Prise en charge ventilatoire du SDRA

AER 2025

Session paramédicale – SDRA

Dr Alexandre PINEDE (Assistant spécialiste – Médecine intensive Réanimation – HCL)

SDRA

Am J Respir Crit Care Med. 2024 Jan 1;209(1):37-47. doi: 10.1164/rccm.202303-0558WS.

A New Global Definition of Acute Respiratory Distress Syndrome

Michael A Matthay [1 2 3], Yaseen Arabi [4], Alejandro C Arroliga [5], Gordon Bernard [6],

Facteur de risque (étiologie)
Sepsis, trauma, brulure, état de choc…

< 7 jours

Opacités pulmonaires bilatérales
Radiographie, scanner, échographie
Hors atélectasie, masse, épanchement

Non expliquées par de l'œdème de surcharge

Hypoxémie

SDRA non intubé

PaO2/FiO2 ≤ 300 mmHg ou SpO2/FiO2 ≤ 315
(avec SpO2 ≤ 97%)

OHD avec débit ≥ 30 L/min
CPAP/VNI avec PEP ≥ 5 cmH2O

SDRA intubé

Léger : 200 < PaO2/FiO2 ≤ 300 mmHg
(ou 235 < SpO2/FiO2 ≤ 315)

Modéré : 100 < PaO2/FiO2 ≤ 200 mmHg
(ou 148 < SpO2/FiO2 ≤ 235)

Sévère : PaO2/FiO2 ≤ 100 mmHg
(ou SpO2/FiO2 ≤ 148)

PaO2/FiO2

PaO2 sur gaz du sang artériel

FiO2 réglée sur le respirateur

Norme : 80/0,21 = 400 mmHg

Hypoxémie

SDRA non intubé

PaO2/FiO2 ≤ 300 mmHg ou SpO2/FiO2 ≤ 315 (avec SpO2 ≤ 97%)

OHD avec débit ≥ 30 L/min
CPAP/VNI avec PEP ≥ 5 cmH2O

SDRA intubé

Léger : 200 < PaO2/FiO2 ≤ 300 mmHg (ou 235 < SpO2/FiO2 ≤ 315)

Modéré : 100 < PaO2/FiO2 ≤ 200 mmHg (ou 148 < SpO2/FiO2 ≤ 235)

Sévère : PaO2/FiO2 ≤ 100 mmHg (ou SpO2/FiO2 ≤ 148)

Physiopathologie du SDRA

Ventilation mécanique

Œdème pulmonaire

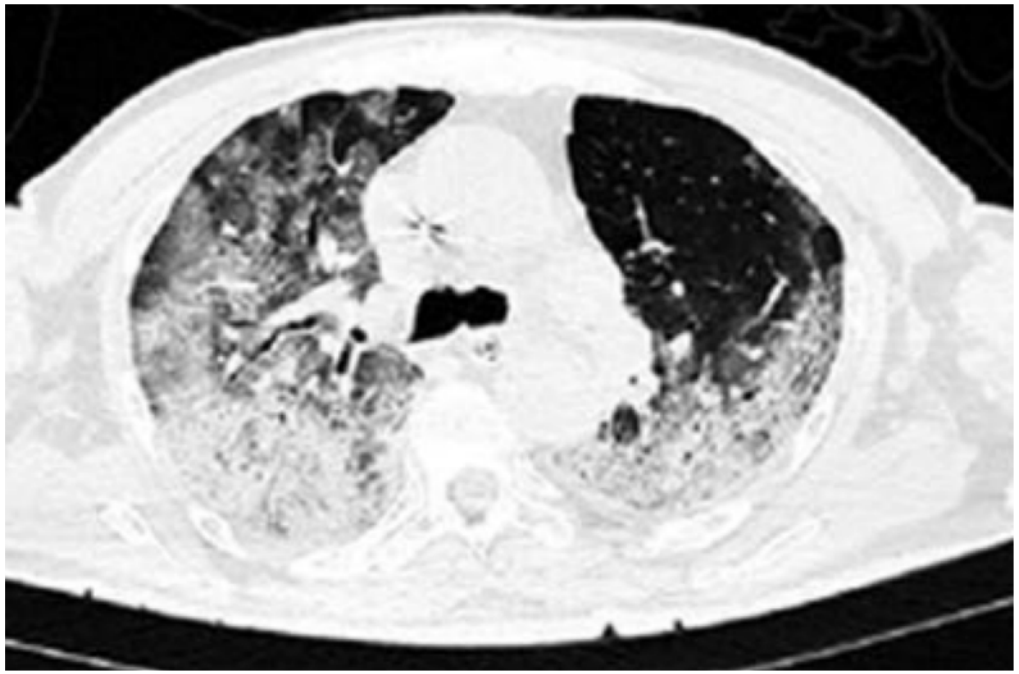
Lésionnel et inflammatoire

Perte d'aération et excès de tissu pulmonaire

Dérecrutement (Baby lung)	Hétérogène

Altération de la physiologie pulmonaire

Hypoxémie (1er mécanisme = shunt)	Diminution de la compliance pulmonaire



Protti et al, Crit Care 2022

Physiopathologie du SDRA

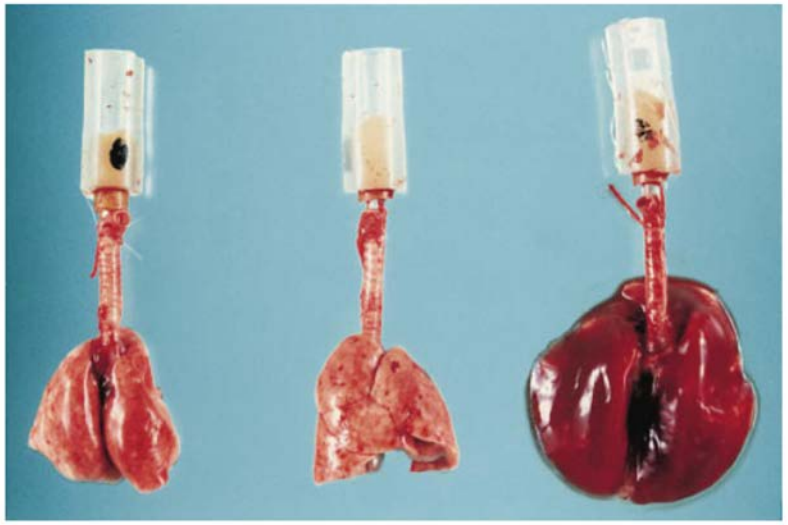
Ventilation mécanique

Ventilator induced lung injury (VILI)

- Barotrauma (excès de pression alvéolaire)
- Volutrauma (surdistension)
- Atelectrauma (recrutement/dérecrutement)
- Biotrauma (stress biologique)
- Ergotrauma

Patient self inflicted lung injury (PSILI)

- Effort inspiratoire important



Review > Am J Respir Crit Care Med. 1998 Jan;157(1):294-323.
doi: 10.1164/ajrccm.157.1.9604014.

Ventilator-induced lung injury: lessons from experimental studies

D Dreyfuss [1], G Saumon

Ventilation protectrice

Oxygénation
Décarboxylation

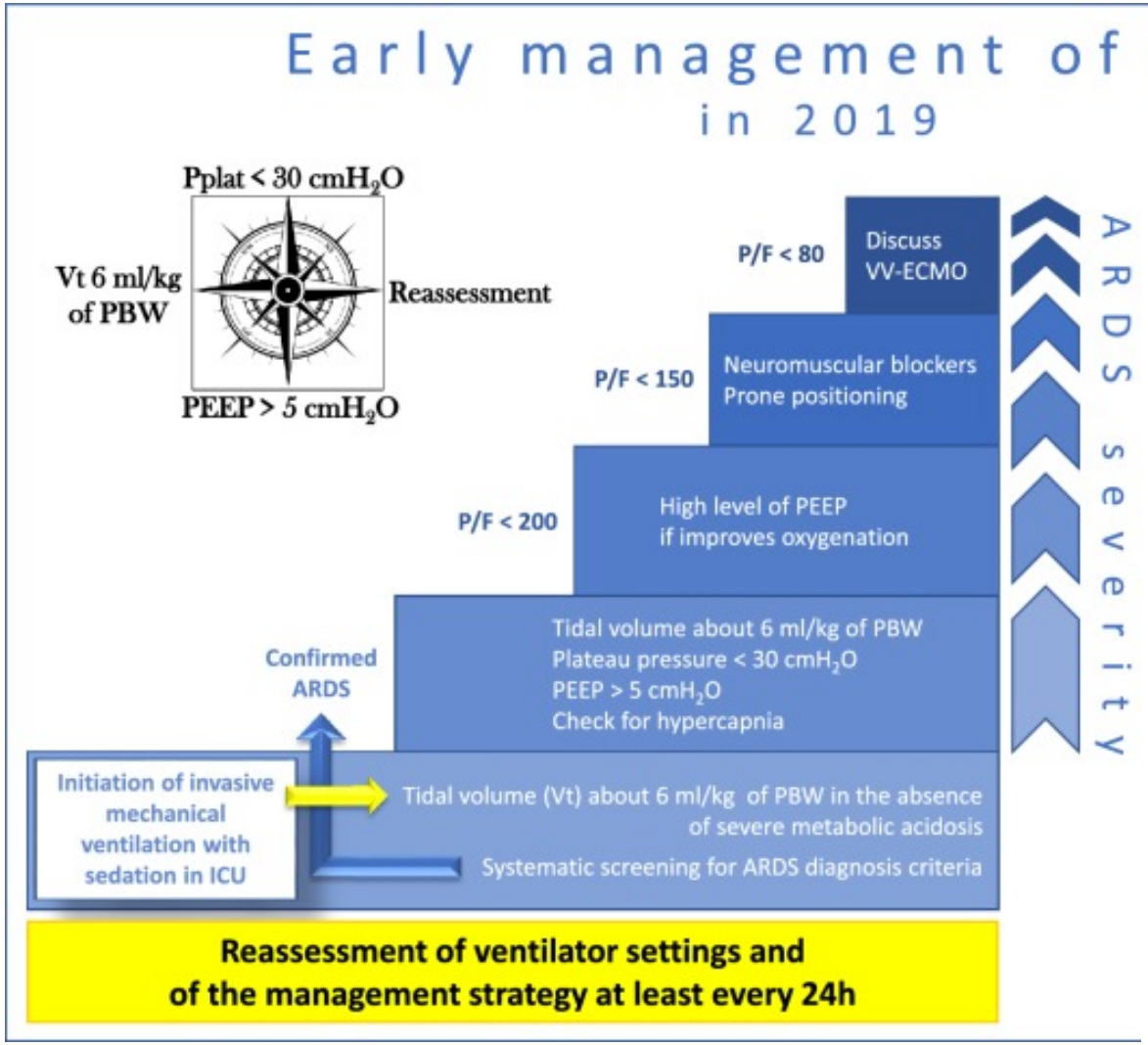
Recrutement pulmonaire

VILI
PSILI

Effet hémodynamique

Primum non nocere

Prise en charge ventilatoire du SDRA



Review > Ann Intensive Care. 2019 Jun 13;9(1):69. doi: 10.1186/s13613-019-0540-9.

Formal guidelines: management of acute respiratory distress syndrome

Laurent Papazian [1], Cécile Aubron [2], Laurent Brochard [3], Jean-Daniel Chiche [4], Alain Combes [5],

> Intensive Care Med. 2023 Jul;49(7):727-759. doi: 10.1007/s00134-023-07050-7. Epub 2023 Jun 16.

ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies

Giacomo Grasselli [# 1 2], Carolyn S Calfee [# 3], Luigi Camporota [# 4 5], Daniele Poole [6],

FiO2

Hypoxémie

- Hypoxie tissulaire
- Vasoconstriction pulmonaire hypoxique

Hyperoxie

- Atélectasies de dénitrogénation FiO2 > 80%
- Radicaux libres

Review > Ann Intensive Care. 2024 Apr 26;14(1):68. doi: 10.1186/s13613-024-01300-7.

Conservative versus liberal oxygen therapy for intensive care unit patients: meta-analysis of randomized controlled trials

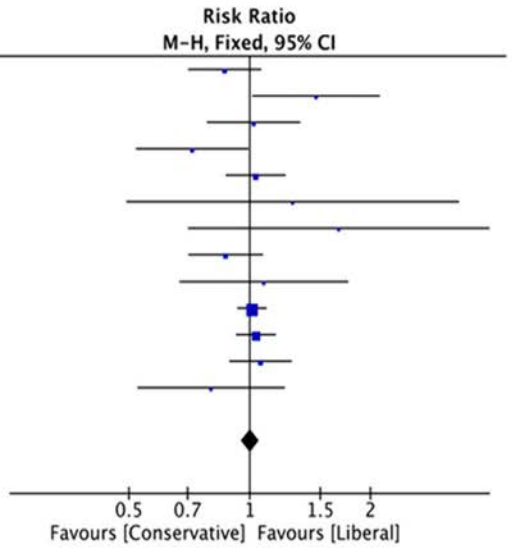
Xin-Yu Li [#1], Bing Dai [#1], Hai-Jia Hou [#1], Hong-Wen Zhao [1], Wei Wang [1], Jian Kang [1],

A

Study or Subgroup	Conservative Events	Conservative Total	Liberal Events	Liberal Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Asfar 2017	90	217	104	217	6.0%	0.87 [0.70, 1.07]
Barrot 2020	44	99	31	102	1.8%	1.46 [1.01, 2.11]
Gelissen 2021	72	205	67	195	3.9%	1.02 [0.78, 1.34]
Girardis 2016	47	216	66	218	3.8%	0.72 [0.52, 0.99]
Mackle 2020	170	476	164	475	9.4%	1.03 [0.87, 1.23]
Martin 2021	6	15	5	16	0.3%	1.28 [0.49, 3.33]
Nafae 2023	10	28	6	28	0.3%	1.67 [0.70, 3.96]
Nielsen 2024	106	351	120	346	6.9%	0.87 [0.70, 1.08]
Panwar 2016	21	52	19	51	1.1%	1.08 [0.67, 1.76]
Schjørring 2021	618	1441	613	1447	35.1%	1.01 [0.93, 1.10]
Semler 2022	573	1667	290	874	21.8%	1.04 [0.92, 1.16]
van der Wal 2023	144	335	133	329	7.7%	1.06 [0.89, 1.27]
Yang 2019	26	100	37	114	2.0%	0.80 [0.52, 1.22]
Total (95% CI)		**5202**		**4412**	**100.0%**	**1.00 [0.95, 1.06]**
Total events	1927		1655			

Heterogeneity: $Chi^2 = 15.34$, df = 12 (P = 0.22); $I^2 = 22\%$

Test for overall effect: Z = 0.06 (P = 0.95)



SpO2 92 - 96% ? 94 – 98% ? Personnalisé ?

Volume courant (VT)

Mesuré en mL/kg de poids prédit par la taille

Volume insufflé à chaque cycle

- Génère une pression motrice (driving pressure DP)

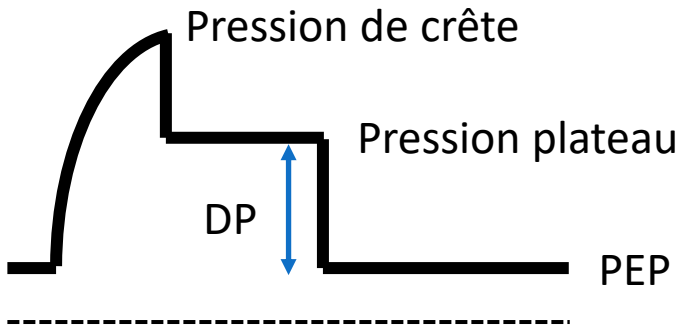
Trop faible

- Dérecrutement
- Hypercapnie (diminution de la ventilation minute)

Trop élevé

- Surdistension, volutrauma, barotrauma... (VILI)

4-8 mL/kg PBW



VAC – pause inspiratoire

Volume courant (VT)

4-8 mL/kg PBW

DP < 15 cmH20
Pplat < 30 cmH2O

Modes contrôlés en volume :

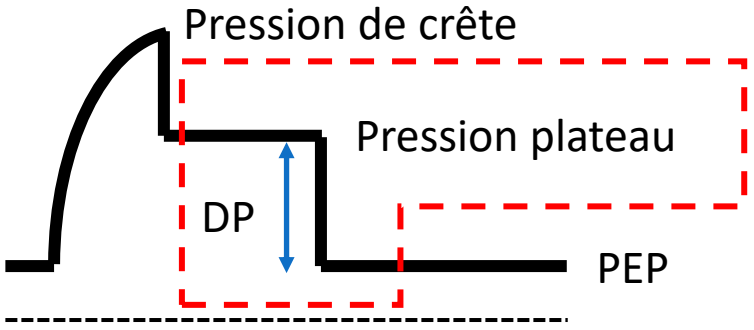
VAC

- VT réglé
- Surveiller les pressions
  - Pression motrice (DP) < 15 cmH20
  - Pression plateau < 30 cmH2O

Modes contrôlés en pression :

PAC, APRV, VSAI

- Pressions réglées
- Surveiller le VT



VAC – pause inspiratoire

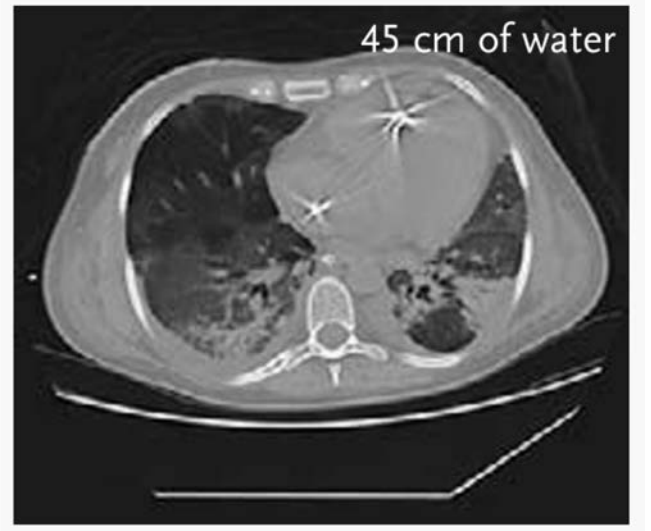
Pression expiratoire positive (PEP)

Objectif = RECRUTEMENT

- Diminution atelectrauma
- Augmentation baby lung
- Augmentation compliance (diminution DP)
- Amélioration échanges gazeux

/ ! \ Attention

- Surdistension
- Retentissement hémodynamique



Clinical Trial > N Engl J Med. 2006 Apr 27;354(17):1775-86. doi: 10.1056/NEJMoa052052.

Lung recruitment in patients with the acute respiratory distress syndrome

Luciano Gattinoni [1], Pietro Caironi, Massimo Cressoni, Davide Chiumello, V Marco Ranieri,

Comment régler la PEP ?

The NEW ENGLAND JOURNAL of MEDICINE
ESTABLISHED IN 1812 JULY 22, 2004 VOL. 351 NO. 4

Higher versus Lower Positive End-Expiratory Pressures in Patients with the Acute Respiratory Distress Syndrome

The National Heart, Lung, and Blood Institute ARDS Clinical Trials Network*

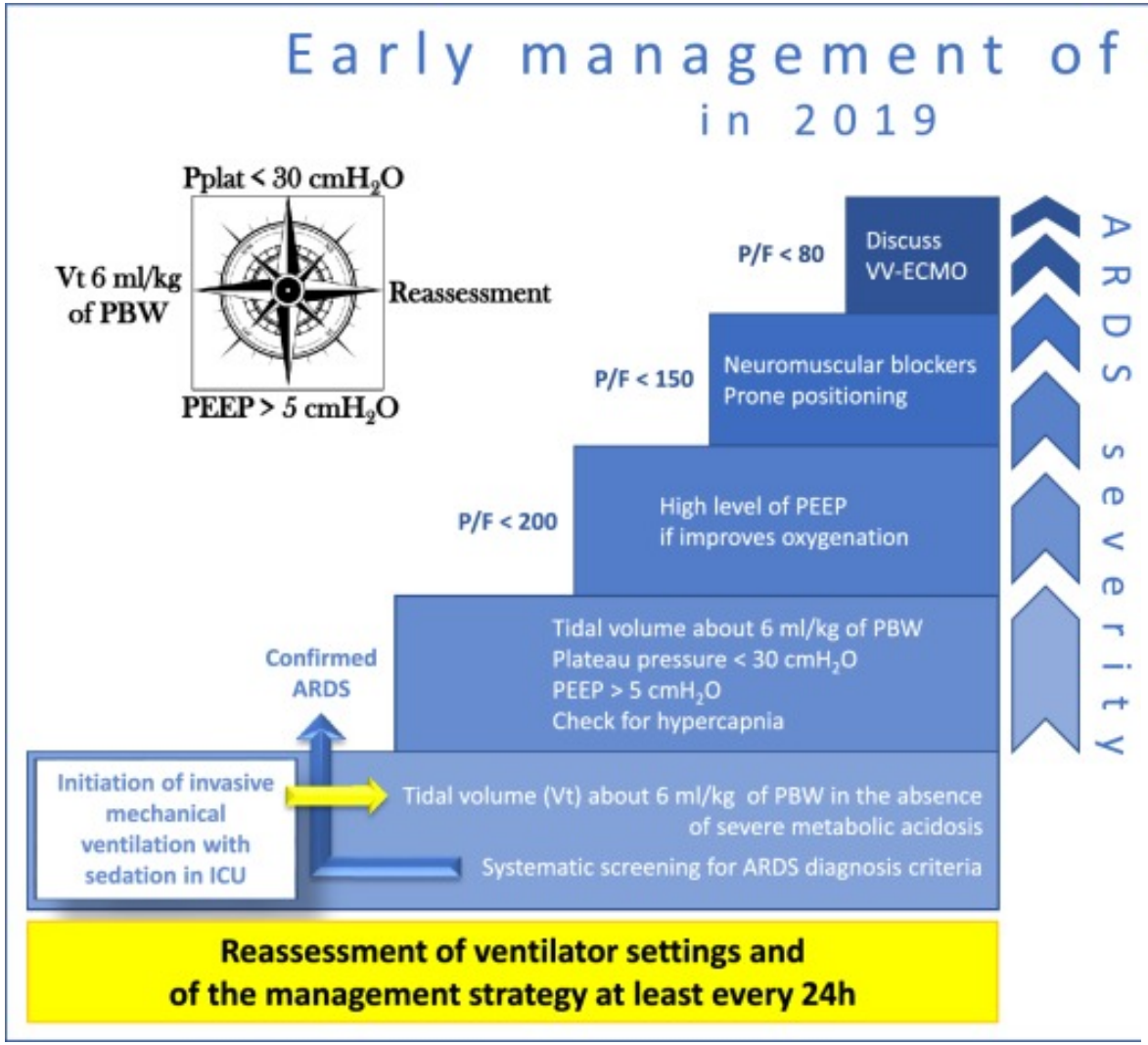
Table PEP/FiO2

Lower-PEEP group														
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	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18–24

Individualisée

- P plateau = 28-30 cmH2O
- Meilleure compliance (DP min)
- Pression transpulmonaire > 0 cmH2O
- …

Comment régler la PEP ?



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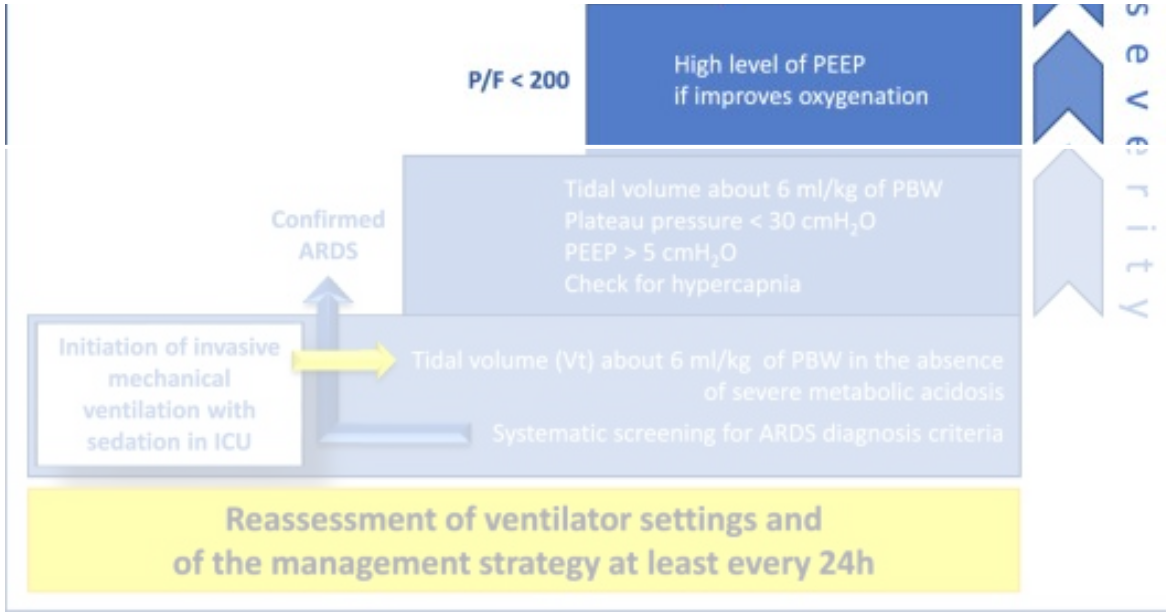

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ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies

Giacomo Grasselli [# 1 2], Carolyn S Calfee [# 3], Luigi Camporota [# 4 5], Daniele Poole [6],

We are **unable to make a recommendation** for or against routine PEEP titration with a higher PEEP/FiO_2 strategy versus a lower PEEP/FiO_2 strategy to reduce mortality in patients with ARDS.

? HIGH LEVEL OF EVIDENCE

We are **unable to make a recommendation** for or against PEEP titration guided principally by respiratory mechanics, compared to PEEP titration based principally on PEEP/FiO_2 strategy, to reduce mortality in patients with ARDS.

? HIGH LEVEL OF EVIDENCE

Recruter autrement

Manœuvres de recrutement

Intensive Care Med. 2023 Jul;49(7):727-759. doi: 10.1007/s00134-023-07050-7. Epub 2023 Jun 16.

ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies

Giacomo Grasselli [#1,2], Carolyn S Calfee [#3], Luigi Camporota [#4,5], Daniele Poole [6],

We **recommend against** use of prolonged high-pressure RMs (defined as airway pressure maintained ≥ 35 cmH_2O for at least one minute) to reduce mortality of patients with ARDS.

We **suggest against** *routine* use of brief high-pressure RMs (defined as airway pressure maintained ≥ 35 cmH_2O for less than one minute) to reduce mortality in patients with ARDS.

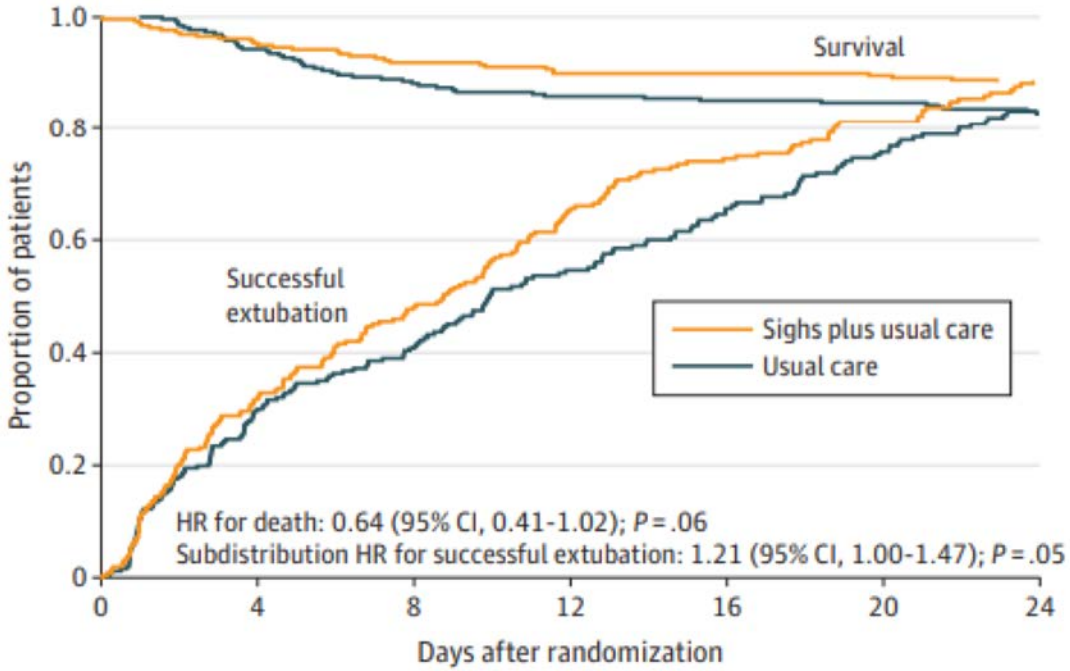
Soupirs

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Sigh Ventilation in Patients With Trauma
The SiVent Randomized Clinical Trial

Richard K. Albert, MD; Gregory J. Jurkovich, MD; John Connett, PhD; Erika S. Helgeson, PhD;

Augmentation du VT pour Pplat 35 cmH2O
1 cycle de 5s / 6 min



Fréquence respiratoire

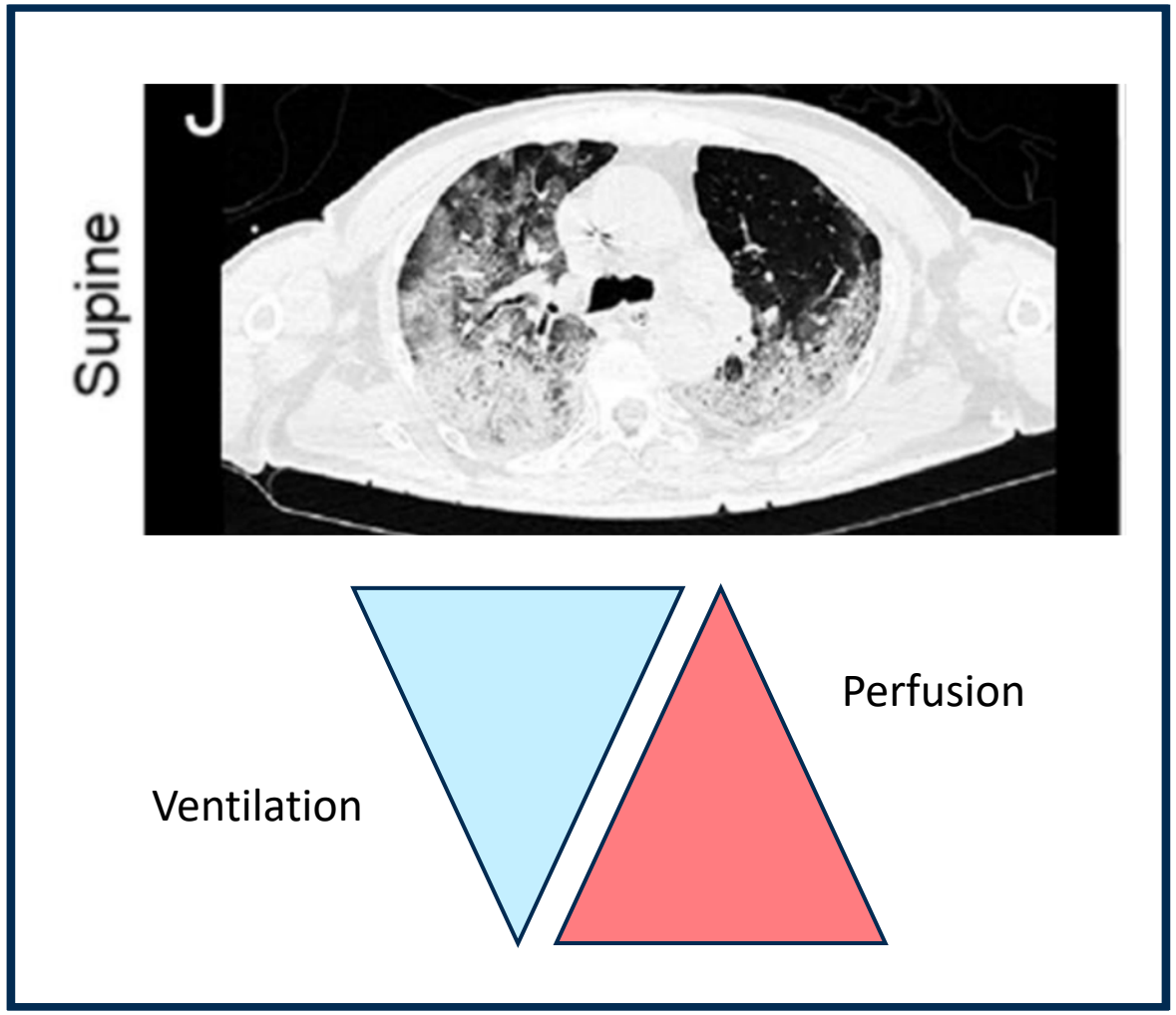
Modifie la ventilation minute

- Augmenter la FR va augmenter l'élimination du CO_2
- Diminue la $PaCO_2$ et augmente le pH

Hypercapnie permissive

- pH > 7,25
- $PaCO_2$ < 60 mmHg

Décubitus ventral (DV)



Crit Care. 2022 May 7;26(1):127. doi: 10.1186/s13054-022-03996-0.

Lung response to prone positioning in mechanically-ventilated patients with COVID-19

Alessandro Protti [1] [2], Alessandro Santini [3], Francesca Pennati [4], Chiara Chiurazzi [3],

Décubitus ventral (DV)

Crit Care. 2022 May 7;26(1):127. doi: 10.1186/s13054-022-03996-0.

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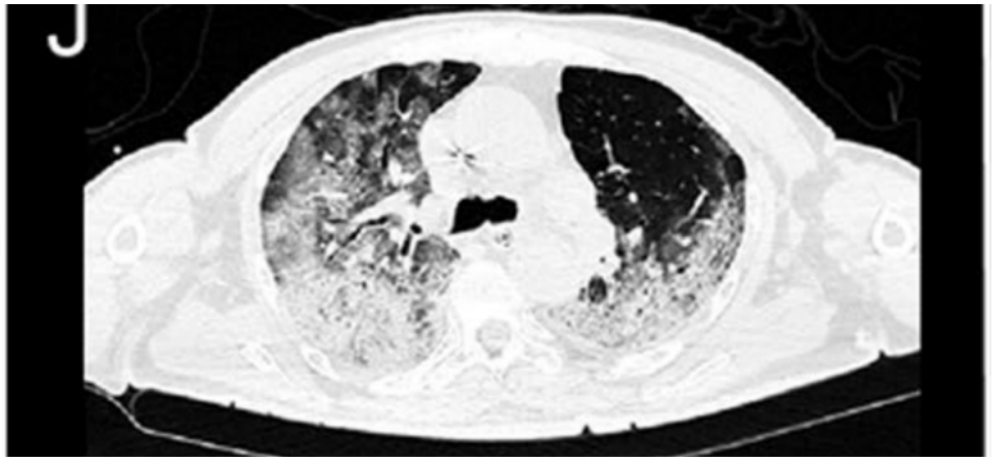
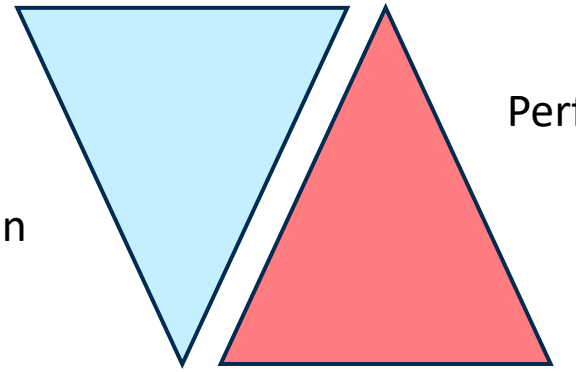
Supine

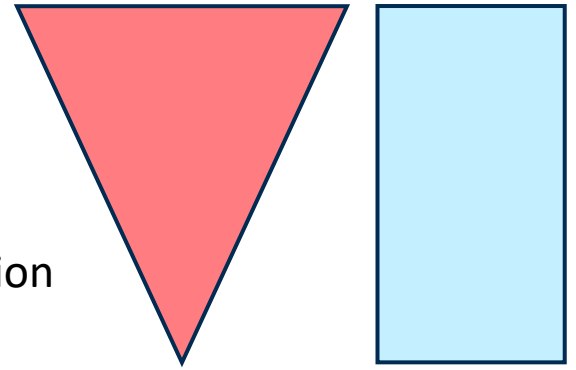




Ventilation

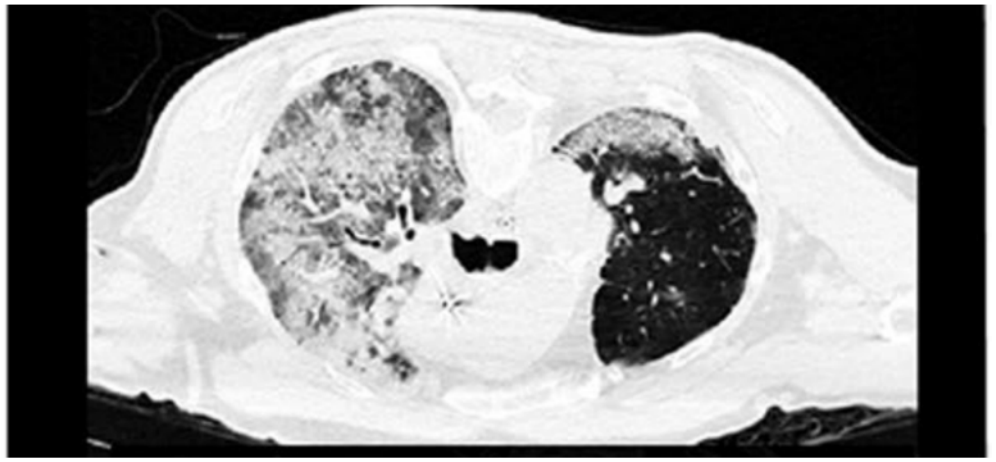
Perfusion

Perfusion



Ventilation

Prone



Décubitus ventral

Recrutement dans les zones dorsales

- Sans surdistendre les zones ventrales
- Amélioration de la compliance (diminution DP)

Homogénéisation de la ventilation mécanique

Amélioration des rapports ventilation/perfusion

Amélioration des échanges gazeux

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JUNE 6, 2013 VOL. 368 NO. 23

Prone Positioning in Severe Acute Respiratory Distress Syndrome

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D., Arnaud Gacouin, M.D., Thierry Boulain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D., Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D.,

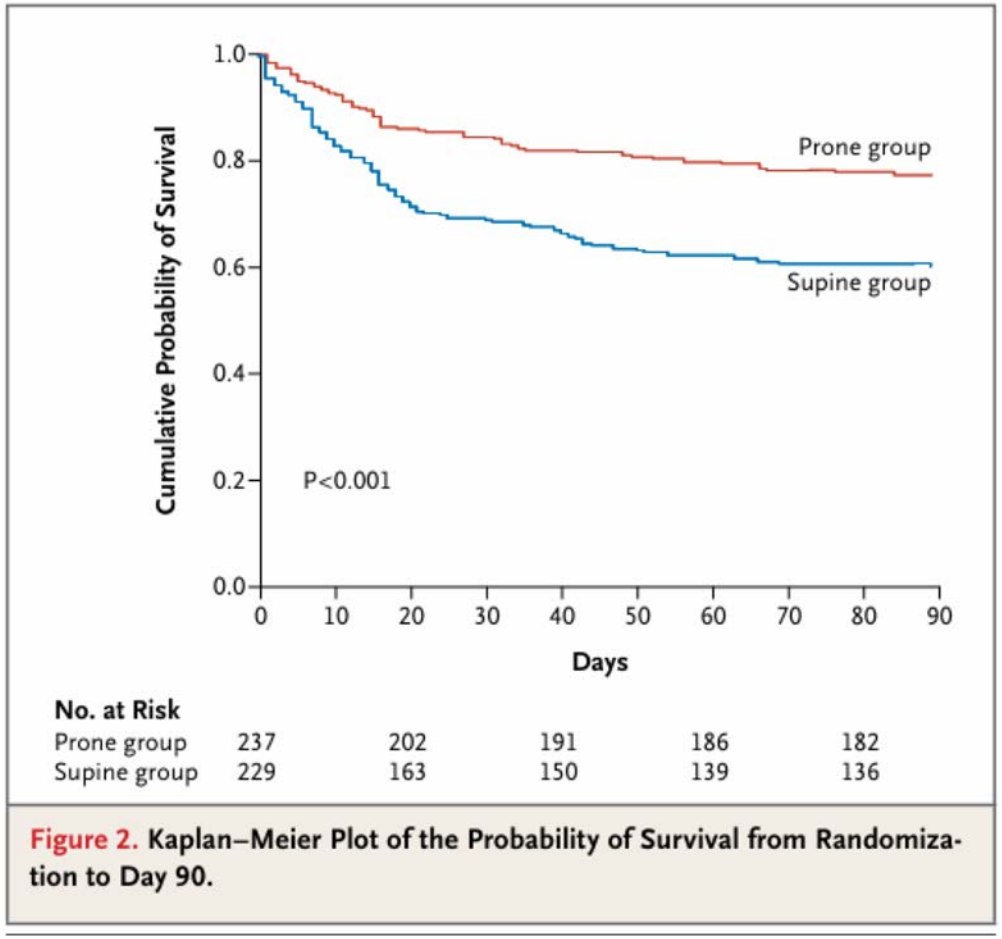


Figure 2. Kaplan–Meier Plot of the Probability of Survival from Randomization to Day 90.

Décubitus ventral

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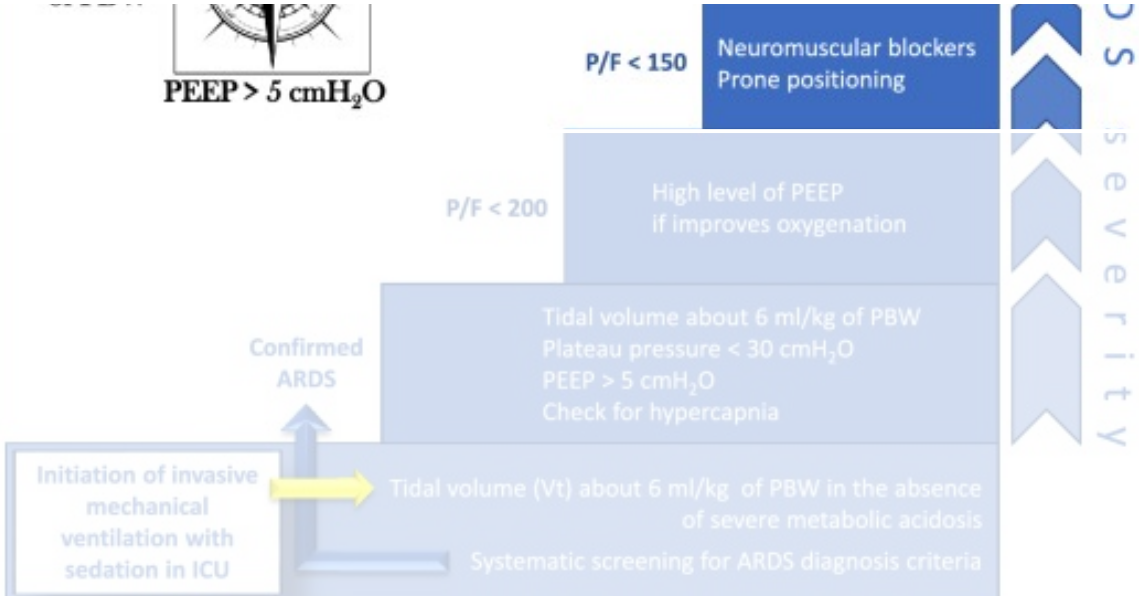

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ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies

Giacomo Grasselli [# 1 2], Carolyn S Calfee [# 3], Luigi Camporota [# 4 5], Daniele Poole [6],

We **recommend** using prone position as compared to supine position for patients with moderate-severe ARDS (defined as PaO_2/FiO_2<150 mmHg and PEEP≥5 cmH_2O, despite optimization of ventilation settings) to reduce mortality.

? HIGH LEVEL OF EVIDENCE

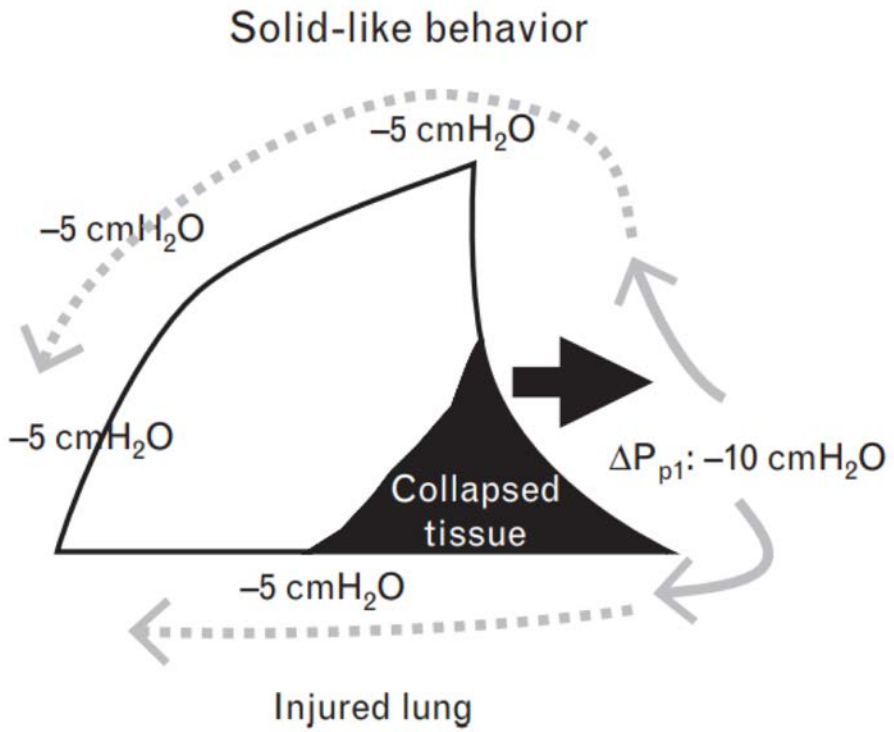
We **recommend** starting prone position in patients with ARDS receiving invasive mechanical ventilation early after intubation, after a period of stabilization during which low tidal volume is applied and PEEP adjusted and at the end of which the PaO_2/FiO_2 remains <150 mmHg; and proning should be applied for prolonged sessions (16 consecutive hours or more) to reduce mortality.

? HIGH LEVEL OF EVIDENCE

Humidification

Vigilance lors des transports

En ventilation assistée : effort inspiratoire



Hraiech et al, Curr Opin Crit Care 2015

Sur poumon lésé, s'exerce principalement sur les zones dorsales et diaphragmatiques

\+

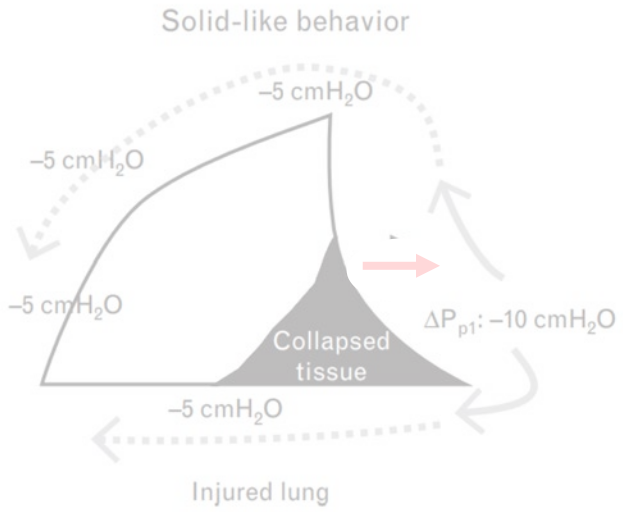
- Recrutement pulmonaire

\-

- Augmentation de la conso O2
- Augmentation du VT
- Hétérogénéité de la ventilation

En ventilation assistée : adapter l'assistance

Sur assistance

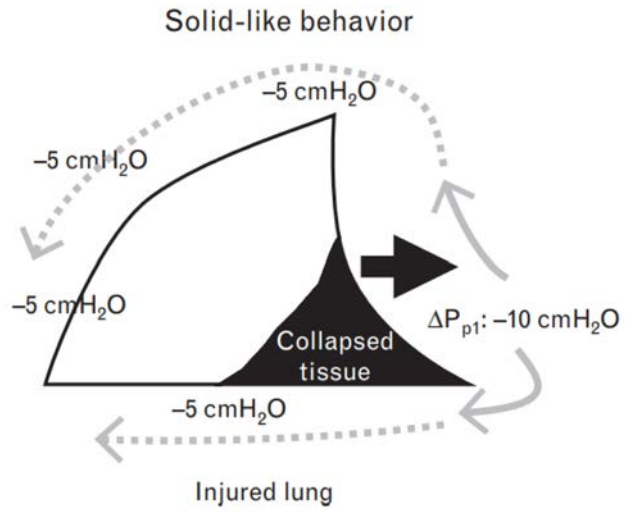


Pas de recrutement

Atélectasies

Atrophie musculaire

Adaptée

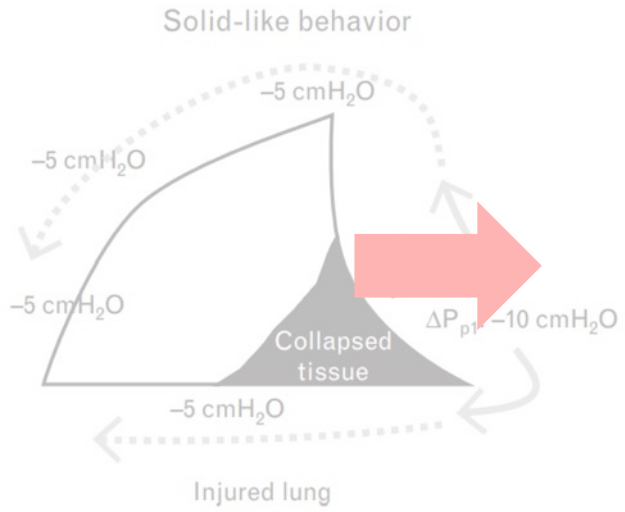


Recrutement

Augmentation de la compliance pulmonaire

Entretien des muscles respiratoires

Sous assistance



Consommation d'O2

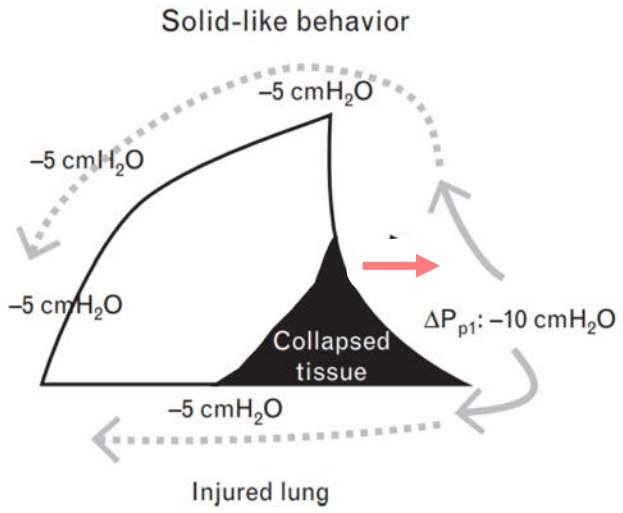
VT élevé

VILI

PSILI

En ventilation assistée : adapter l'assistance

Sur assistance



Pas de recrutement

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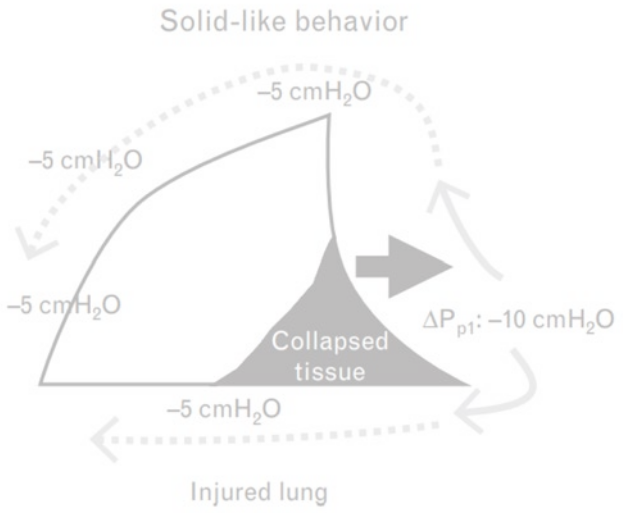
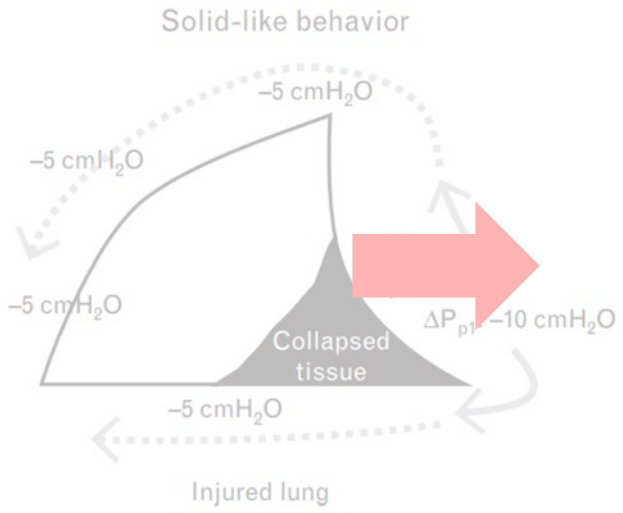


Recrutement

Augmentation de la compliance pulmonaire

Entretien des muscles respiratoires

Sous assistance



Consommation d'O2

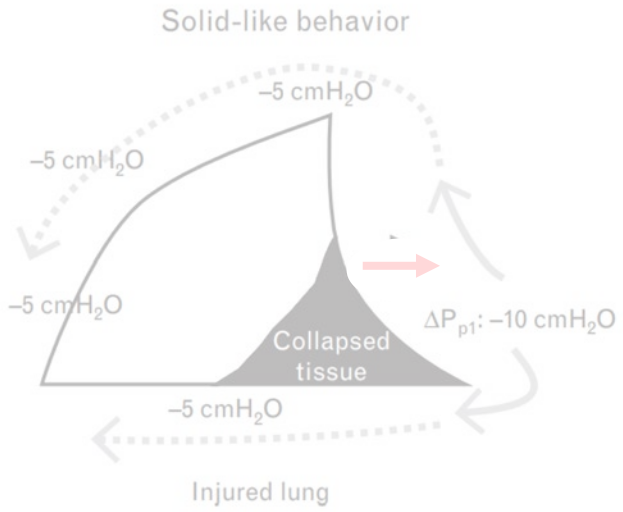
VT élevé

VILI

PSILI

En ventilation assistée : adapter l'assistance

Sur assistance



Pas de recrutement

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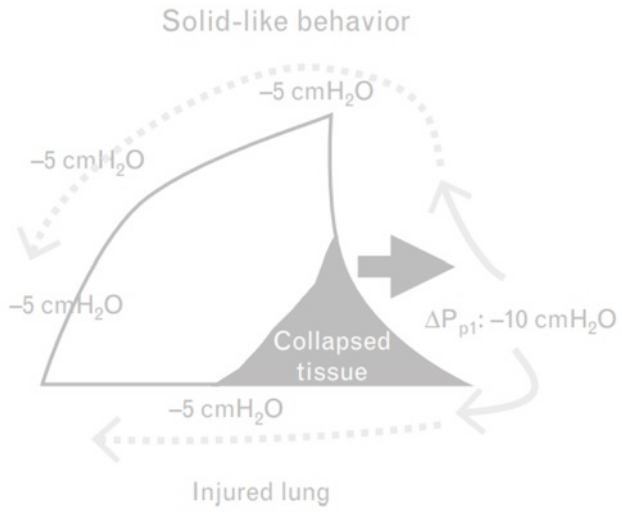
Atrophie musculaire

Adaptée

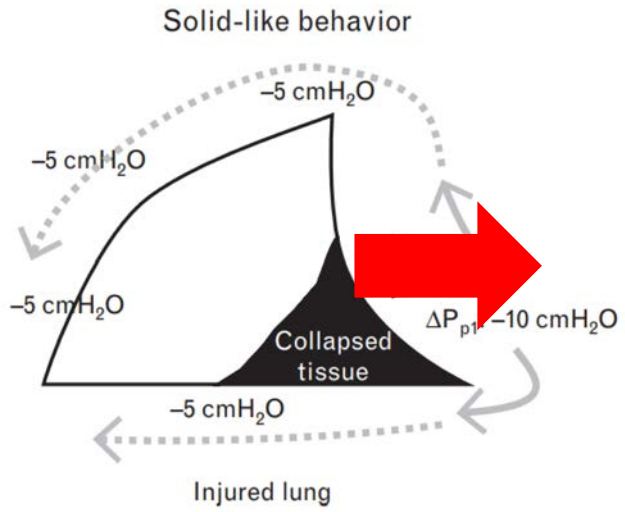


Recrutement

Augmentation de la compliance pulmonaire

Entretien des muscles respiratoires

Sous assistance



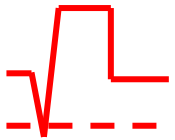
Consommation d'O2

VT élevé

VILI

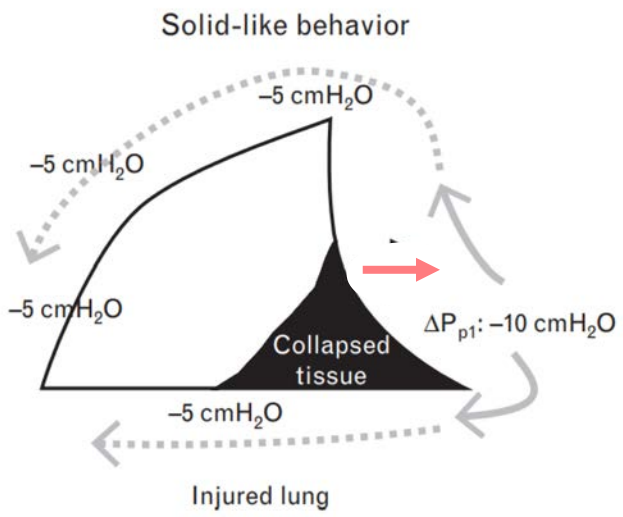
PSILI

DRA



En ventilation assistée : adapter l'assistance

Sur assistance

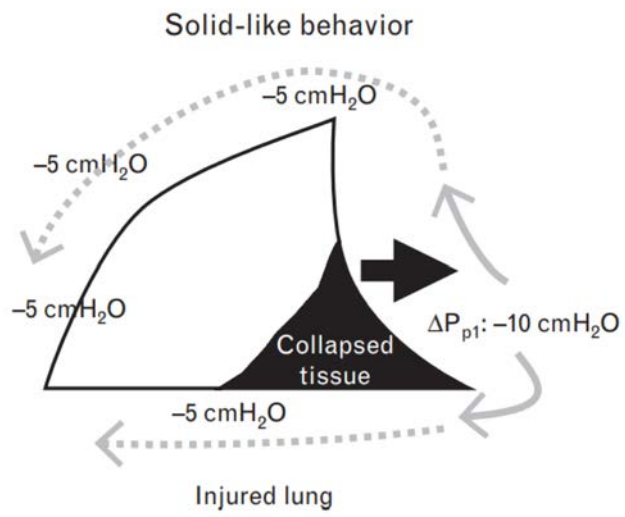


Pas de recrutement

Atélectasies

Atrophie musculaire

Adaptée

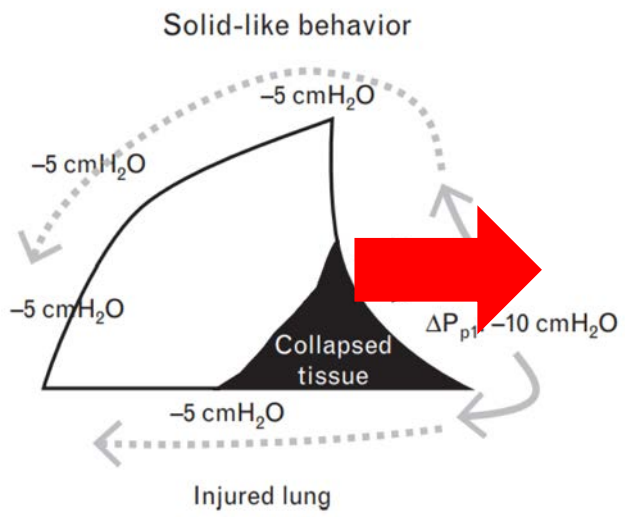


Recrutement

Augmentation de la compliance pulmonaire

Entretien des muscles respiratoires

Sous assistance



Consommation d'O2

VT élevé

VILI

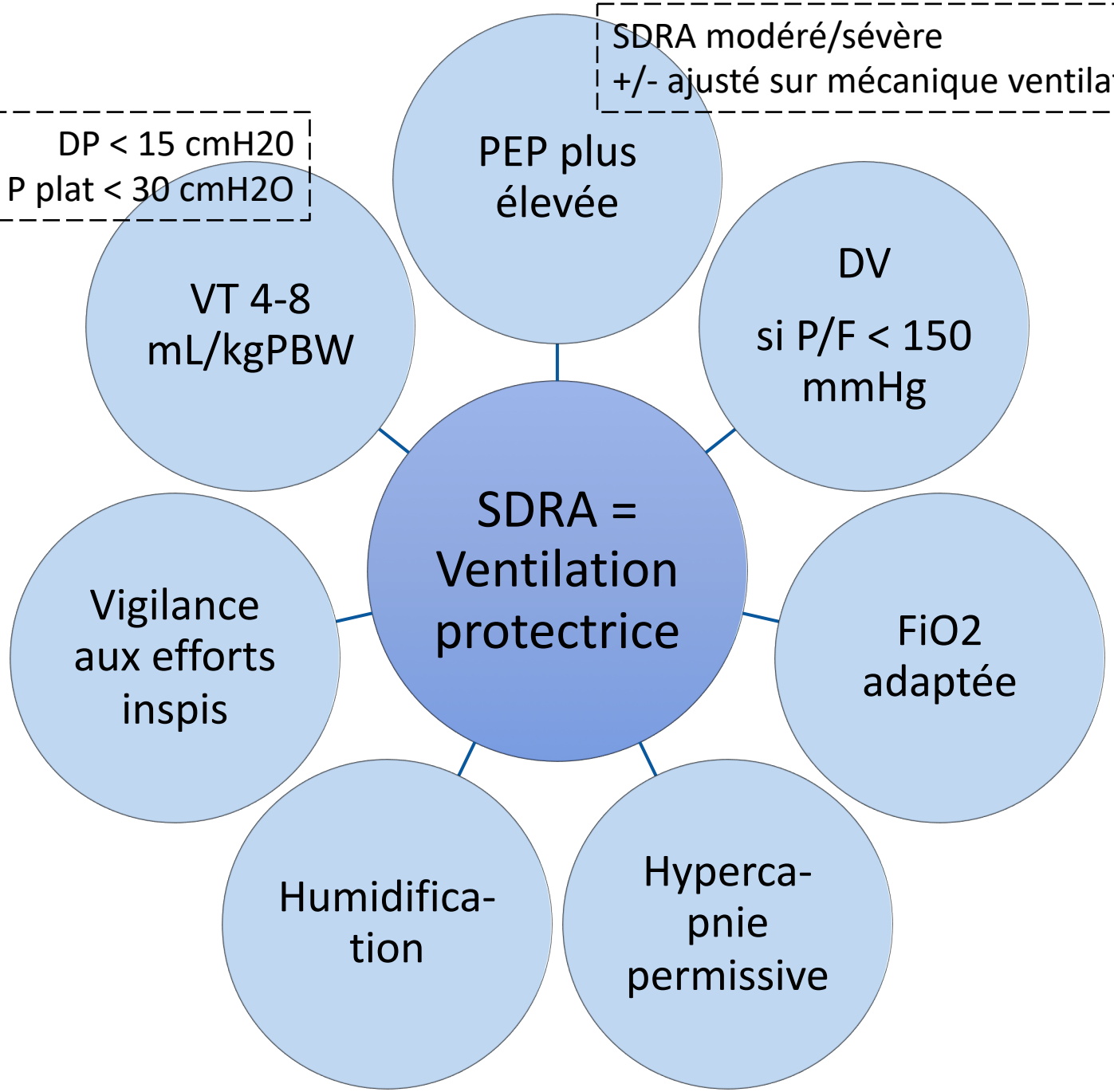
PSILI

DRA

Conclusion

VILI

PSILI



Merci de votre attention