VENTILATION DU SDRA

Dr Q. BLANC
Service de Réanimation Polyvalente

AER 24 NOVEMBRE 2017

Centre Hospitalier de Valence

- Pas de conflit d’intérêt

- Définition
- VENTILATION INVASIVE : réglage du respirateur
- Autres thérapeutiques
- Place de la VNI

ACUTE RESPIRATORY DISTRESS IN ADULTS

DAVID G. ASHBAUGH
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ASSISTANT IN MEDICINE AND AMERICAN ...ETY-NATIONAL TUBERCULOSIS ASSOCIATION ... ...MONARY DISEASE

T... ...ETTY
...olorado
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BERNARD E. LEVINE
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From the Departments of Surgery and Medicine, University of Colorado Medical Center, Denver, Colorado, U.S.A.

An Expanded Definition of the Adult Respiratory Distress Syndrome[1]

JOHN F. MURRAY, MICHAEL A. MATTHAY, JOHN M. LUCE, and MICHAEL R. FLICK

COMPONENTS AND INDIVIDUAL VALUES OF THE LUNG INJURY SCORE*

		Value
1. Chest roentgenogram score		
No alveolar consolidation		0
Alveolar consolidation confined to 1 quadrant		1
Alveolar consolidation confined to 2 quadrants		
Alveolar consolidation confined to 3 quadrants		
Alveolar consolidation in all 4 quadrants		
2. Hypoxemia score		
Pa_{O_2}/FI_{O_2}	>300	
Pa_{O_2}/FI_{O_2}	225–...	
Pa_{O_2}/FI_{O_2}	1...	2
Pa_{O_2}/FI_{O_2}		3
Pa_{O_2}/FI_{O_2}		4
3. PEEP score (when ventilated)		
PEEP	...cm H_2O	0
PEEP	... cm H_2O	1
PEEP	9–11 cm H_2O	2
PEEP	12–14 cm H_2O	3
PEEP	≥15 cm H_2O	4
4. Respiratory system ... ...ble)		
Compliance	≥80 ml/cm H_2O	0
Compli...	60–79 ml/cm H_2O	1
Co...	40–59 ml/cm H_2O	2
	20–39 ml/cm H_2O	3
	≤19 ml/cm H_2O	4

...ined by dividing the aggregate sum by the number of components that were used

	Score
No lung injury	0
Mild-to-moderate lung injury	0.1–2.5
Severe lung injury (ARDS)	>2.5

The American-European Consensus Conference on ARDS

Definitions, Mechanisms, Relevant Outcomes, and Clinical Trial Coordination

GORDON R. BERNARD, ANTONIO ARTIGAS, KENNETH L. BRIGHAM, JEAN CARLET, KONRAD FALKE, LEONARD HUDSON, MAURICE LAMY, JEAN ROGER LEGALL, ALAN MORRIS, ROGER SPRAGG, and the Consensus Committee

RECOMMENDED CRITERIA FOR ACUTE LUNG INJURY (ALI) AND ACUTE RESPIRATORY DISTRESS SYNDROME (ARDS)

		Oxygenation	Chest Radiograph	Pulmonary Artery Wedge Pressure
	...nset	Pa_{O_2}/FI_{O_2} ≤ 300 mm Hg (regardless of PEEP level)	Bilateral infiltrates seen on frontal chest radiograph	≤ 18 mm Hg when measured or no clinical evidence of left atrial hypertension
ARDS criteria	Acute onset	Pa_{O_2}/FI_{O_2} ≤ 200 mm Hg (regardless of PEEP level)	Bilateral infiltrates seen on frontal chest radiograph	≤ 18 mm Hg when measured or no clinical evidence of left atrial hypertension

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From the Departments of Surgery and Medicine, University of Colorado Medical Center, Denver, Colorado, U.S.A.

The Lancet · Saturday 12 August 1967

Tachypnée
Cyanose réfractaire
Infiltrats diffus
↓ compliance pulmonaire

Acute Respiratory Distress Syndrome

The Berlin Definition

JAMA, June 20, 2012—Vol 307, No. 23

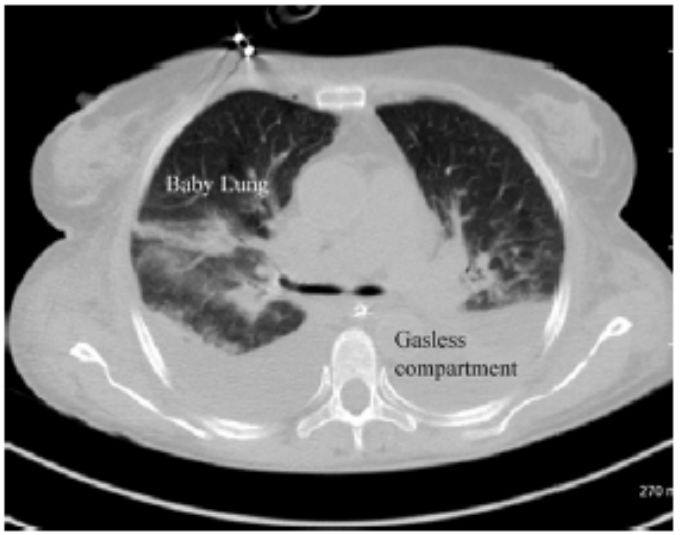
Temps	Pas plus d'une semaine après la survenue d'un événement clinique (facteur de risque) ou de nouveaux symptômes ou d'une aggravation
Radio de thorax[1]	Opacités bilatérales non expliquées entièrement par des épanchements, des nodules ou des atélectasies
Origine de l'œdème	– Insuffisance respiratoire non expliquée entièrement par une insuffisance cardiaque ou une surcharge hydrosodée – Évaluation objective nécessaire (*e.g.*, échocardiographie) en l'absence de facteur de risque pour exclure un œdème hydrostatique
Oxygénation : PaO_2/FiO_2	– Léger : 200 mmHg < PaO_2/FiO_2 ≤ 300 mmHg avec PEP ou CPAP ≥ 5 cmH_2O – Modéré : 100 mmHg < PaO_2/FiO_2 ≤ 200 mmHg avec PEP ≥ 5 cm H_2O – Sévère : < 100 mmHg avec PEP ≥ 5 cmH_2O

Agressions pulmonaires directes	**Agressions pulmonaires indirectes**
Pneumonies (40-50 %)	Sepsis extrapulmonaire (20-30 %)
Inhalation de liquide gastrique (10-15 %)	Polytraumatisme (5-10 %)
Contusion pulmonaire	Choc
Noyade	Pancréatite aiguë
Embolie graisseuse ou amniotique	Transfusion massive
Inhalation de fumées	Brûlures étendues
Intoxications médicamenteuses	*Crush syndrome*

SDRA : particularités

- Concept du Baby lung

L.Gattinoni ICM 2016



- Hétérogénéité des lésions
- Compliance basse
- Shunt pulmonaire d'ou hypoxémie

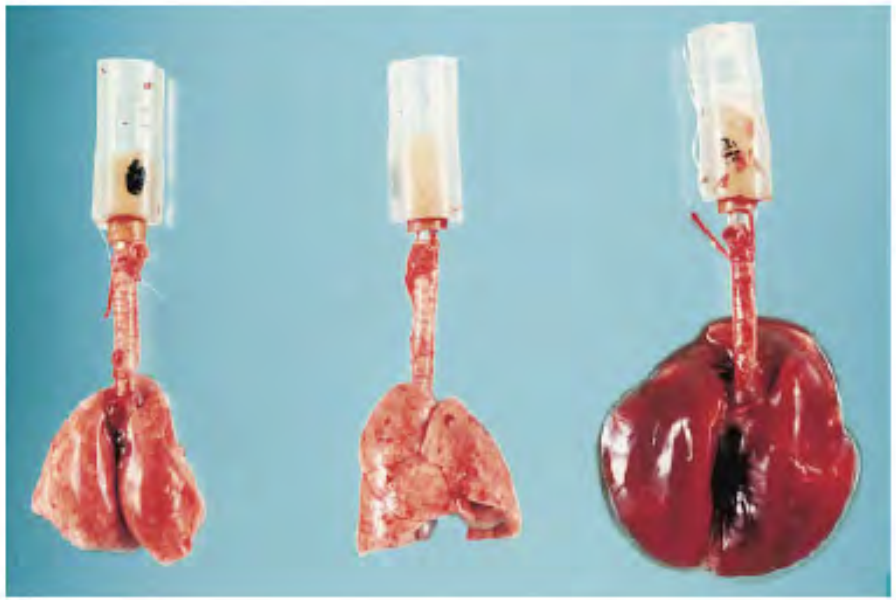
But de la ventilation du SDRA

- Corriger l'hypoxémie

- Ne pas aggraver les lésions : ventilation PROTECTRICE

Ventilator-induced Lung Injury
Lessons from Experimental Studies

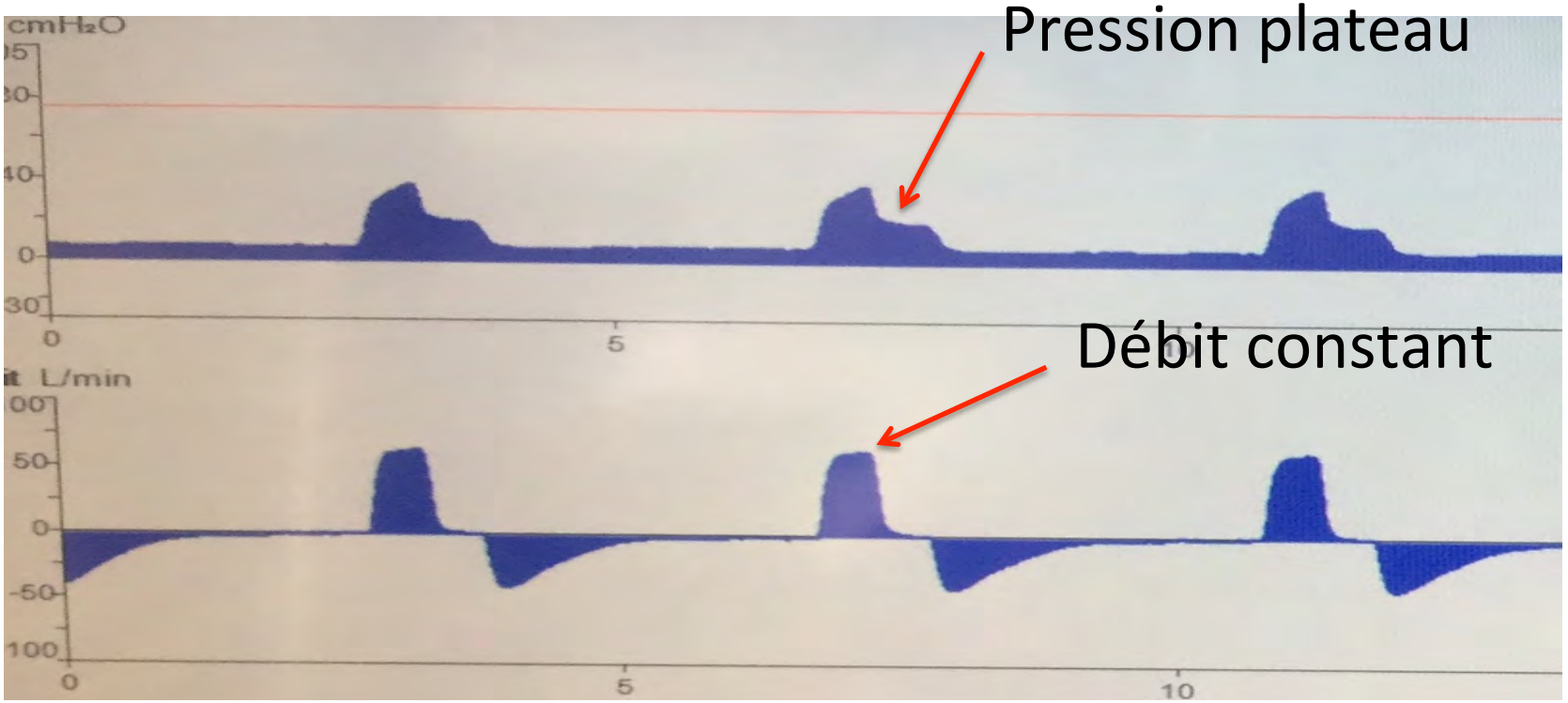
DIDIER DREYFUSS and GEORGES SAUMON



Am J Respir Crit Care Med Vol 157. pp 294–323, 1998

MODE VENTILATOIRE : VAC

- DEBIT CONSTANT (rectangulaire) : 40-60 l/min
- Pause téléinspiratoire de 0,2-0,3 s (mesure de la Pplat)



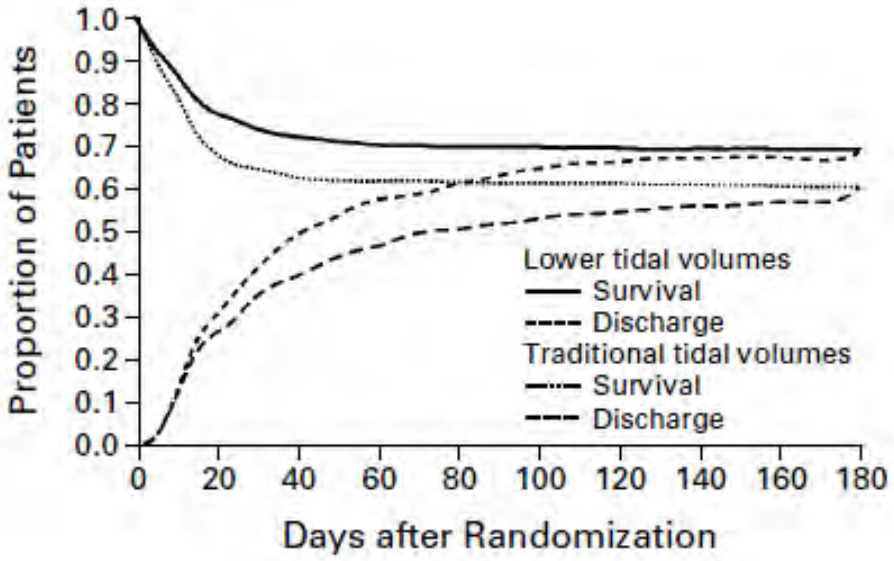
REGLAGE DU VT

VENTILATION WITH LOWER TIDAL VOLUMES AS COMPARED WITH TRADITIONAL TIDAL VOLUMES FOR ACUTE LUNG INJURY AND THE ACUTE RESPIRATORY DISTRESS SYNDROME

NEJM 2000

THE ACUTE RESPIRATORY DISTRESS SYNDROME NETWORK*

VARIABLE	GROUP RECEIVING LOWER TIDAL VOLUMES	GROUP RECEIVING TRADITIONAL TIDAL VOLUMES	P VALUE
Death before discharge home and breathing without assistance (%)	31.0	39.8	0.007
Breathing without assistance by day 28 (%)	65.7	55.0	<0.001
No. of ventilator-free days, days 1 to 28	12±11	10±11	0.007
Barotrauma, days 1 to 28 (%)	10	11	0.43
No. of days without failure of nonpulmonary organs or systems, days 1 to 28	15±11	12±11	0.006



Vt 6 ml/kg et Pplat < 30 cmH2O

Tables donnant les valeurs d'un volume courant (VT) de 6 ml/kg en fonction du poids idéal théorique

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

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

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

Formule : Poids (kg) = X + 0,91 (taille en cm – 152,4)

X = 50 pour les hommes, 45,5 pour les femmes

An Official American Thoracic Society/European Society of Intensive Care Medicine/Society of Critical Care Medicine Clinical Practice Guideline: Mechanical Ventilation in Adult Patients with Acute Respiratory Distress Syndrome

Am J Respir Crit Care Med Vol 195, Iss 9, pp 1253–1263, May 1, 2017

Question 1: Should Patients with ARDS Receive Mechanical Ventilation Using LTVs and Inspiratory Pressures?

Recommendation. We recommend that adult patients with ARDS receive mechanical ventilation with strategies that limit tidal volumes (4–8 ml/kg PBW) and inspiratory pressures (plateau pressure < 30 cm H_2O) (strong recommendation, moderate confidence in effect estimates).

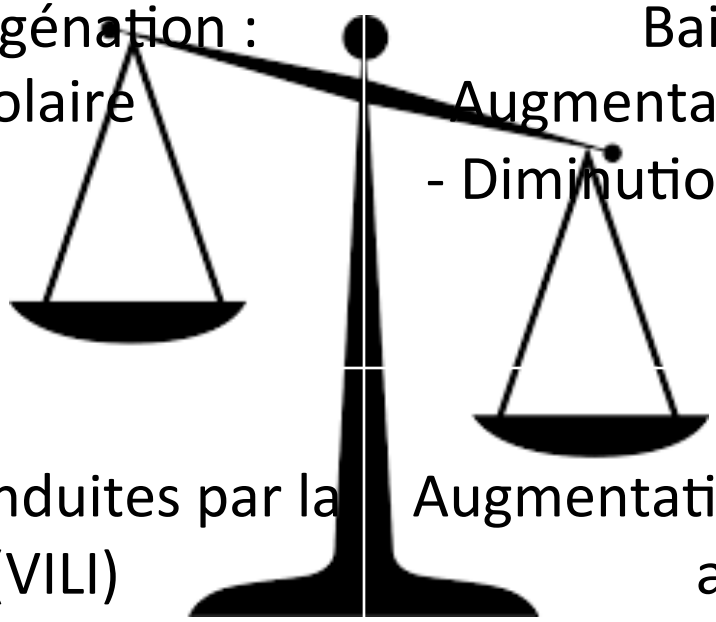
REGLAGE DE LA PEP

BENEFICES

Amélioration oxygénation :

- Recrutement alvéolaire
- Diminution shunt

Attenue les lésions induites par la ventilation (VILI)



INCONVENIENTS

Baisse du DC :

Augmentation post charge VD

- Diminution précharge VD/VG

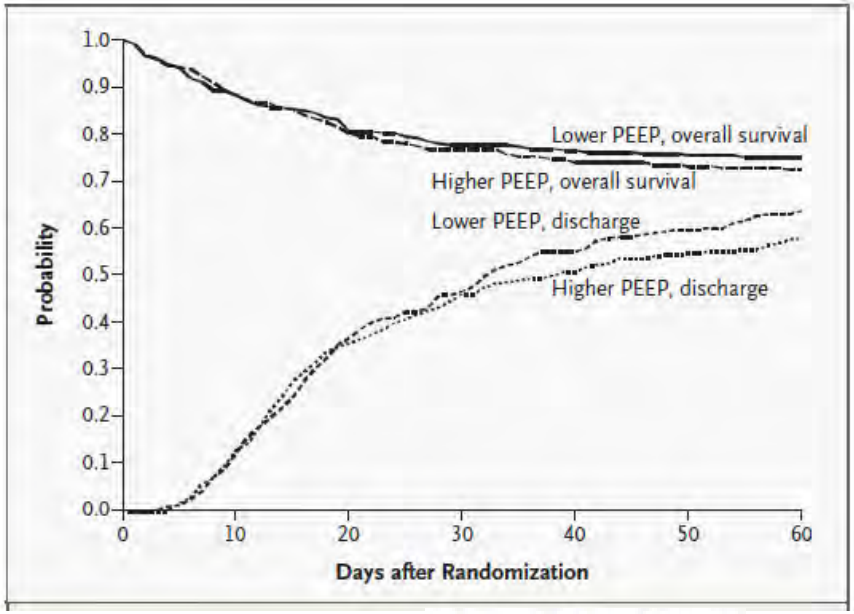
Augmentation de l'espace mort alvéolaire

Aggravation VILI

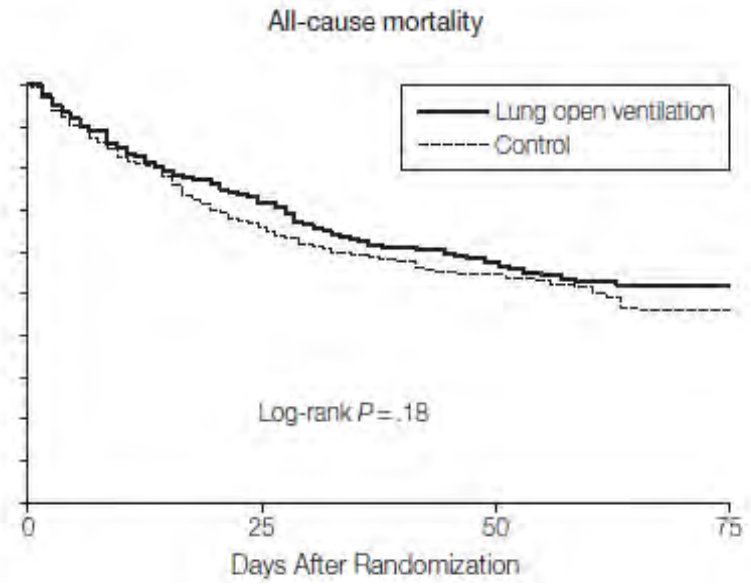
REGLAGE DE LA PEP : quelle technique?

- Table PEP/FIO2:

FIO_2	0.3–0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	1
PEEP	5	8	8	10	10	10	12	14	14	16	18	18–25



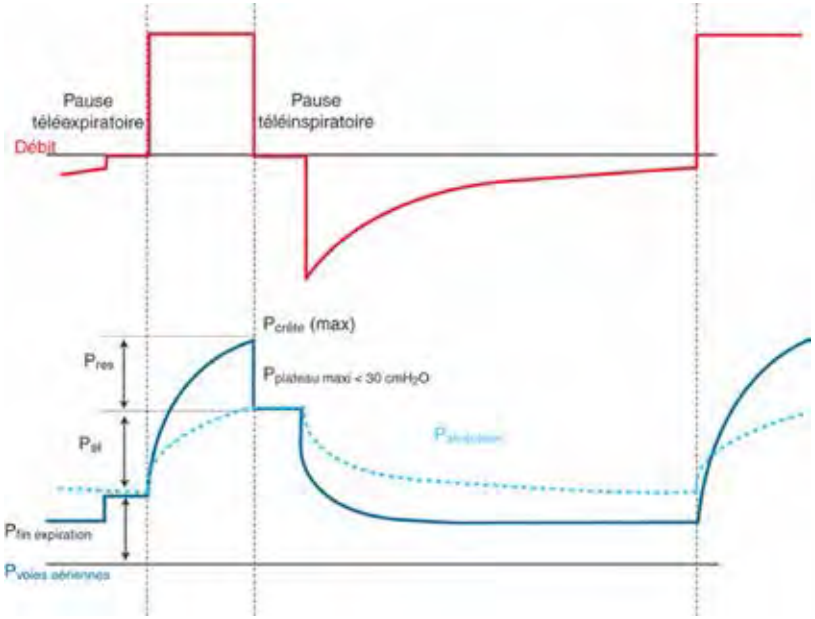
Brower et al N Engl J Med 2004;



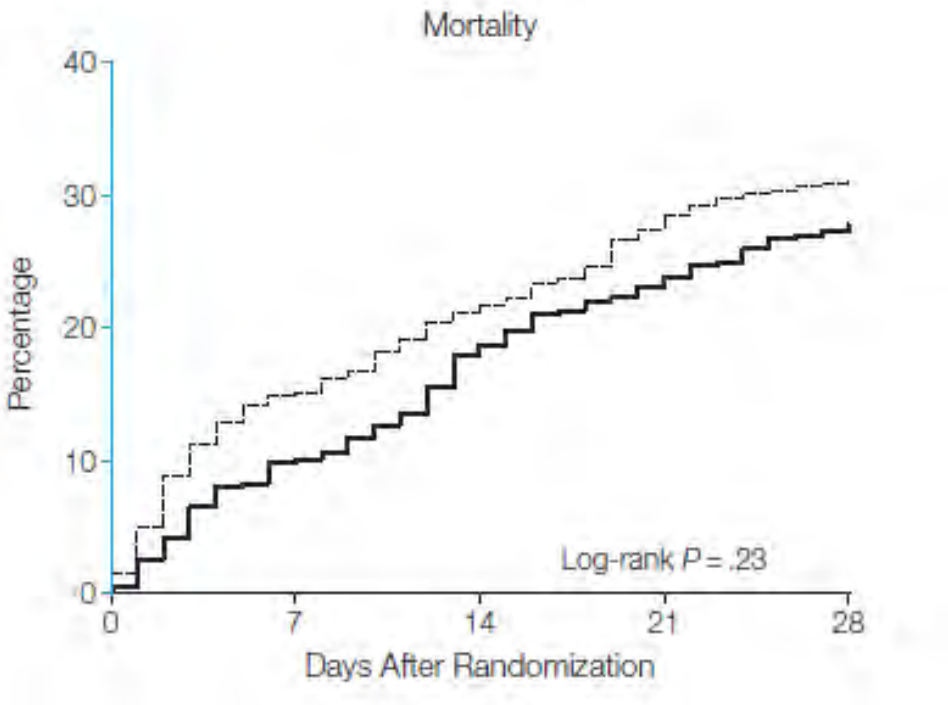
Meade JAMA 2008

REGLAGE DE LA PEP : quelle technique?

- Table PEP/FIO2
- PEP pour Pplat < 30 cmH2O :

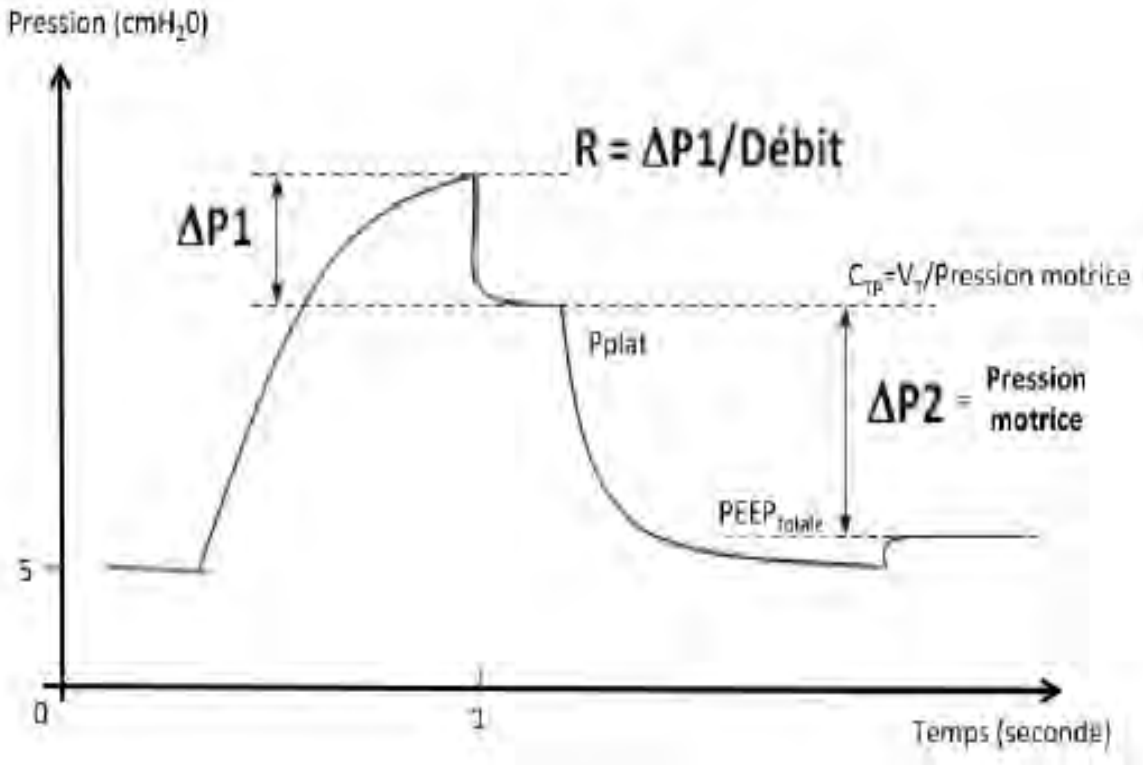


Mercat JAMA 2008



REGLAGE DE LA PEP : quelle technique?

- Table PEP/FIO2
- PEP pour Pplat < 30 cmH2O
- Pression motrice :



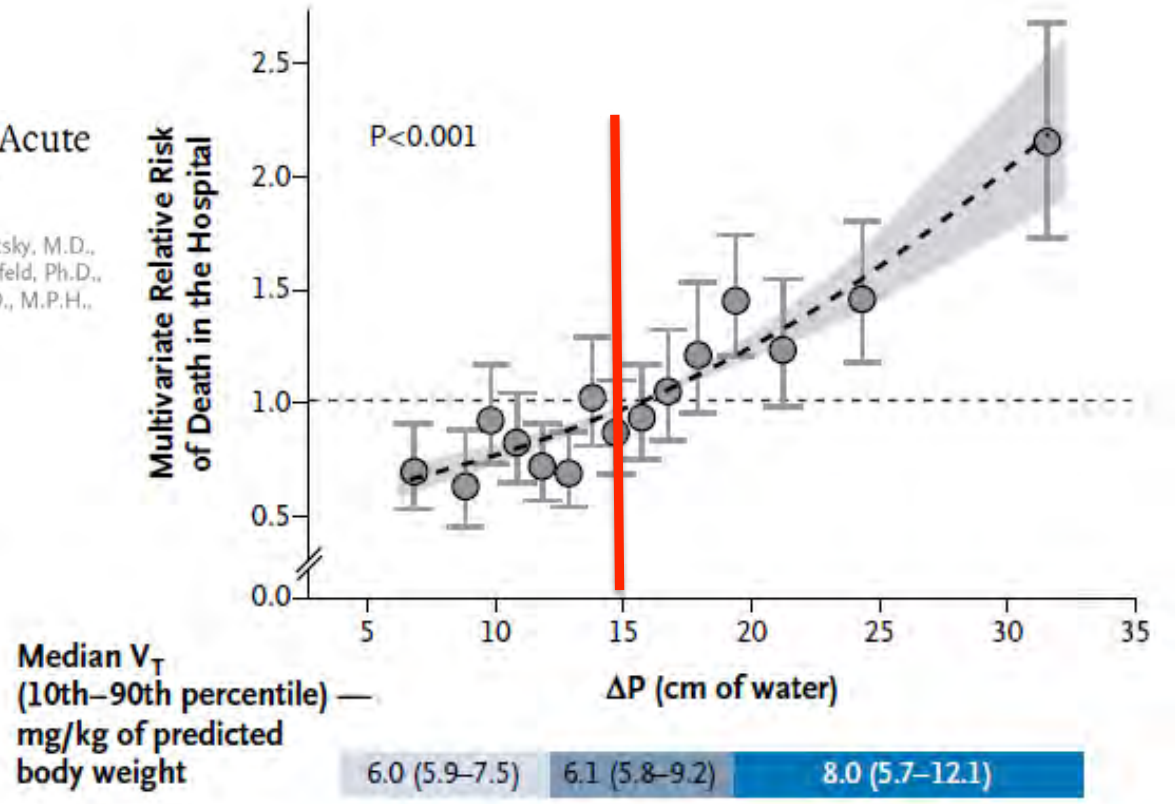
REGLAGE DE LA PEP : quelle technique?

- Table PEP/FIO2
- PEP pour Pplat < 30 cmH2O
- Pression motrice < 15 cmH2O :

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome

Marcelo B.P. Amato, M.D., Maureen O. Meade, M.D., Arthur S. Slutsky, M.D., Laurent Brochard, M.D., Eduardo L.V. Costa, M.D., David A. Schoenfeld, Ph.D., Thomas E. Stewart, M.D., Matthias Briel, M.D., Daniel Talmor, M.D., M.P.H., Alain Mercat, M.D., Jean-Christophe M. Richard, M.D., Carlos R.R. Carvalho, M.D., and Roy G. Brower, M.D.

N Engl J Med 2015



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Am J Respir Crit Care Med Vol 195, Iss 9, pp 1253–1263, May 1, 2017

Question 4: Should Patients with ARDS Receive Higher, as Compared with Lower, PEEP?

Recommendation. We suggest that adult patients with moderate or severe ARDS receive higher rather than lower levels of PEEP (conditional recommendation, moderate confidence in effect estimates).

REGLAGE DE LA FR

- FR entre 20-35/ min
- Pour obtenir une PaCO2 permettant d'avoir un pH >7,3

→ HYPERCAPNIE PERMISSIVE

- autoPEEP
- Défaillance VD
- HIC

REGLAGE DE LA FIO2

- Toxicité de l'O2? : aucune étude clinique dans le SDRA

→ FIO2 pour: **55 < PaO2 < 80 mmHg**
88< Spo2< 95%

ORIGINAL ARTICLE

Arterial Blood Gases and Oxygen Content in Climbers on Mount Everest

Michael P.W. Grocott, M.B., B.S., Daniel S. Martin, M.B., Ch.B., Denny Z.H. Levett, B.M., B.Ch., Roger McMorrow, M.B., B.Ch., Jeremy Windsor, M.B., Ch.B., and Hugh E. Montgomery, M.B., B.S., M.D., for the Caudwell Xtreme Everest Research Group*

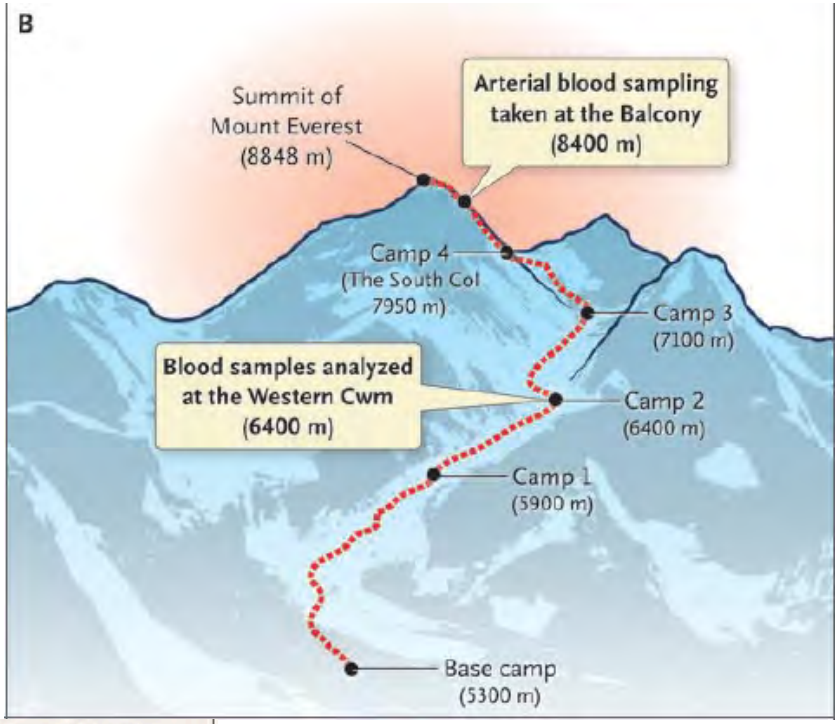
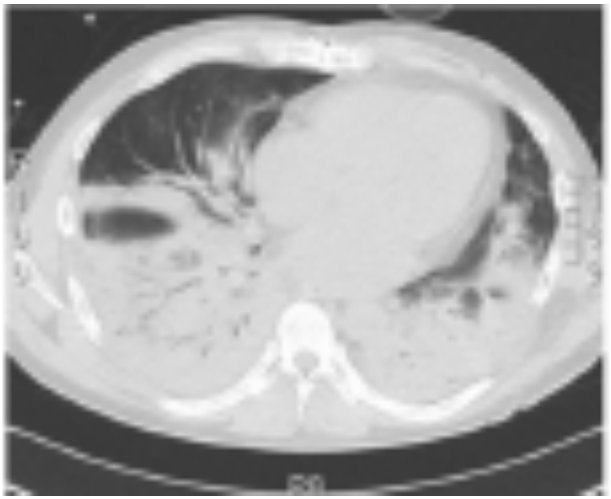


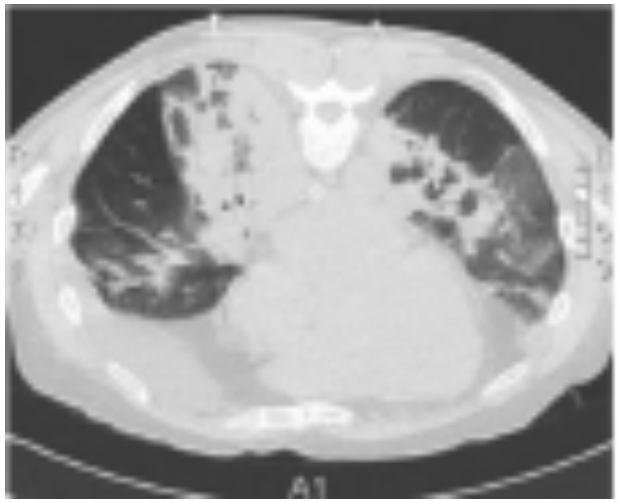
Table 2. Arterial Blood Gas Measurements and Calculated Values for Pulmonary Gas Exchange from Four Subjects at an Altitude of 8400 m, during Descent from the Summit of Mount Everest.*

Variable	Subject No.				Group Mean
	1	2	3	4	
pH	7.55	7.45	7.52	7.60	7.53
PaO_2 (mm Hg)†	29.5	19.1	21.0	28.7	24.6
$PaCO_2$ (mm Hg)†	12.3	15.7	15.0	10.3	13.3
Bicarbonate (mmol/liter)‡	10.5	10.67	11.97	9.87	10.8
Base excess of blood‡	−6.3	−9.16	−6.39	−5.71	−6.9
Lactate concentration (mmol/liter)	2.0	2.0	2.9	1.8	2.2
SaO_2 (%)‡	68.1	34.4	43.7	69.7	54.0
Hemoglobin (g/dl)§	20.2	18.7	18.8	19.4	19.3
Respiratory exchange ratio¶	0.81	0.74‖	0.72	0.70	0.74
P_AO_2 — mm Hg†**	32.4	26.9	27.4	33.2	30.0
Alveolar–arterial oxygen difference — mm Hg†	2.89	7.81	6.44	4.51	5.41

DECUBITUS VENTRAL

- Améliore l'oxygénation : ↓ du shunt pulmonaire
- Prévention VILI : ↓ masse poumon non aéré
- Prévention défaillance VD

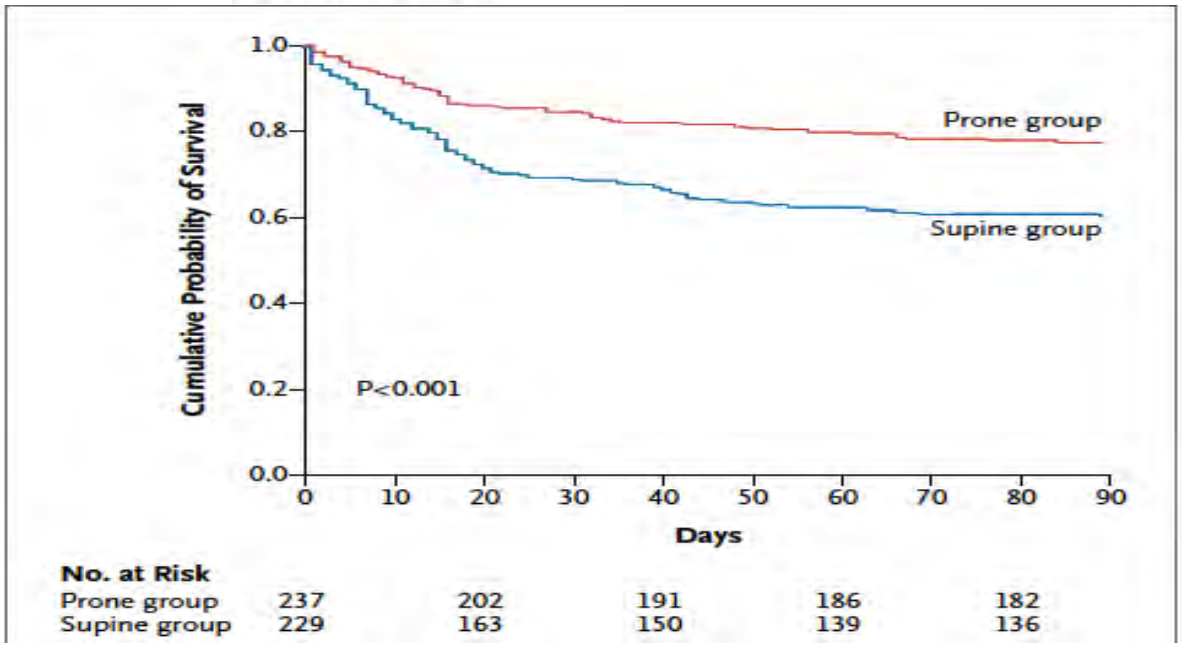




Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D.,

N Engl J Med 2013.



- DV précoce
- Durée séance 16 h
- Arrêt si :
  - P/F> 150 4h après remise en DD
  - Complications DV
  - Diminution P/F en DV

→ Mortalité 16 vs 32%

An Official American Thoracic Society/European Society of Intensive Care Medicine/Society of Critical Care Medicine Clinical Practice Guideline: Mechanical Ventilation in Adult Patients with Acute Respiratory Distress Syndrome

Am J Respir Crit Care Med Vol 195, Iss 9, pp 1253–1263, May 1, 2017

Question 2: Should Patients with ARDS Receive Prone Positioning?

Recommendation. We recommend that adult patients with severe ARDS receive prone positioning for more than 12 hours per day (strong recommendation, moderate-high confidence in effect estimates).

MANŒUVRES DE RECRUTEMENT

- Elévation transitoire de la pression
- But : « ouvrir » alvéoles collabées
- Techniques multiples, non standardisées
- Effets à court terme : oxygénation, compliance
- Risques hémodynamiques, barotraumatiques

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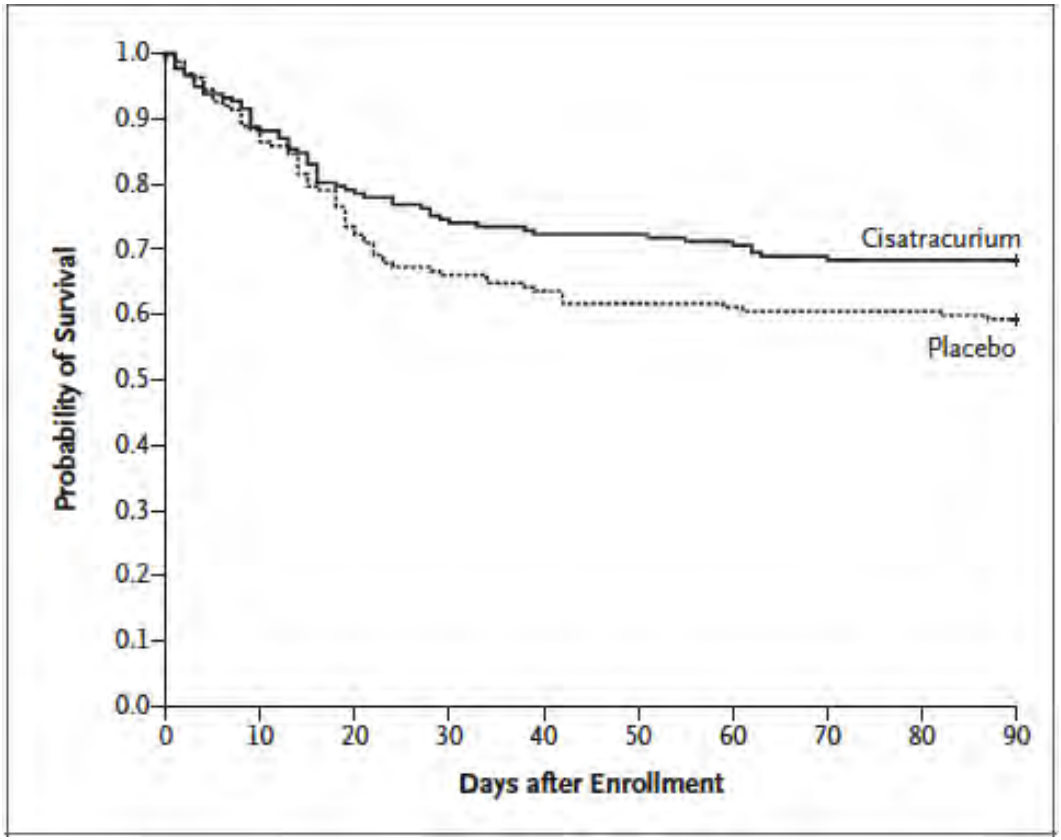
Question 5: Should Patients with ARDS Receive RMs?

Recommendation. We suggest that adult patients with ARDS receive RMs (conditional recommendation, low–moderate confidence in the effect estimates).

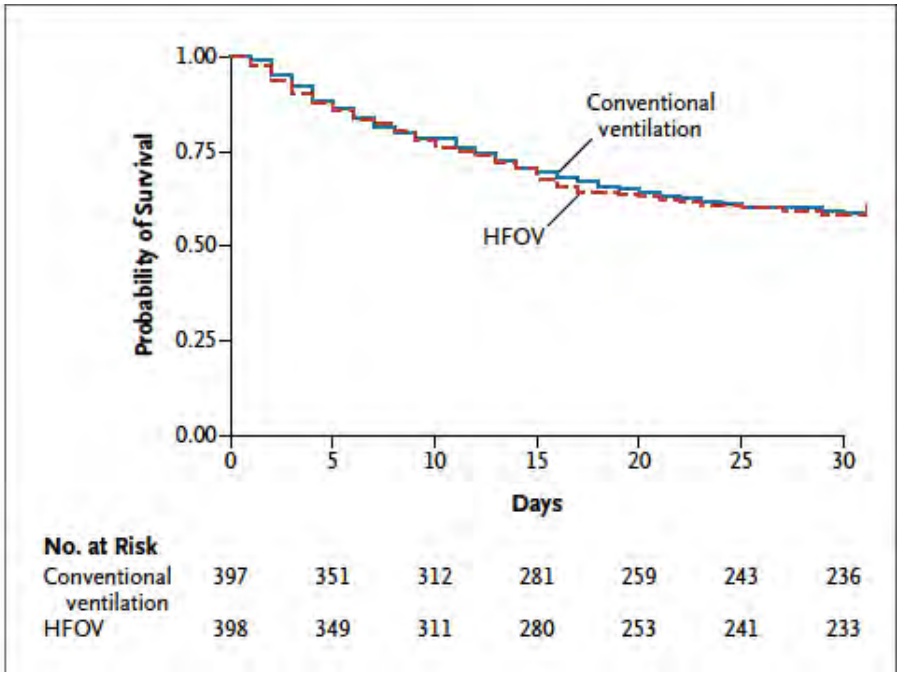
CURARES

- Limitation des asynchronies
- Réduction consommation O2 musculaire

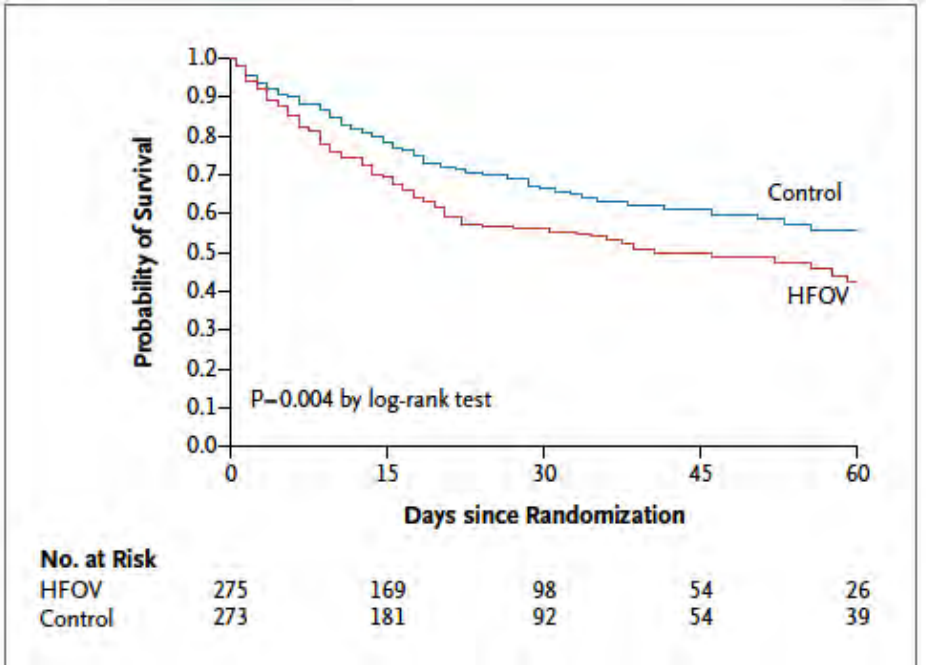
Papazian, NEJM 2010



Ventilation par Oscillation Haute fréquence (HFOV)



Etude OSCAR NEJM 2013



Etude OSCILLATE NEJM 2013

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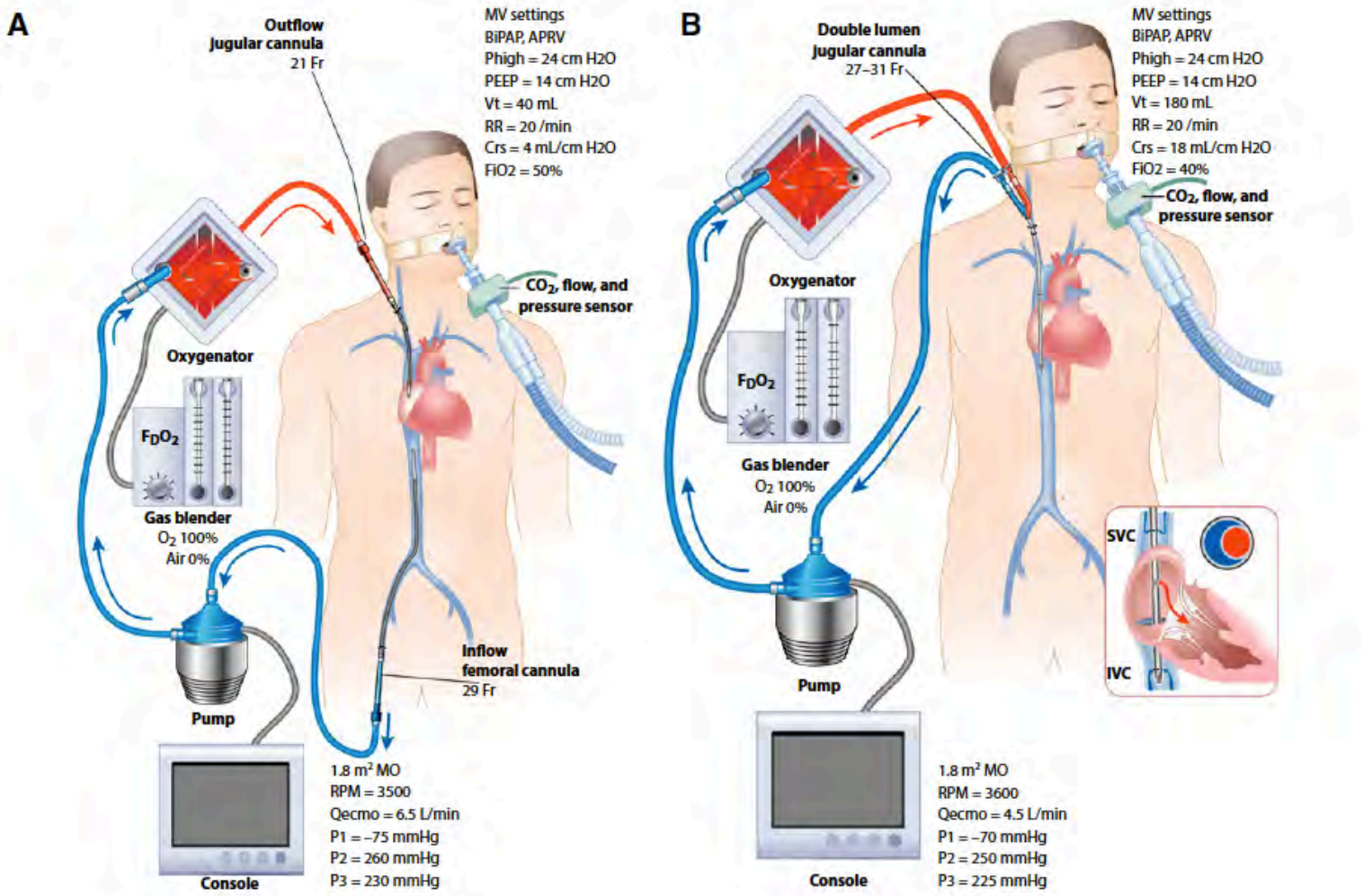
Question 3: Should Patients with ARDS Receive High-Frequency Oscillatory Ventilation?

Recommendation. We recommend that HFOV not be used routinely in patients with moderate or severe ARDS (strong recommendation, moderate-high confidence in effect estimates).

ECMO


A
Outflow
Jugular cannula
21 Fr
MV settings
BiPAP, APRV
Phigh = 24 cm H2O
PEEP = 14 cm H2O
Vt = 40 mL
RR = 20 /min
Crs = 4 mL/cm H2O
FiO2 = 50%
CO2, flow, and
pressure sensor
Oxygenator
FDO2
Gas blender
O2 100%
Air 0%
Inflow
femoral cannula
29 Fr
Pump
1.8 m2 MO
RPM = 3500
Qecmo = 6.5 L/min
P1 = –75 mmHg
P2 = 260 mmHg
P3 = 230 mmHg
Console
B
Double lumen
Jugular cannula
27–31 Fr
MV settings
BiPAP, APRV
Phigh = 24 cm H2O
PEEP = 14 cm H2O
Vt = 180 mL
RR = 20 /min
Crs = 18 mL/cm H2O
FiO2 = 40%
CO2, flow, and
pressure sensor
Oxygenator
FDO2
Gas blender
O2 100%
Air 0%
SVC
IVC
Pump
1.8 m2 MO
RPM = 3600
Qecmo = 4.5 L/min
P1 = –70 mmHg
P2 = 250 mmHg
P3 = 225 mmHg
Console

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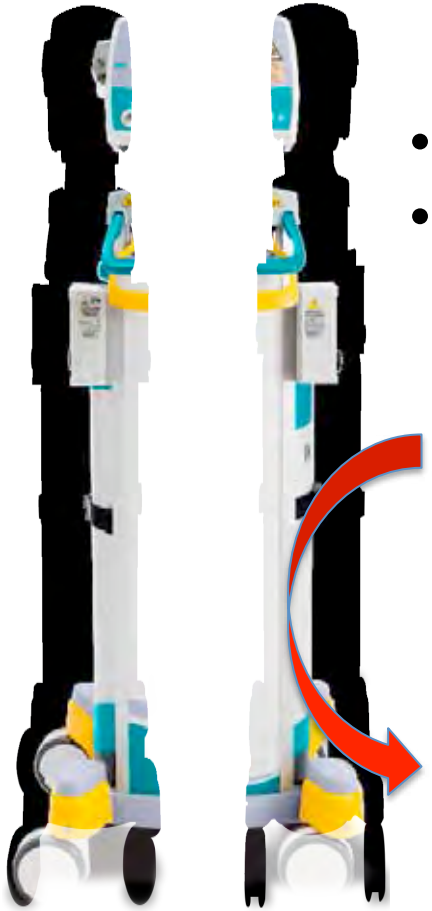
Question 6: Should Patients with ARDS Receive Extracorporeal Membrane Oxygenation?

Recommendation. Additional evidence is necessary to make a definitive recommendation for or against the use of ECMO in patients with severe ARDS. In the interim, we recommend ongoing research measuring clinical outcomes among patients with severe ARDS who undergo ECMO.

NO



- Diminue le shunt pulmonaire
- Augmentation PaO2

- Toxicité : Met Hb, NO2
- Insuffisance rénale

Thérapeutique de sauvetage
Indication d'ECMO?

Place de la VNI

- Avantages potentiels :
  - Prévention dysfonction diaphragmatique
  - Diminution de la sédation, des complications liées à l'intubation (PAVM…)
- Inconvénients :
  - Travail respiratoire excessif
  - Pas de contrôle du Vt (VILI)
  - Asynchronie, Intolérance
  - Intubation retardée
  - Non invasif ??

ORIGINAL ARTICLE

Noninvasive Ventilation of Patients with Acute Respiratory Distress Syndrome

Insights from the LUNG SAFE Study

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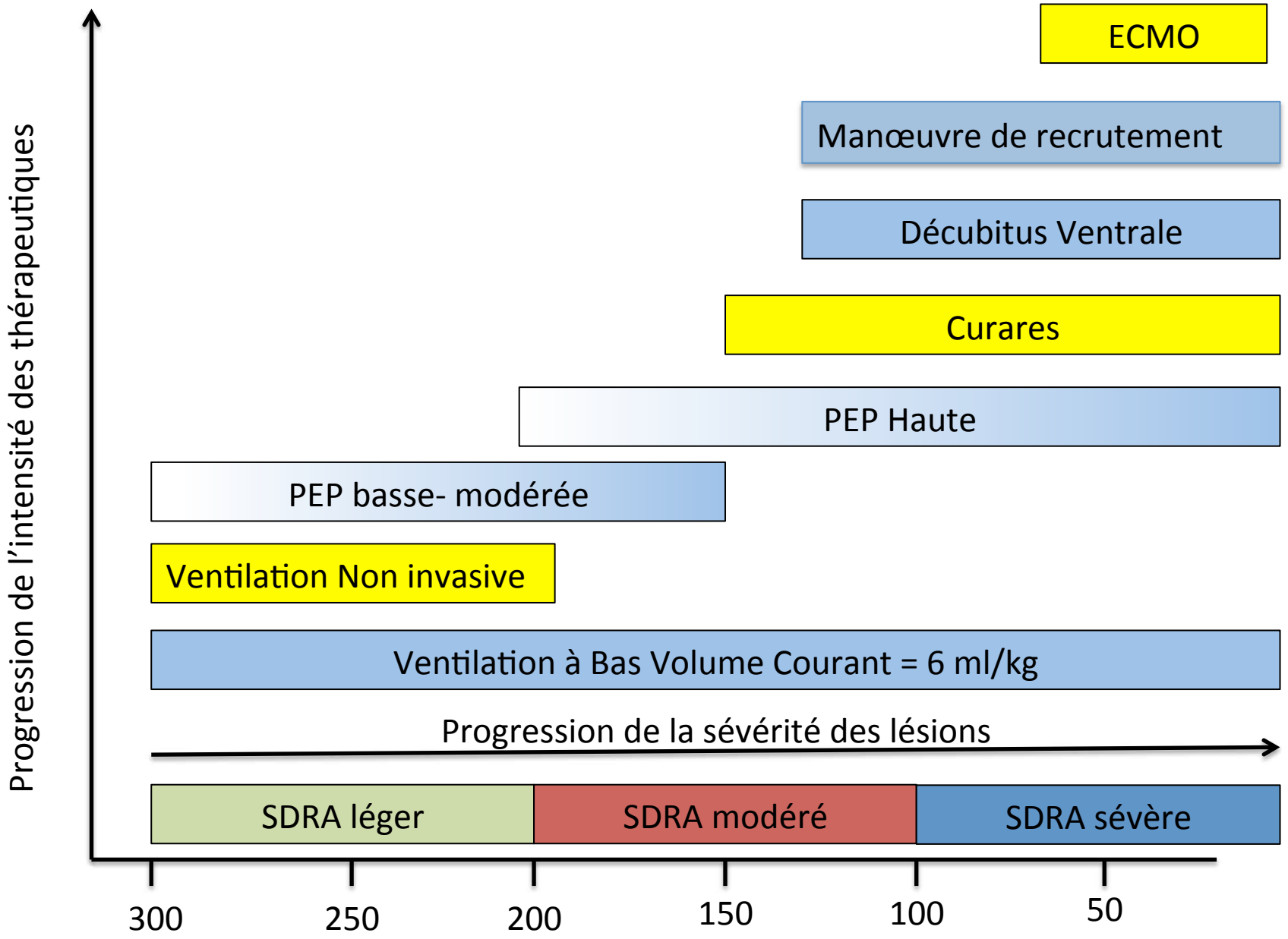
- 15% des SDRA sont pris en charge par VNI.
- Gravité du SDRA est associée à l'échec de la VNI (de 22% à 47%).
- Mortalité plus élevée si échec de VNI (42,7 vs 10,6%)
- VNI associée à une mortalité plus élevée si P/F < 150

SDRA léger

LATA?

Réévaluer les patients (PaCO2, FR…)


ECMO
Manœuvre de recrutement
Décubitus Ventrale
Curares
PEP Haute
PEP basse- modérée
Ventilation Non invasive
Ventilation à Bas Volume Courant = 6 ml/kg
Progression de la sévérité des lésions
SDRA léger
SDRA modéré
SDRA sévère
Progression de l'intensité des thérapeutiques
300
250
200
150
100
50