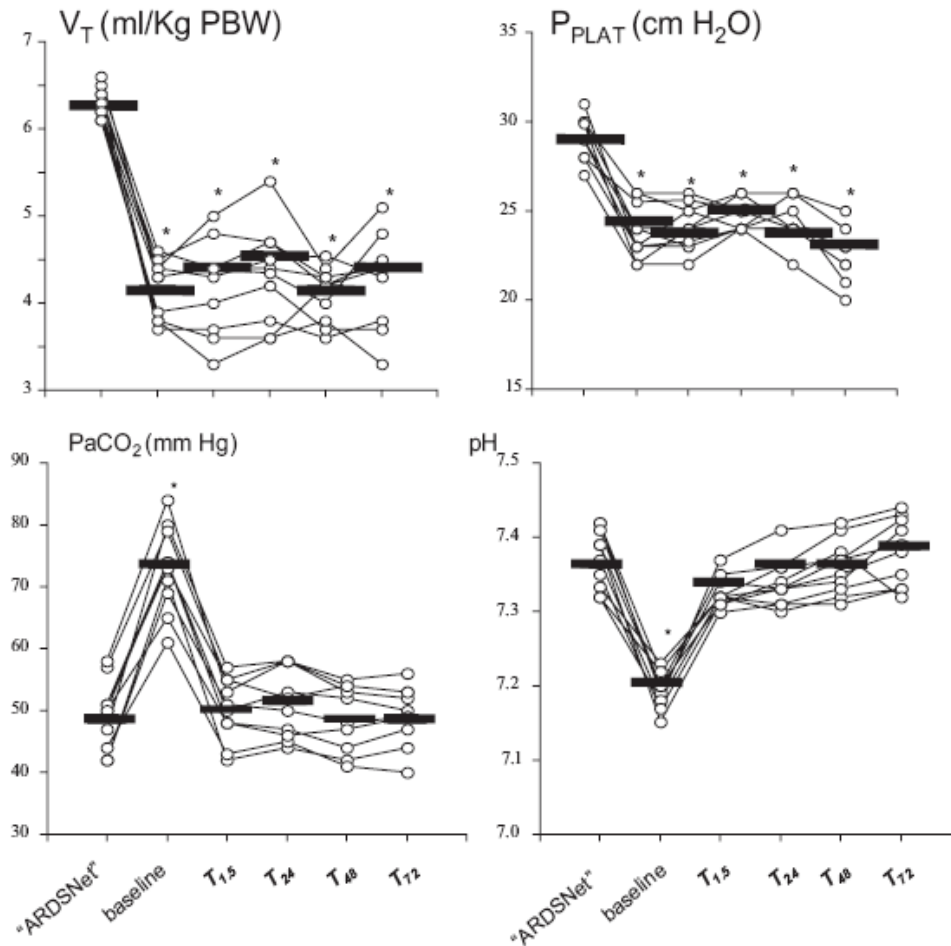
- Moderate blood flow (≤ 1 L/mn) $\rightarrow$ One double lumen catheter (< 20 Fr)



Tidal Volume Lower than 6 ml/kg Enhances Lung Protection

Role of Extracorporeal Carbon Dioxide Removal

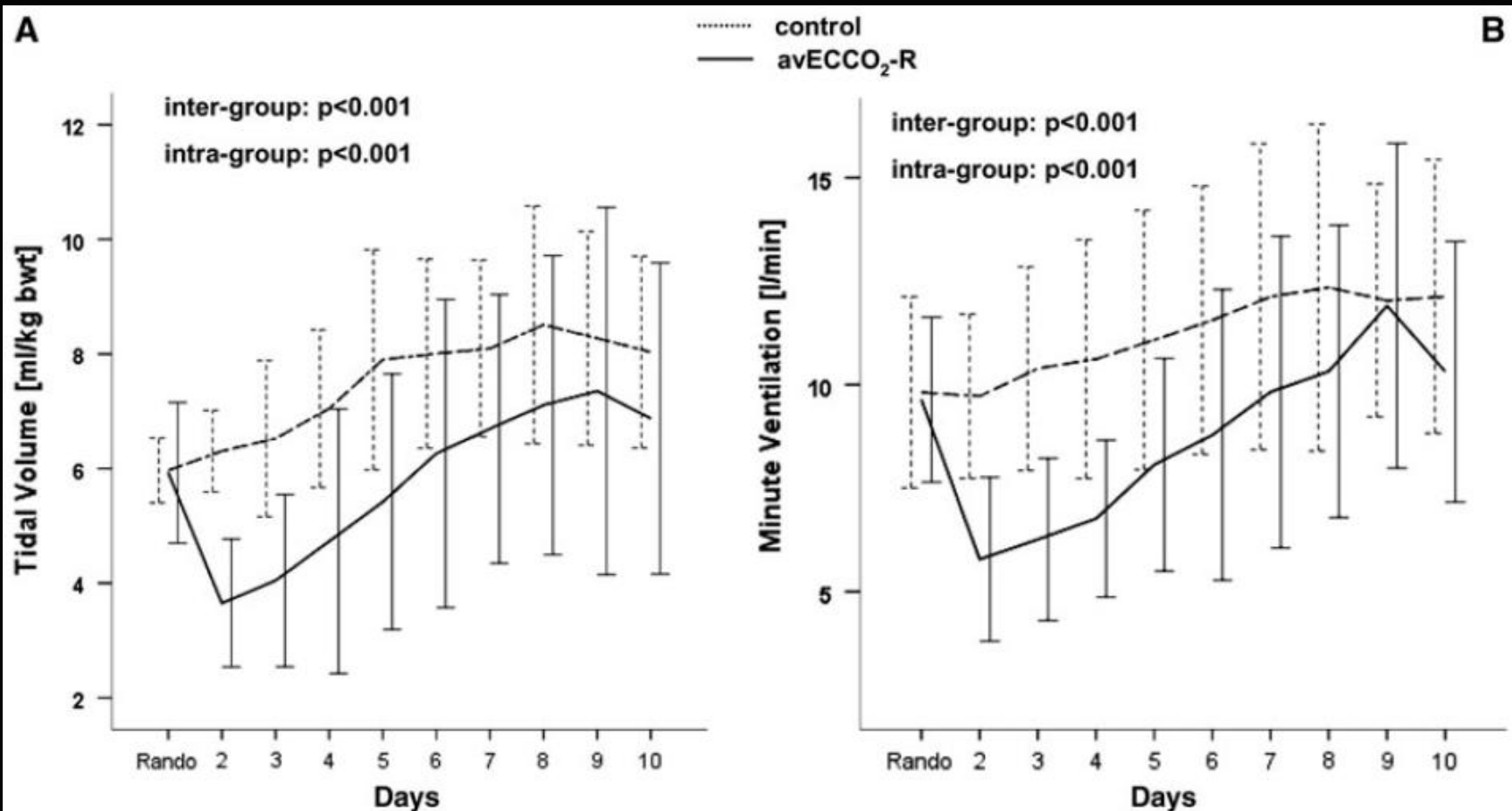
Pier Paolo Terragni, M.D.,* Lorenzo Del Sorbo, M.D.,* Luciana Mascia, M.D., Ph.D.,* Rosario Urbino, M.D.,* Erica L. Martin, Ph.D.,* Alberto Birocco, M.D.,† Chiara Faggiano, M.D.,† Michael Quintel, M.D.,‡ Luciano Gattinoni, M.D.,§ V. Marco Ranieri, M.D.||



Thomas Bein
 Steffen Weber-Carstens
 Anton Goldmann
 Thomas Müller
 Thomas Staudinger
 Jörg Brederlau
 Ralf Muellenbach
 Rolf Dembinski
 Bernhard M. Graf
 Marlene Wewalka
 Alois Philipp
 Klaus-Dieter Wernecke
 Matthias Lubnow
 Arthur S. Slutsky

Lower tidal volume strategy (≈ 3 ml/kg) combined with extracorporeal CO₂ removal versus 'conventional' protective ventilation (6 ml/kg) in severe ARDS

The prospective randomized Xtravent-study



A Strategy of UltraProtective lung ventilation
With Extracorporeal CO₂ Removal for
New-Onset moderate to seVere ARDS

The SUPERNOVA trial



12 heures après l'intubation

- VAC, V_T 440 ml, FR 35/mn, FiO_2 0.7, PEEP 16 cmH₂O
- midazolam 5 mg/h, fentanyl 100 µg/, cisatracurium 5 mg/h
- P_{pic} 47 cmH₂O, P_{plateau} 30 cmH₂O, PEEP_{tot} 17 cmH₂O
- pH 7.34 PaCO₂ 46 mmHg PaO₂ 68 mmHg SaO₂ 90 %

Q9 : Que proposez-vous à ce stade?

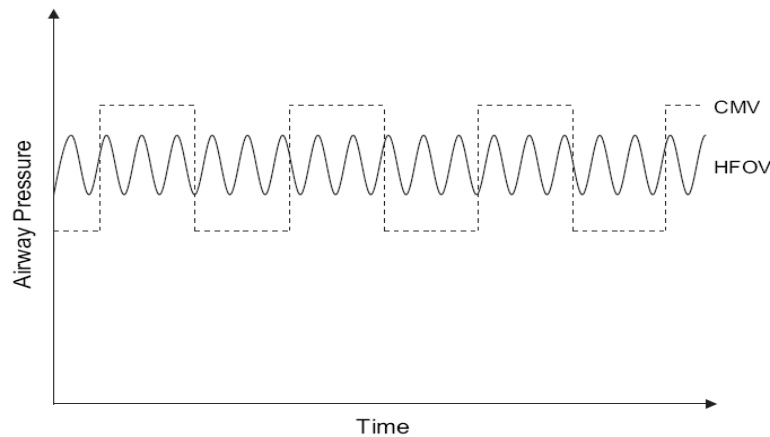
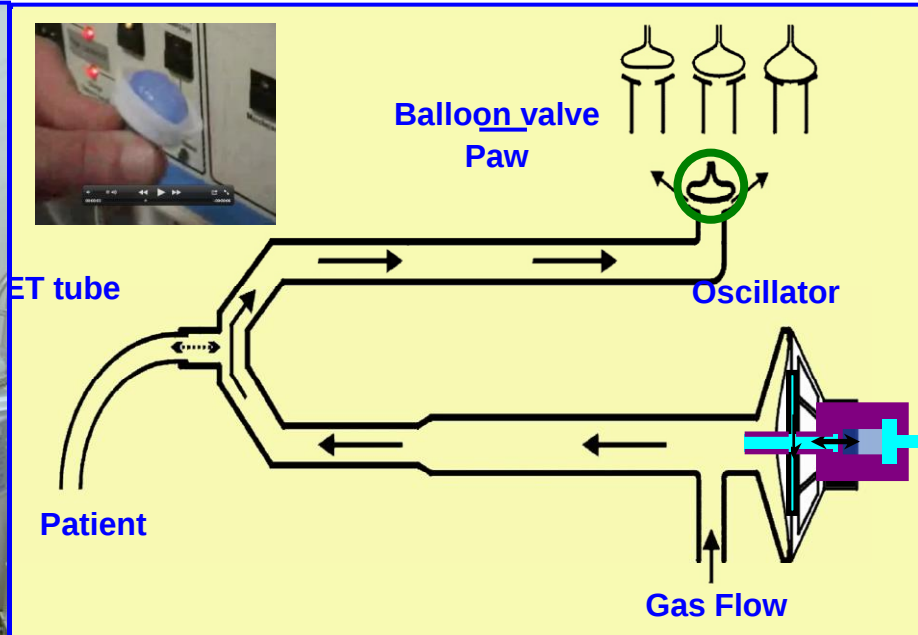
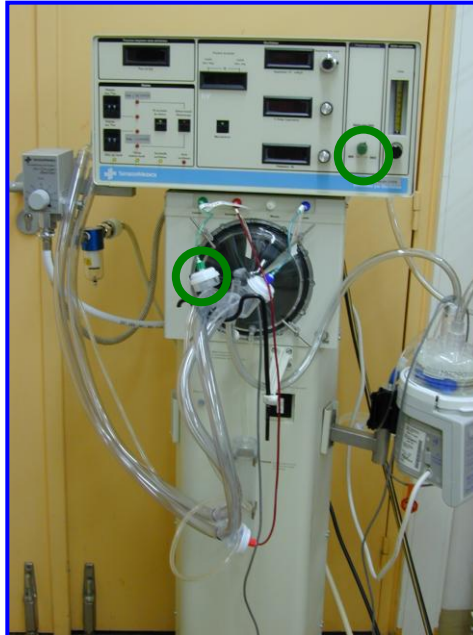
- Rien de plus

NO inhalé

HFO

Décubitus ventral

HFOV: Principles



- mPaw
 - FiO_2
 - $\Delta\text{Pressure}$
 - Ti/Ttot
 - Rate (Hz)
- $\rightarrow \text{PaO}_2$
- $\rightarrow \text{PaCO}_2$

HFO in ARDS : 2 large negative RCT

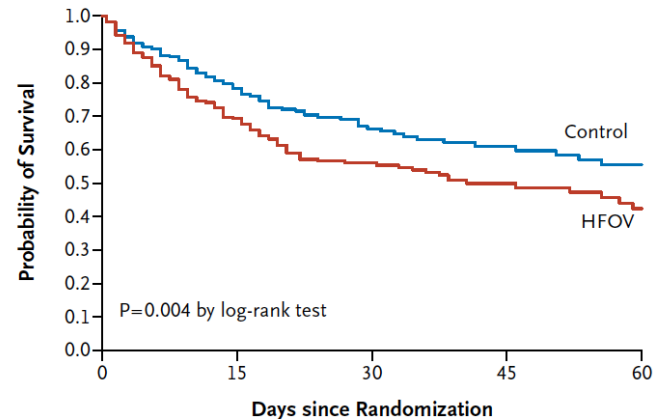
High-Frequency Oscillation in Early Acute Respiratory Distress Syndrome

Niall D. Ferguson, M.D., Deborah J. Cook, M.D., Gordon H. Guyatt, M.D.,
Sangeeta Mehta, M.D., Lori Hand, R.R.T., Peggy Austin, C.C.R.A.,
Qi Zhou, Ph.D., Andrea Matte, R.R.T., Stephen D. Walter, Ph.D.,
Francois Lamontagne, M.D., John T. Granton, M.D., Yaseen M. Arabi, M.D.,
Alejandro C. Arroliga, M.D., Thomas E. Stewart, M.D., Arthur S. Slutsky, M.D.,
and Maureen O. Meade, M.D., for the OSCILLATE Trial Investigators
and the Canadian Critical Care Trials Group*

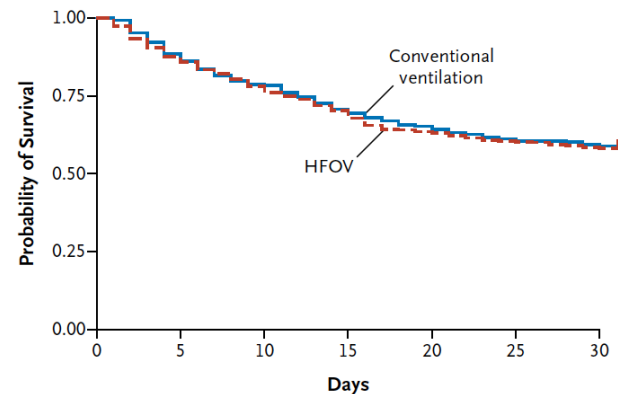


High-Frequency Oscillation for Acute Respiratory Distress Syndrome

Duncan Young, D.M., Sallie Lamb, D.Phil., Sanjoy Shah, M.D.,
Iain MacKenzie, M.D., William Tunnicliffe, M.Sc., Ranjit Lall, Ph.D.,
Kathy Rowan, D.Phil., and Brian H. Cuthbertson, M.D.,
for the OSCAR Study Group*



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

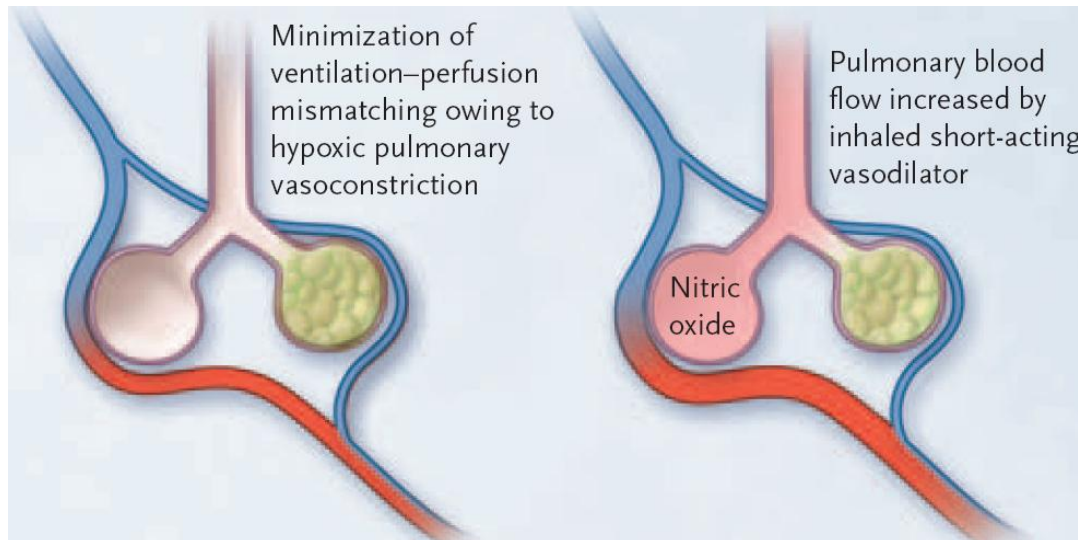


No. at Risk							
Conventional ventilation	397	351	312	281	259	243	236
HFOV	398	349	311	280	253	241	233

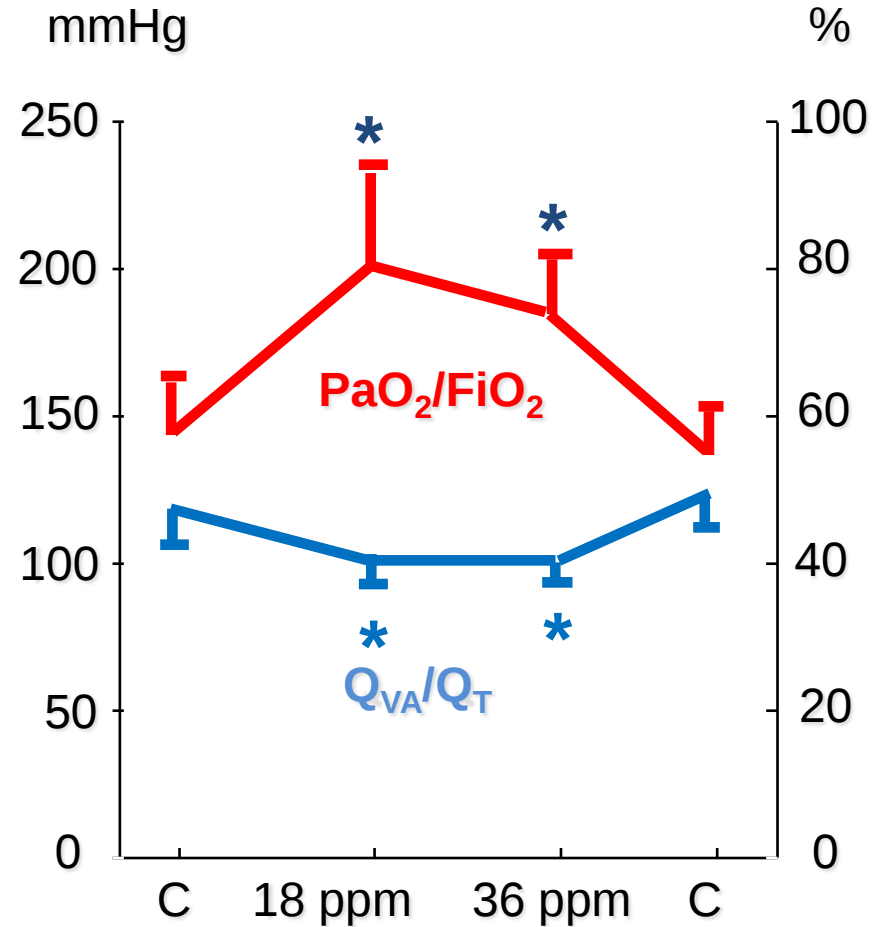
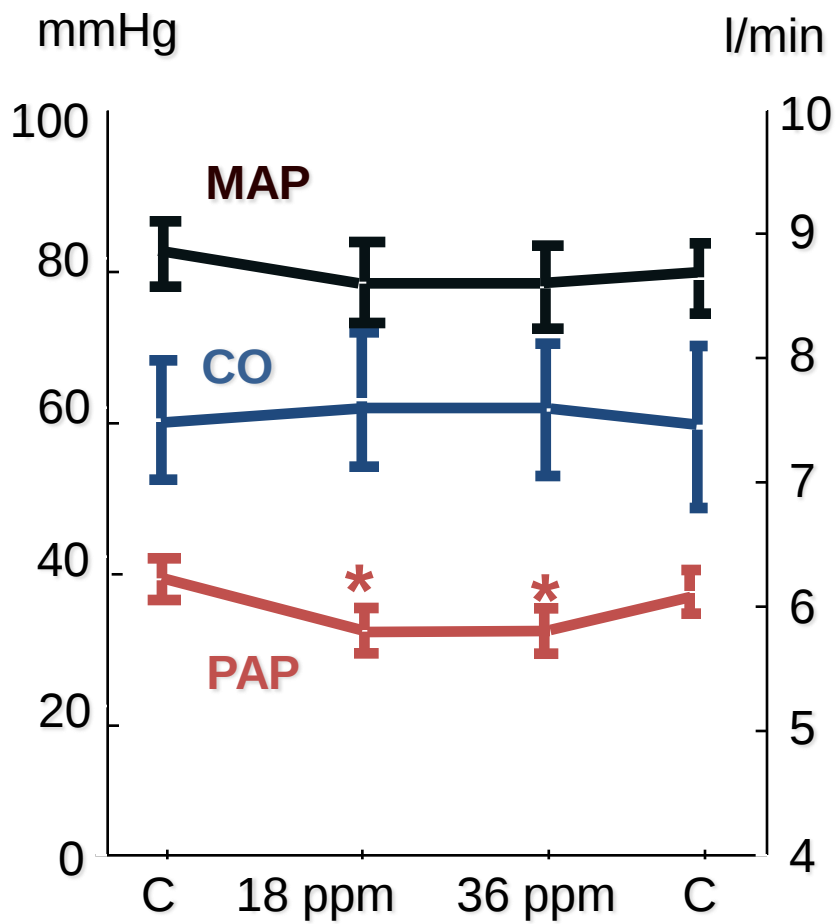
NEJM January 22, 2013

Inhaled NO in ARDS

- Selective pulmonary vasodilator
- Redistribution of blood flow toward well ventilated areas
→ decreased shunt → $\nearrow$ PaO₂ (in 60 % of cases)
- Initial dose 5 – 10 ppm
- No proven impact on outcome

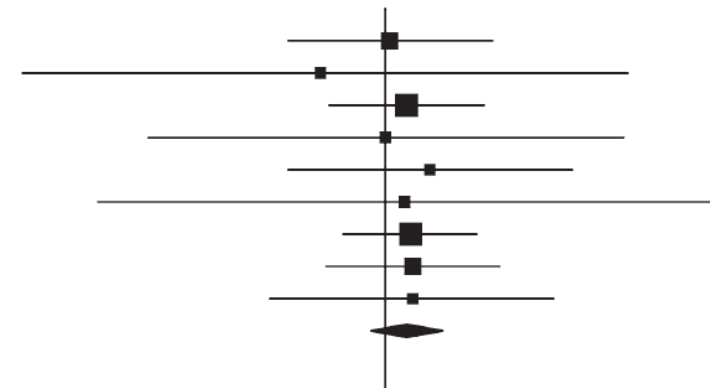


Inhaled NO in ARDS



Inhaled NO in ARDS : No effect on mortality

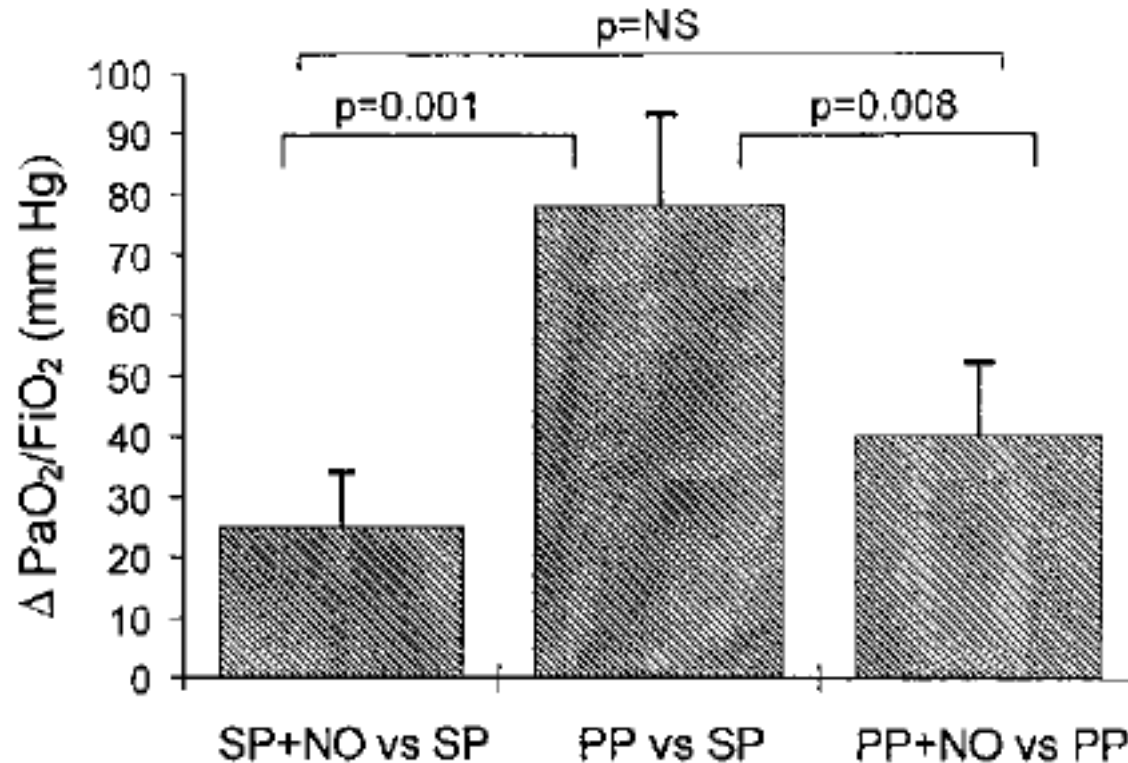
Study	Nitric oxide		Control		Weight	Risk Ratio [95% CI]
	Events	Total	Events	Total		
All Patients						
Dellinger et al, 1998	43	158	20	75	12.6%	1.02 [0.65, 1.61]
Gerlach et al, 2003	3	20	4	20	1.4%	0.75 [0.19, 2.93]
Lundin et al, 1999	41	93	35	87	21.9%	1.10 [0.78, 1.55]
Mehta et al, 2001	4	8	3	6	2.3%	1.00 [0.35, 2.88]
Michael et al, 1998	11	20	9	20	6.6%	1.22 [0.65, 2.29]
Park et al, 2003	4	11	2	6	1.4%	1.09 [0.28, 4.32]
Payen et al, 1999	48	98	46	105	29.5%	1.12 [0.83, 1.50]
Taylor et al, 2004	44	192	39	193	17.7%	1.13 [0.77, 1.66]
Troncy et al, 1998	9	15	8	15	6.6%	1.13 [0.60, 2.11]
Total (95% CI)	207	615	166	527	100.0%	1.10 [0.94, 1.29]
Overall effect: p=0.24; Heterogeneity: I ² =0%						



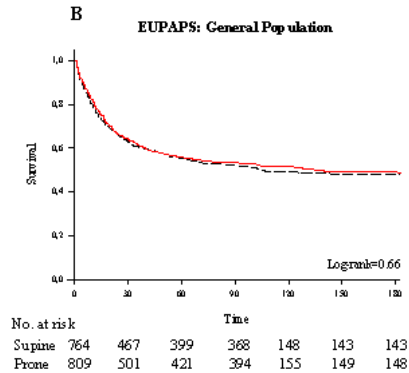
Inhaled NO vs prone position

Short-term Effects of Inhaled Nitric Oxide and Prone Position in Pulmonary and Extrapulmonary Acute Respiratory Distress Syndrome

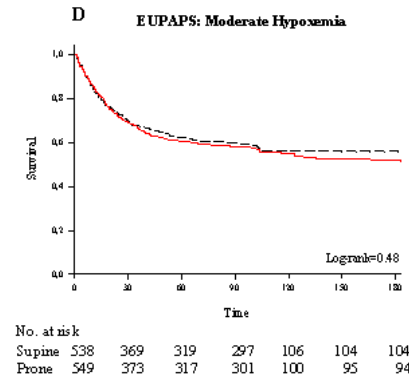
GEMMA RIALP, ANTONI J. BETBESÉ, MANUEL PÉREZ-MÁRQUEZ, and JORDI MANCEBO



PP in ARDS : Meta-analysis (individual data)

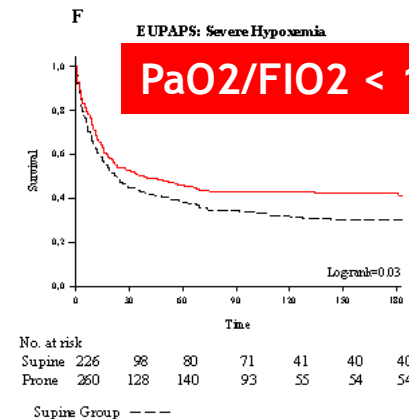


	Prone group		Supine group		Weight	Risk Ratio	Risk Ratio
	Events	Total	Events	Total		M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
EUPAPS: general population							
Gattinoni 2001	92	152	87	152	22.7%	1.06 [0.88, 1.28]	
Guerin 2004	179	413	159	378	43.3%	1.03 [0.88, 1.21]	
Mancebo 2006	38	76	37	60	10.8%	0.81 [0.60, 1.10]	
Gattinoni 2008	79	168	91	174	23.3%	0.90 [0.73, 1.11]	
Subtotal (95% CI)		809		764	100.0%	0.98 [0.89, 1.09]	
Total events	388		374				
Heterogeneity: Chi² = 3.15, df = 3 (P = 0.37); I² = 5%							
Test for overall effect: Z = 0.35 (P = 0.73)							



EUPAPS: moderate hypoxemia

Gattinoni 2001	57	99	52	106	22.6%	1.17 [0.91, 1.52]
Guerin 2004	126	323	110	303	51.1%	1.07 [0.88, 1.32]
Mancebo 2006	16	33	16	31	7.4%	0.94 [0.58, 1.53]
Gattinoni 2008	40	94	43	98	18.9%	0.97 [0.70, 1.34]
Subtotal (95% CI)		549		538	100.0%	1.07 [0.93, 1.22]
Total events	239		221			
Heterogeneity: $\text{Chi}^2 = 1.12$, $\text{df} = 3$ ($P = 0.77$); $I^2 = 0\%$						
Test for overall effect: $Z = 0.92$ ($P = 0.36$)						



P = 0.03

EUPAPS: severe hypoxemia

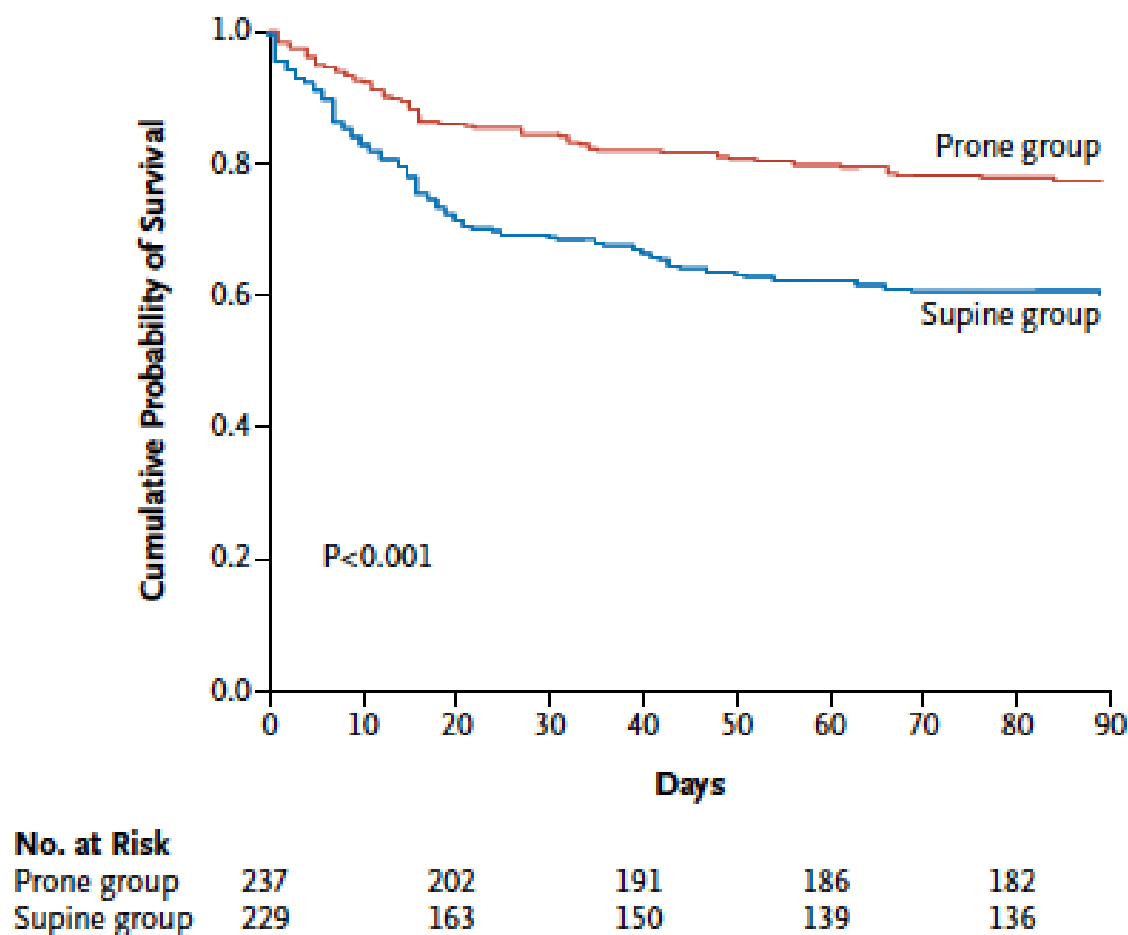
Gattinoni 2001	35	53	35	46	22.9%	0.87 [0.67, 1.12]
Guerin 2004	53	90	49	75	32.7%	0.90 [0.71, 1.14]
Mancebo 2006	22	43	21	29	15.4%	0.71 [0.49, 1.02]
Gattinoni 2008	39	74	48	76	29.0%	0.83 [0.63, 1.10]
Subtotal (95% CI)		260		226	100.0%	0.84 [0.74, 0.97]
Total events	149		153			
Heterogeneity: $\text{Chi}^2 = 1.24$, $\text{df} = 3$ ($P = 0.74$); $I^2 = 0\%$						
Test for overall effect: $Z = 2.41$ ($P = 0.02$)						

RR reduction of 16%

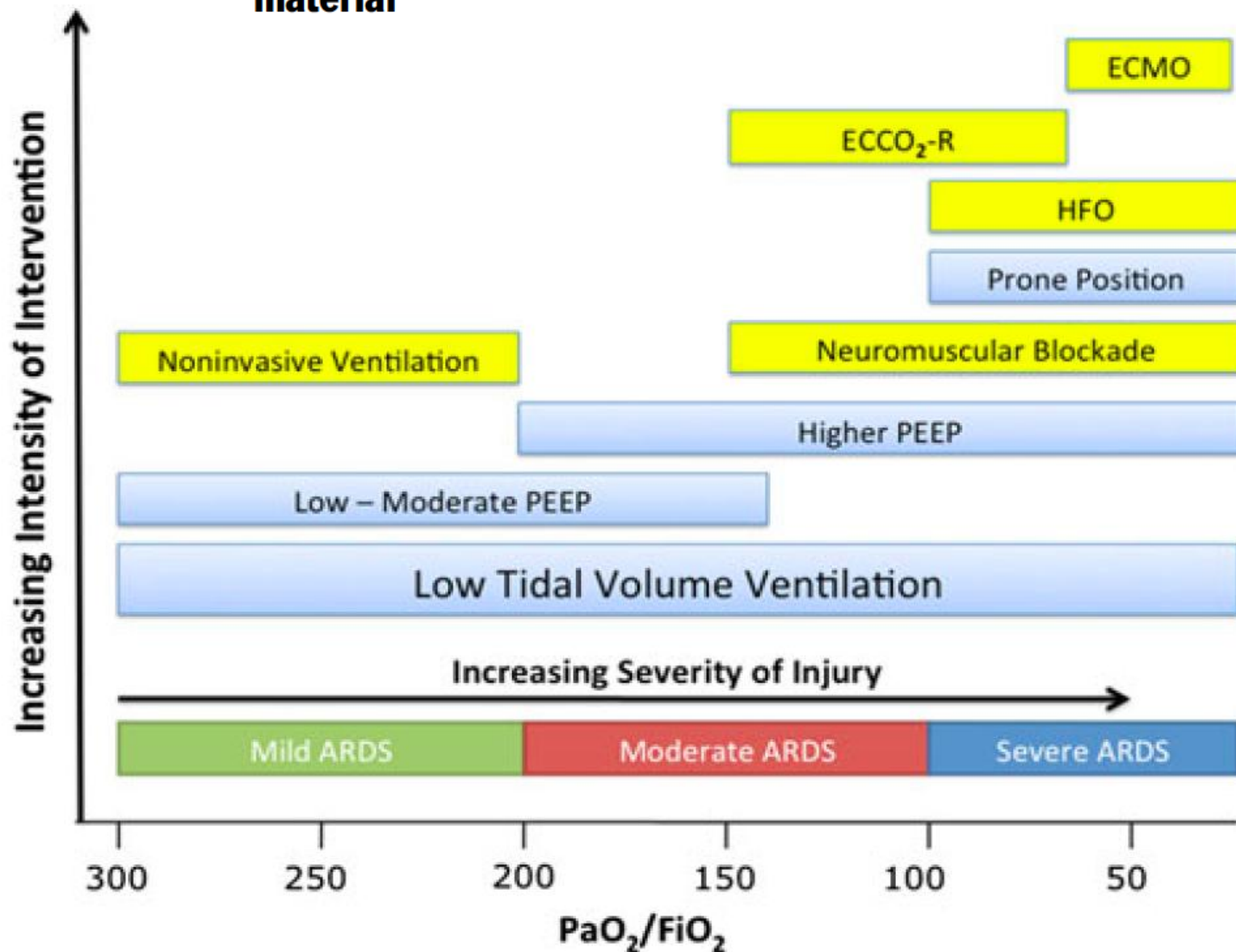
P = 0.02

0.5 0.7 1 1.5 2
Favours prone Favours supine

Prone Positioning in Severe Acute Respiratory Distress Syndrome



The Berlin definition of ARDS: an expanded rationale, justification, and supplementary material





VAC : 400 x 35, FiO2 70 %, PEEP 16

	Dorsal	Ventral (H1)
PaO2 (mmHg)	68	84
PaCO2 (mmHg)	46	44
Pplateau (cmH2O)	30	32

Q10 : Comment expliquez-vous
l'augmentation de $P_{plateau}$ en DV ?

Augmentation des résistances

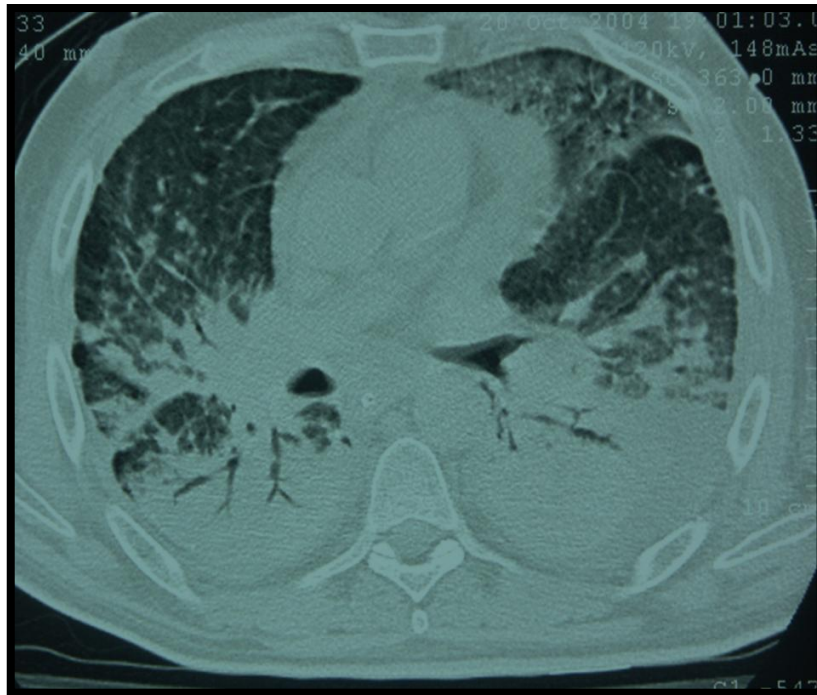
Recrutement

Diminution de la compliance pulmonaire

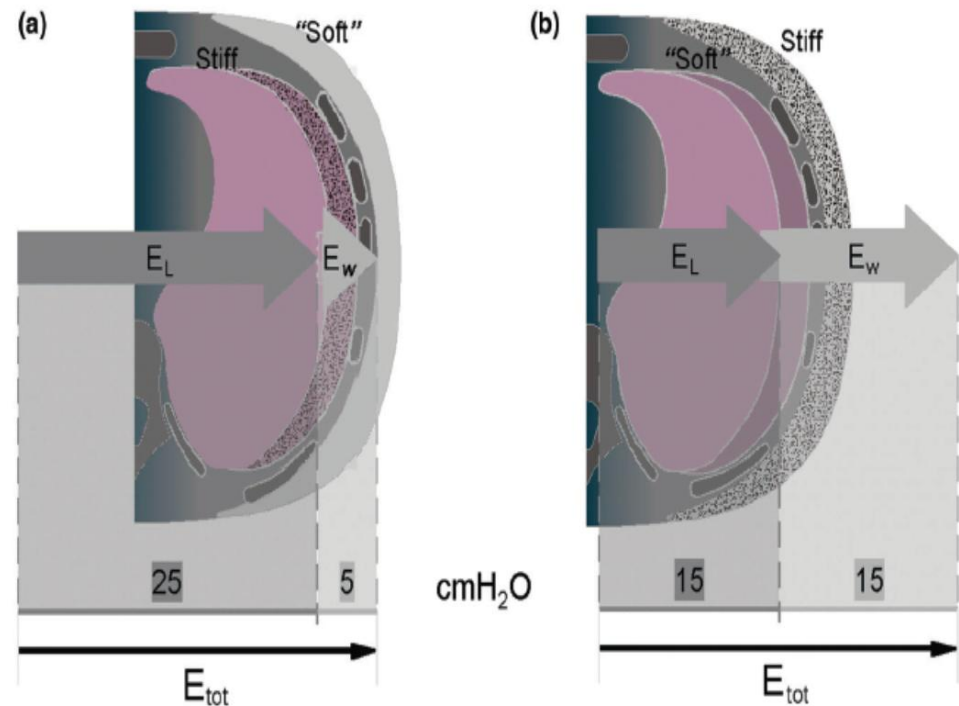
Diminution de la compliance de la paroi

Low compliance of the respiratory system in ARDS

Small lung +/- stiff chest wall

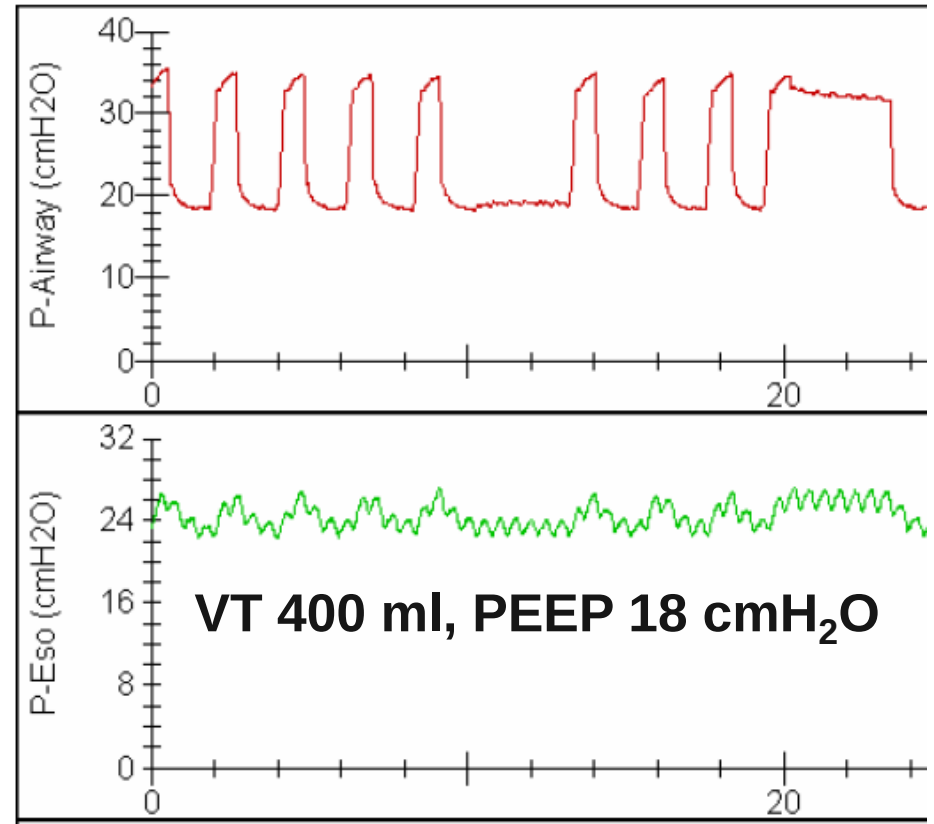


ARDS : baby lung



$$E_{RS} = E_L + E_{CW}$$

Elastance paroi ? → Pression oesophagienne

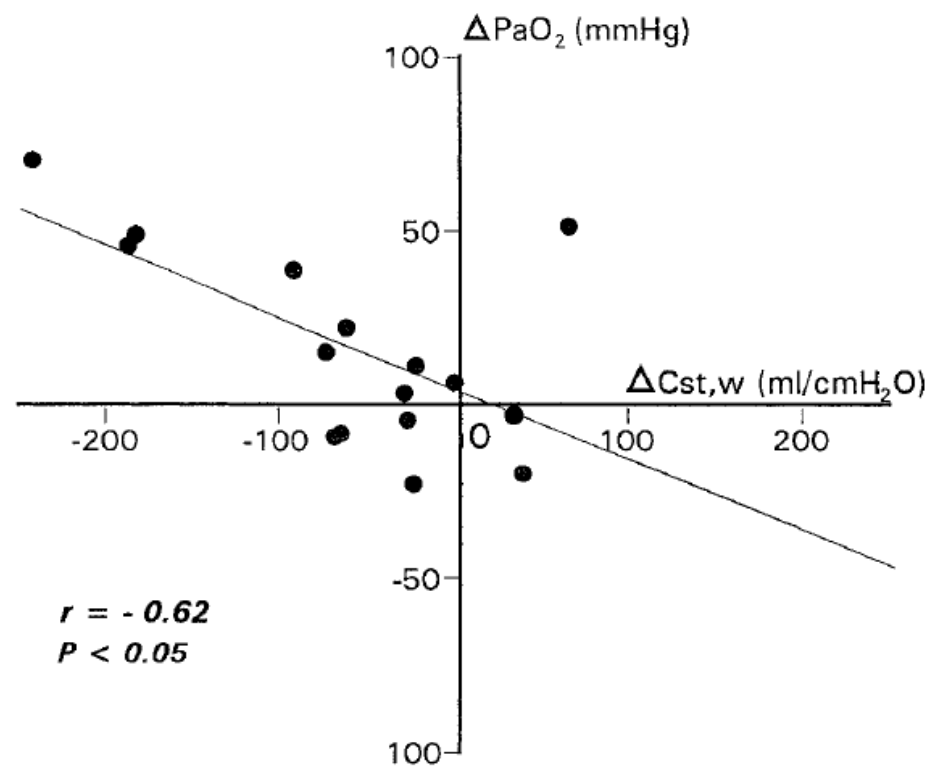
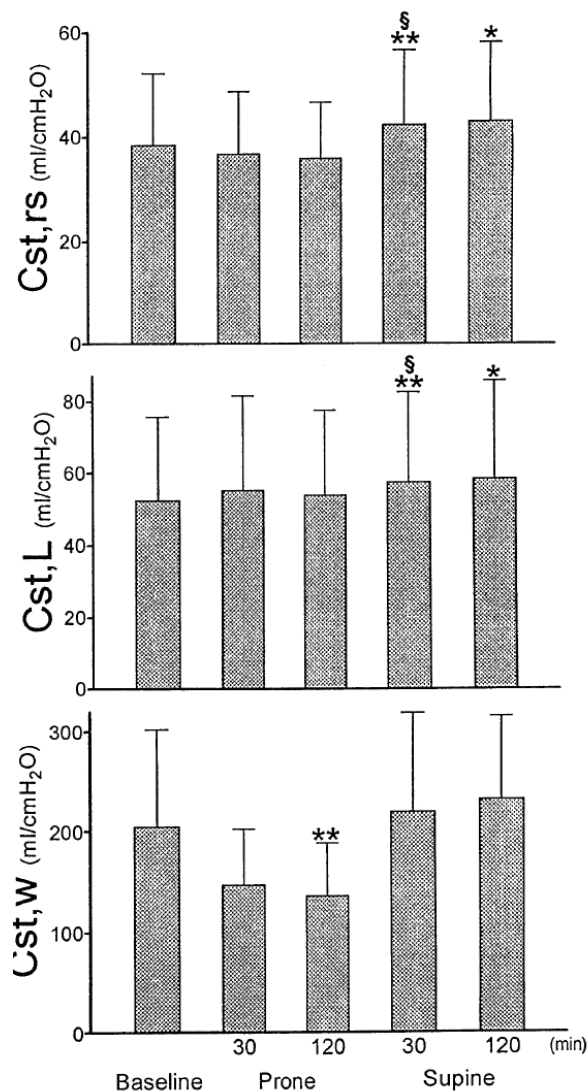


$$E_{cw} = (P_{e \text{ insp}} - P_{e \text{ exp}}) / VT$$

$$E_{cw} = (25 - 23) / 0.4 = 5 \text{ cmH}_2\text{O/L}$$

Effects of the Prone Position on Respiratory Mechanics and Gas Exchange during Acute Lung Injury

PAOLO PELOSI, DANIELA TUBIOLO, DANIELE MASCHERONI, PIERLUIGI VICARDI, STEFANIA CROTTI, FRANCO VALENZA, and LUCIANO GATTINONI



36^{ème} heure, en décubitus dorsal

- VAC, VT 400 ml, FR 30/mn, FiO₂ 80 %, PEEP 15 cmH₂O
- 3750 ml de sérum salé depuis l' admission
- noradrénaline 0.3 µg/kg/mn
- Pplateau 29 cmH₂O, PEEP totale 16 cmH₂O
- pH 7.37 PaCO₂ 45 mmHg PaO₂ 62 mmHg SaO₂ 90 %
- FC 97 bpm, PA 110/55 mmHg, IC 3.7 l/mn/m², PAPm 29 mmHg, PAPO 13 mmHg, POD 11 mmHg, SvO₂ 66 %, Lactates 1.8 mmol/L, Hb 9,8 g/dl
- Echo : RVEDA/LVEDA : 0.7

Q11 : Que proposez-vous?

Dobutamine

Furosémide

Expansion volémique

Aucune de ces mesures

Comparison of Two Fluid-Management Strategies in Acute Lung Injury

Measured intravascular pressure (mm Hg)				MAP <60 mm Hg or a need for any vasopressor (except dopamine ≤5 μg/kg/min); consider cor- rectable causes of shock first	MAP ≥60 mm Hg without vasopressors (except dopamine ≤5 μg/kg/min)			
CVP		PAOP ^G			Average urinary output <0.5 ml/kg/hr		Average urinary output ≥0.5 ml/kg/hr	
Conservative strategy	Liberal strategy	Conservative strategy	Liberal strategy		Ineffective Circulation Cardiac index <2.5 liters/min/m ² or cold, mottled skin with capillary- refilling time >2 sec	Effective Circulation Cardiac index ≥2.5 liters/min/m ² or absence of criteria for ineffec- tive circulation	Ineffective Circulation Cardiac index <2.5 liters/min/m ² or cold, mottled skin with capillary- refilling time >2 sec	Effective Circulation Cardiac index ≥2.5 liters/min/m ² or absence of criteria for ineffec- tive circulation
Range 1				1 Vasopressor ^F Fluid bolus ^F	3 KVO IV Dobutamine ^A Furosemide ^{B,1,2,4}	7 KVO IV Furosemide ^{B,1,2,4}	11 KVO IV Dobutamine ^A Furosemide ^{B,1,3,4}	15 KVO IV Furosemide ^{B,1,3,4}
>13	>18	>18	>24					
Range 2					4 KVO IV Dobutamine ^A	8 KVO IV Furosemide ^{B,1,2,4}	12 KVO IV Dobutamine ^A	16 KVO IV Furosemide ^{B,1,3,4}
9–13	15–18	13–18	19–24					
Range 3				2 Fluid bolus ^F Vasopressor ^F	5 Fluid bolus ^C	9 Fluid bolus ^C	13 Fluid bolus ^C	17 Liberal KVO IV
4–8	10–14	8–12	14–18					18 Conservative Furosemide ^{B,1,3,4}
Range 4					6 Fluid bolus ^C	10 Fluid bolus ^C	14 Fluid bolus ^C	19 Liberal fluid bolus
<4	<10	<8	<14					20 Conservative KVO IV

N Engl J Med 2006;354:2564-75.

Comparison of Two Fluid-Management Strategies in Acute Lung Injury

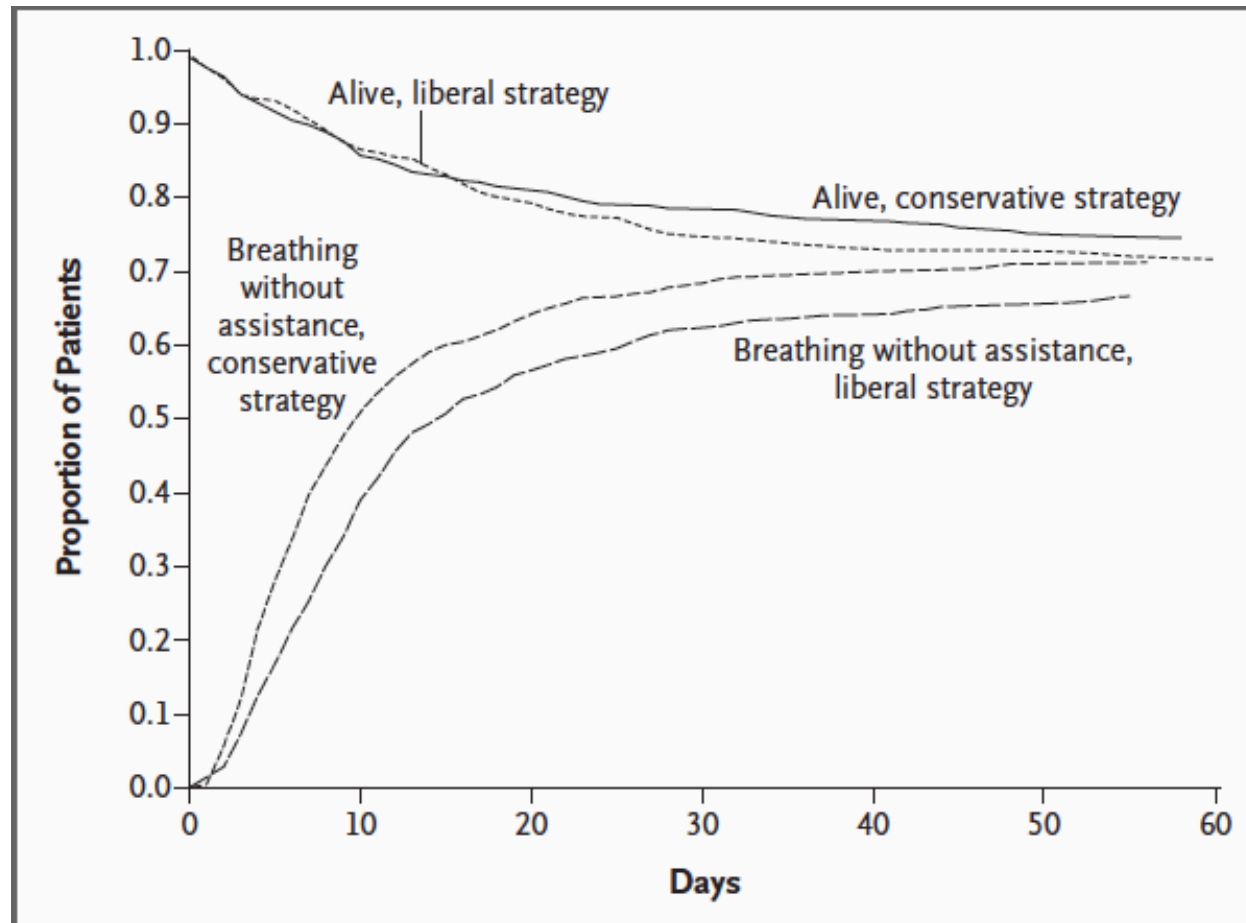
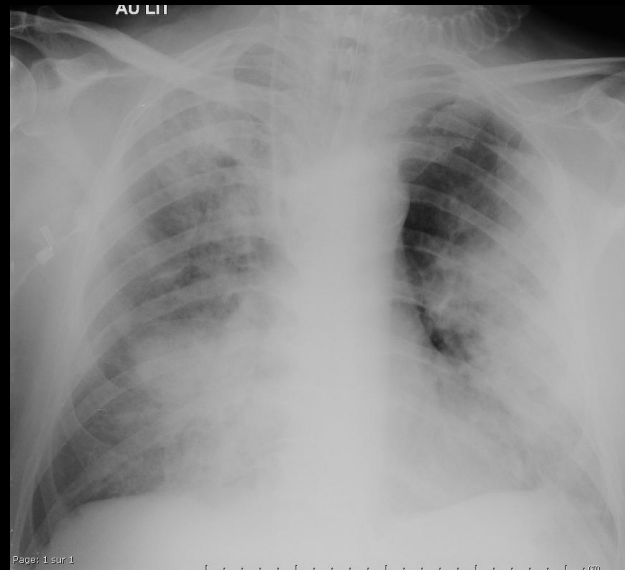


Figure 3. Probability of Survival to Hospital Discharge and of Breathing without Assistance during the First 60 Days after Randomization.

N Engl J Med 2006;354:2564-75.

Situation à J4

- Dégradation progressive des échanges gazeux et de la compliance
- VAC, VT 380 ml, FR 35/mn, FiO₂ 1, PEEP 14 cmH₂O, séances longues de DV (16 – 18 heures)
- Pplateau : 33 cmH₂O, PEEPtot 15 cmH₂O
- pH 7.22 PaCO₂ 61 mmHg PaO₂ 52 mmHg SaO₂ 79 % (décubitus dorsal)



Q12 : A ce stade, que proposez-vous ?

Corticothérapie

ECMO

Croiser les doigts

Corticosteroids in the prevention and treatment of acute respiratory distress syndrome (ARDS) in adults: meta-analysis

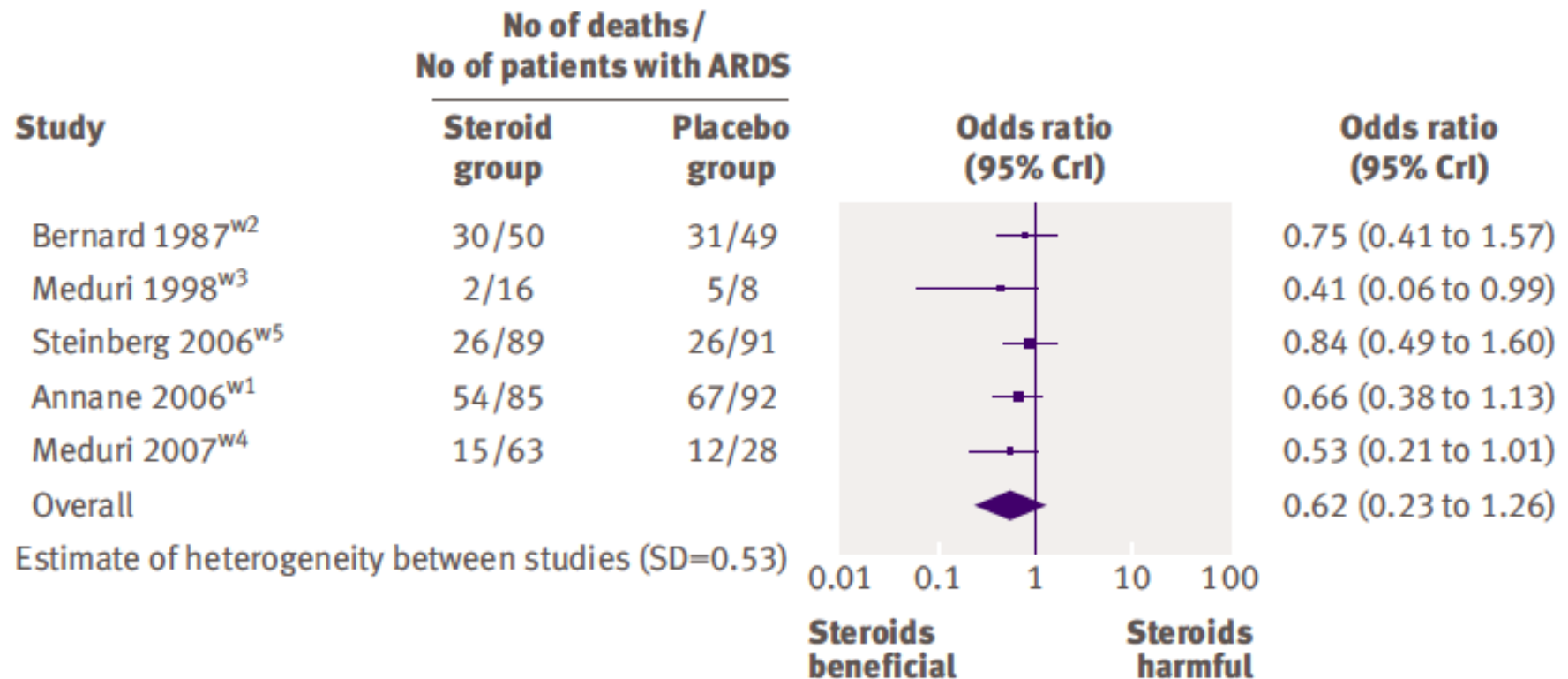
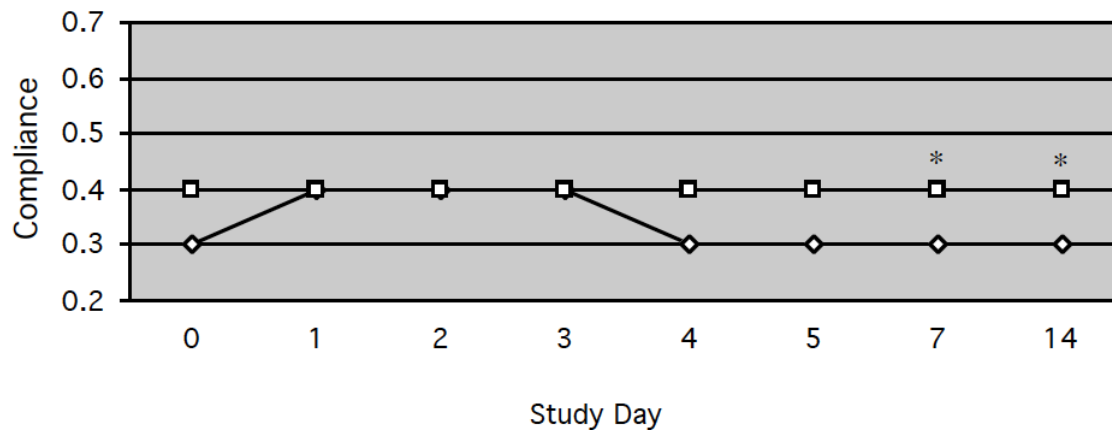
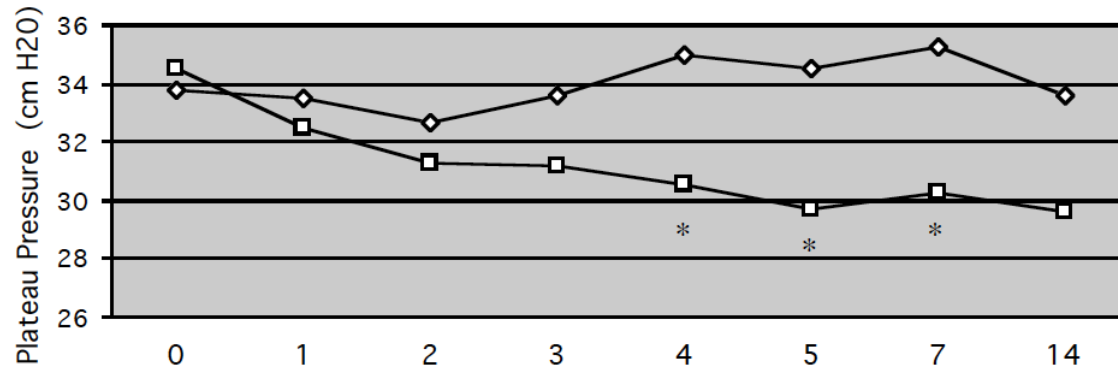
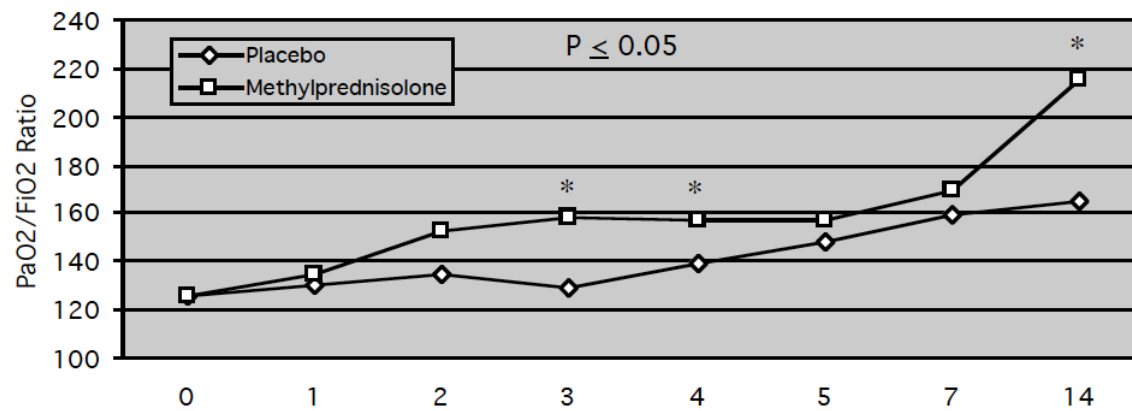


Fig 4 | Effect of therapeutic steroids on mortality in patients with acute respiratory distress syndrome

Efficacy and Safety of Corticosteroids for Persistent Acute Respiratory Distress Syndrome

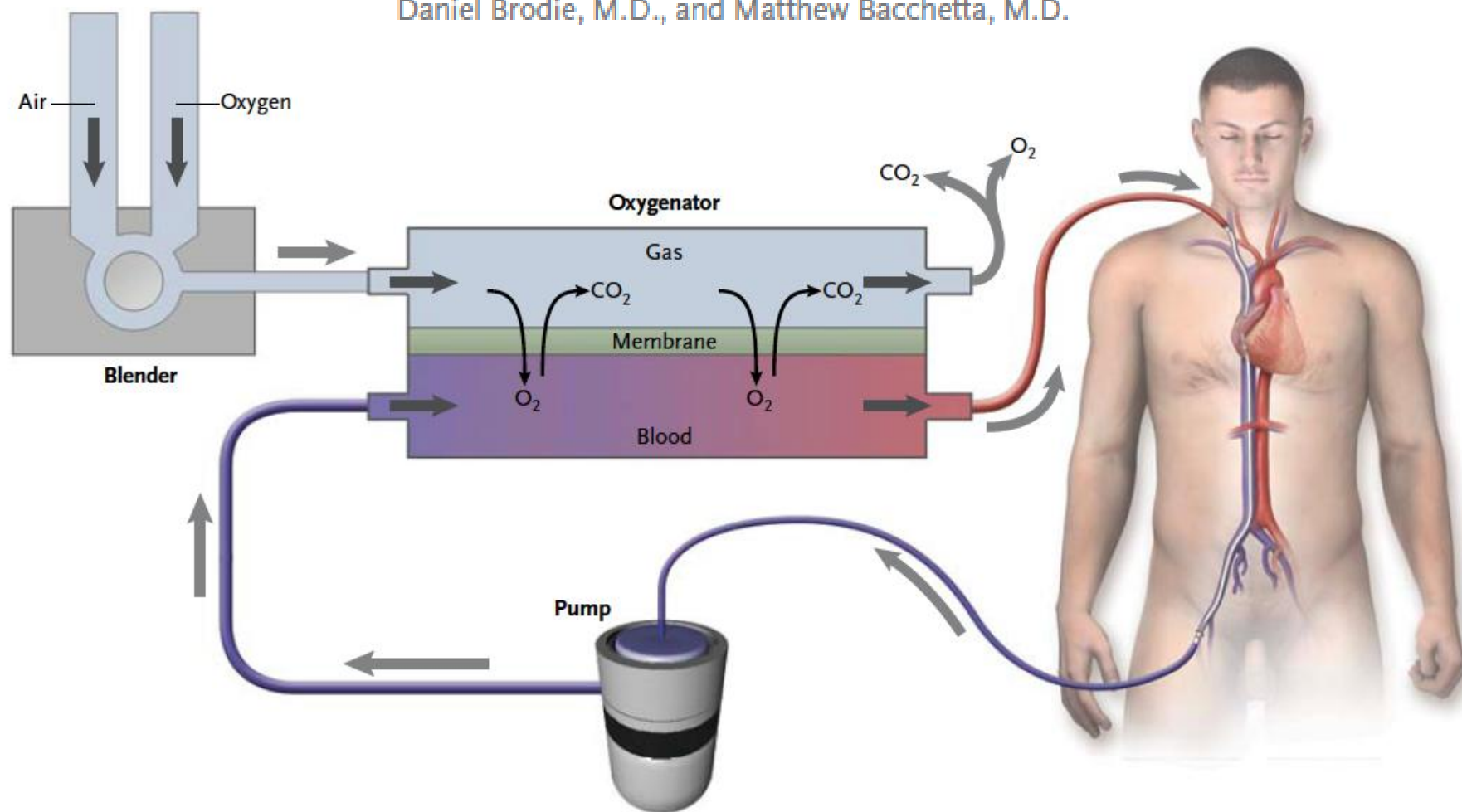
The National Heart, Lung, and Blood Institute Acute Respiratory Distress Syndrome (ARDS) Clinical Trials Network*

Variable	Placebo (N = 91)	Methylprednisolone (N = 89)	P Value
60-Day mortality (%)	28.6	29.2	1.0
95% CI	20.8–38.6	20.8–39.4	
No. of ventilator-free days at day 28	6.8±8.5	11.2±9.4	<0.001
60-Day mortality according to time from ARDS onset			
7–13 Days (%)	36	27	0.26
No. of patients	66	66	
>14 Days (%)†	8	35	0.02
No. of patients	25	23	



Extracorporeal Membrane Oxygenation for ARDS in Adults

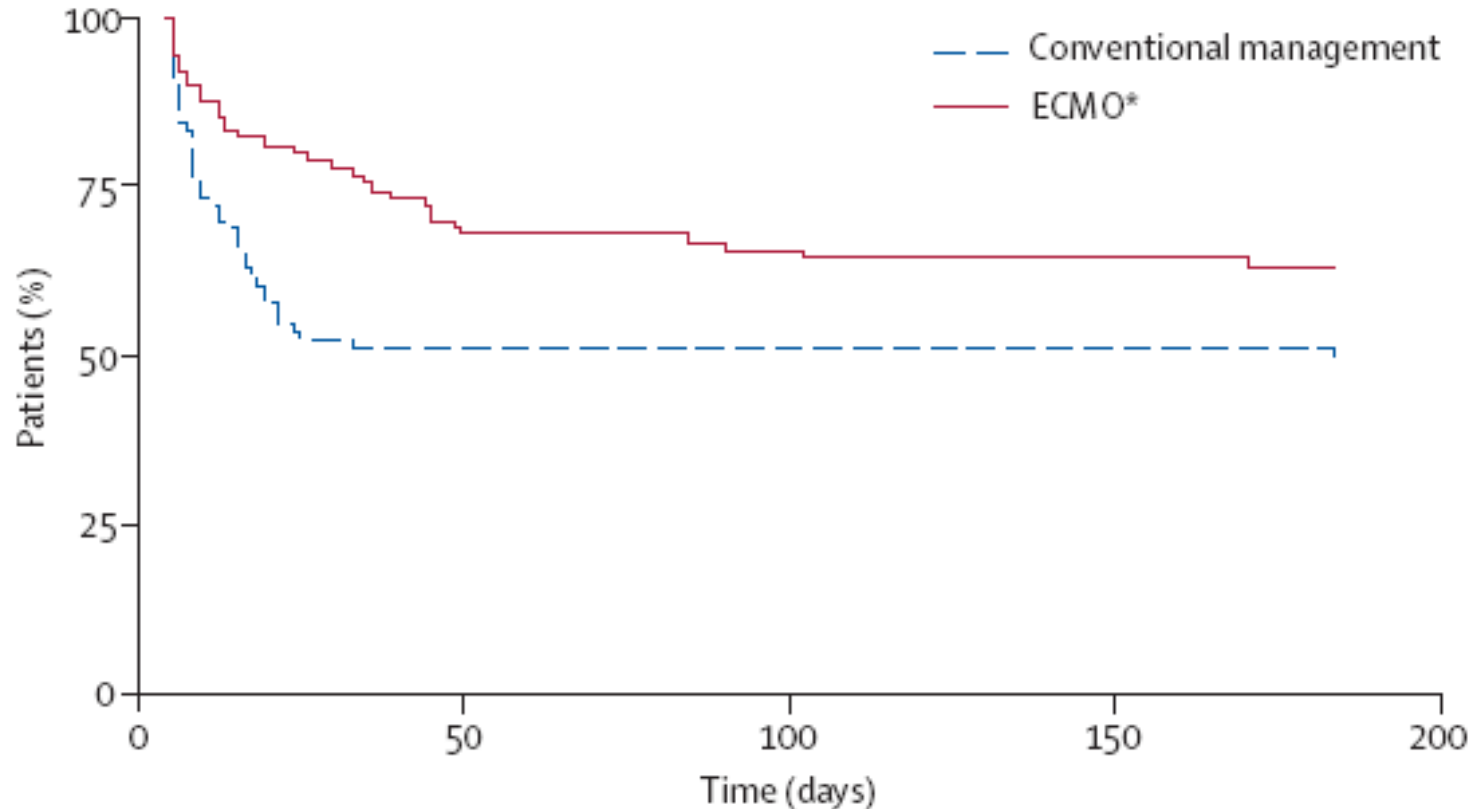
Daniel Brodie, M.D., and Matthew Bacchetta, M.D.



N Engl J Med 2011;365:1905-14.

CESAR : résultats

- 6 months mortality : 37 % vs 45 % ($p = 0.07$)
- Alive without disability at 6 months : 63 % vs 47 % ($p = 0.03$)



Essai *EOLIA*



INSTITUT DE CARDIOLOGIE
Pitié-Salpêtrière
Paris



EOLIA

« ECMO to rescue Lung Injury severe ARDS »

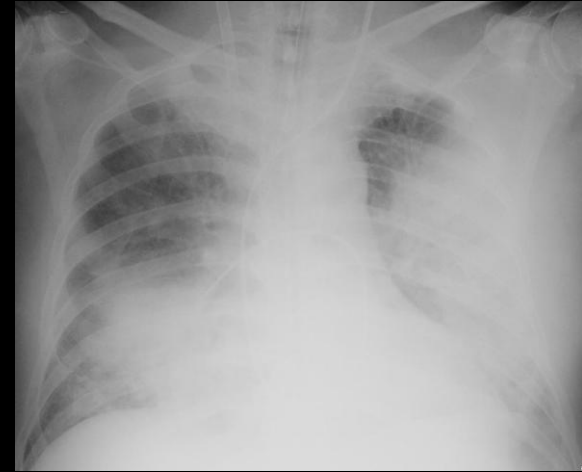
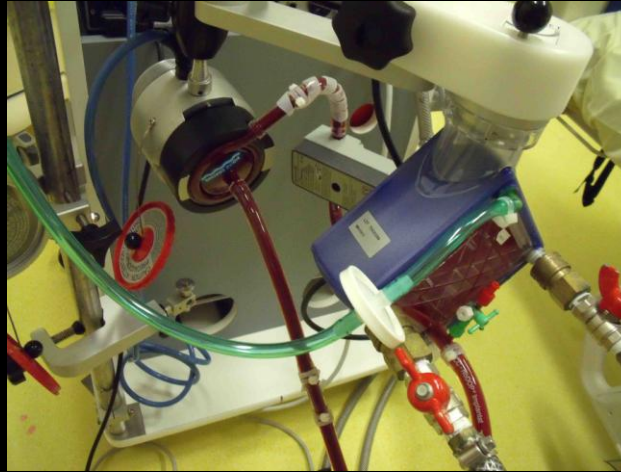


Croiser les doigts au cours du SDRA

- Données publiées = 0
- Expérience personnelle positive
- Effets secondaires limités



J4 → ECMO



- V-V ECMO, fémoro (24 F) – jugulaire (21 F)
- débit sang 5 L/mn, Sweep gas flow 8 L/mn (FiO_2 1)
- Heparine pour anti Xa : 0.2 à 0.3
- pression contrôlée : P_{insp} 25 cmH₂O, PEEP 15 cmH₂O

Devenir

- J 9 : PAVM (E. Coli) → tazocilline
- J10 → J15 : Amélioration progressive de la compliance
- J15 : sevrage ECMO (FiO_2 0.6, PEEP 12) → VAC → AI
- J25 : Extubation
- J27 : Sortie de réanimation

Un mois plus tard

- De retour au travail à Savennières (Maine et Loire)





alain.mercat@univ-angers.fr