Prise en charge Ventilatoire du Traumatisé Thoracique Grave

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DMU **DREAM** (Département de Réanimation Anesthésie Médecine Périopératoire)
Groupe de Recherche Clinique ARPE

MÉDECINE SORBONNE UNIVERSITÉ

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Links of interest

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French Ministry of Education & research
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Traumatismes du thorax

Quel est le but de la ventilation ?

Ventilator-induced Lung Injury

Barotrauma **Biotrauma** **Volotrauma**

Atelectrauma

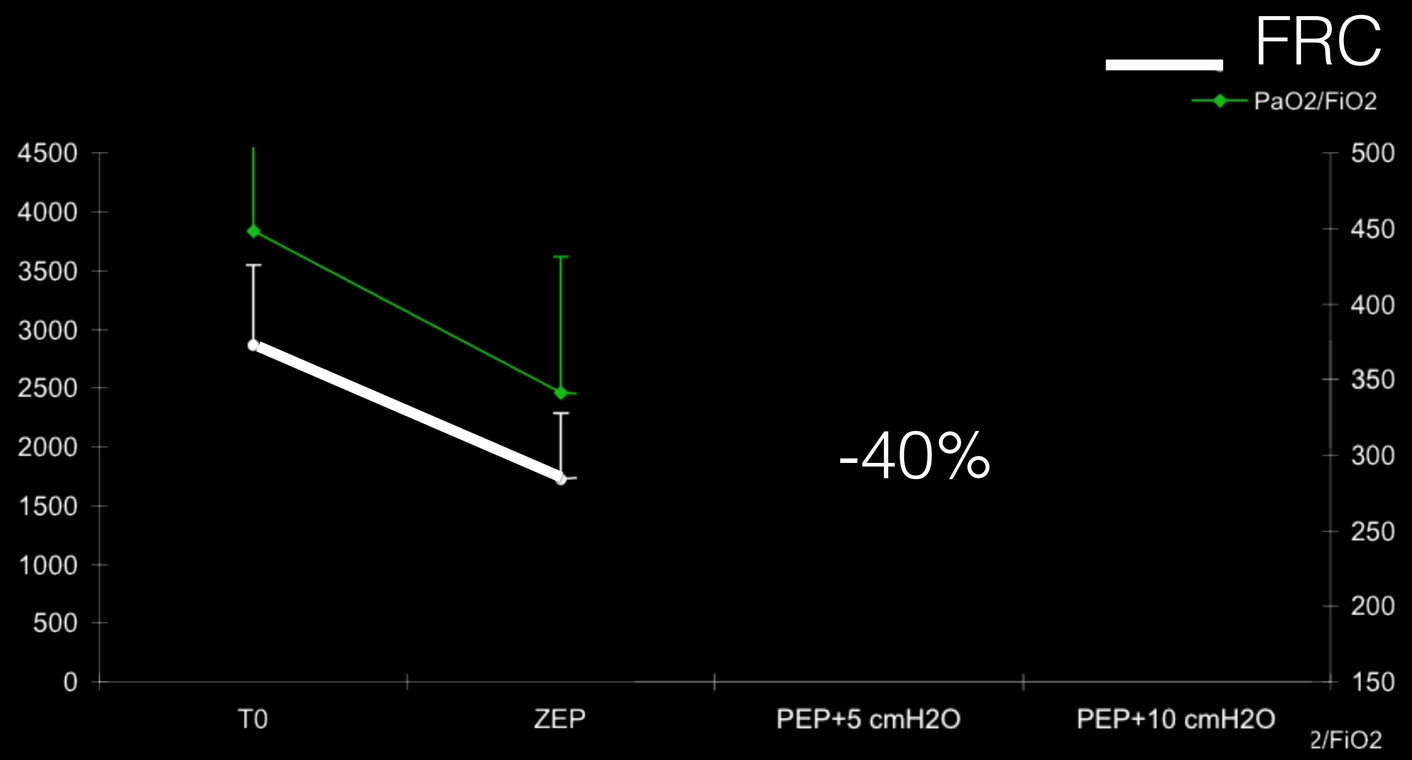
Ventilator-induced Lung Injury

Barotrauma **Biotrauma** **Volotrauma**

Atelectrauma

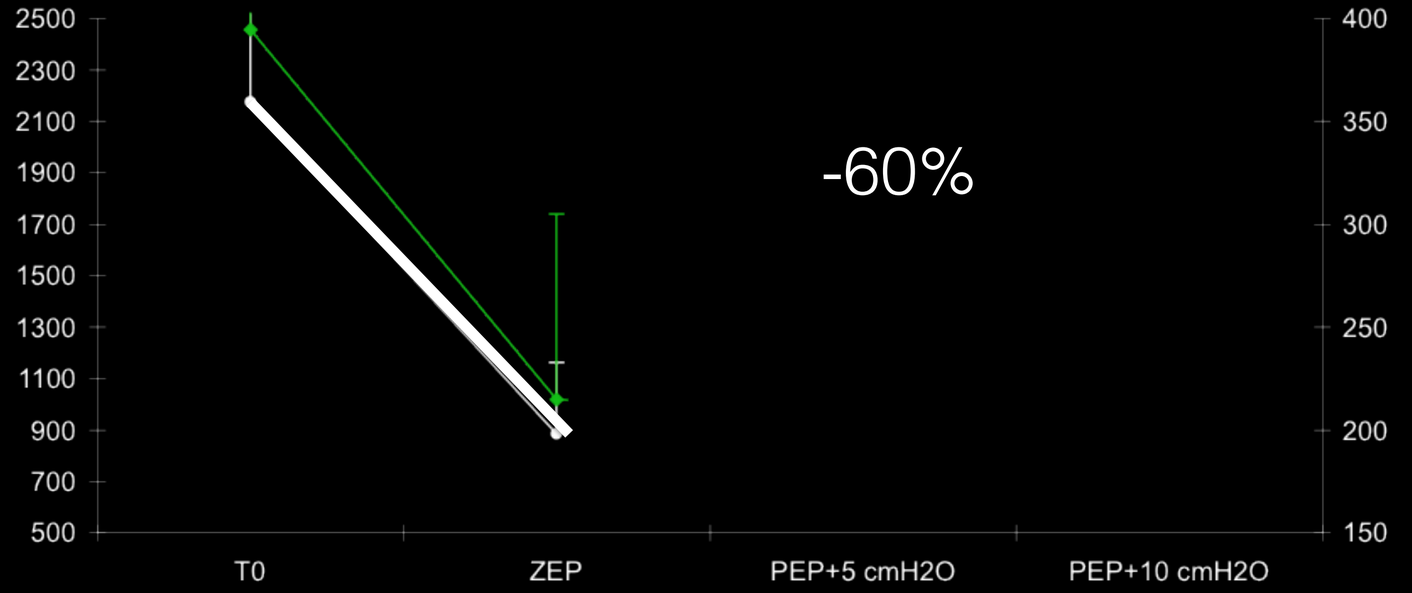
Primum …
Ne pas intuber

Non Obese



-40%

Obese

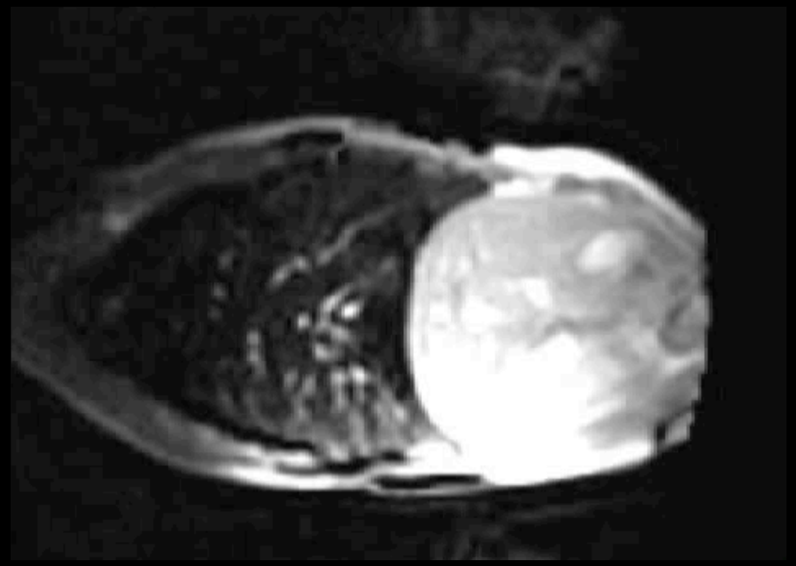


-60%

Futier EJA 2010

Atelectasis and General Anesthesia

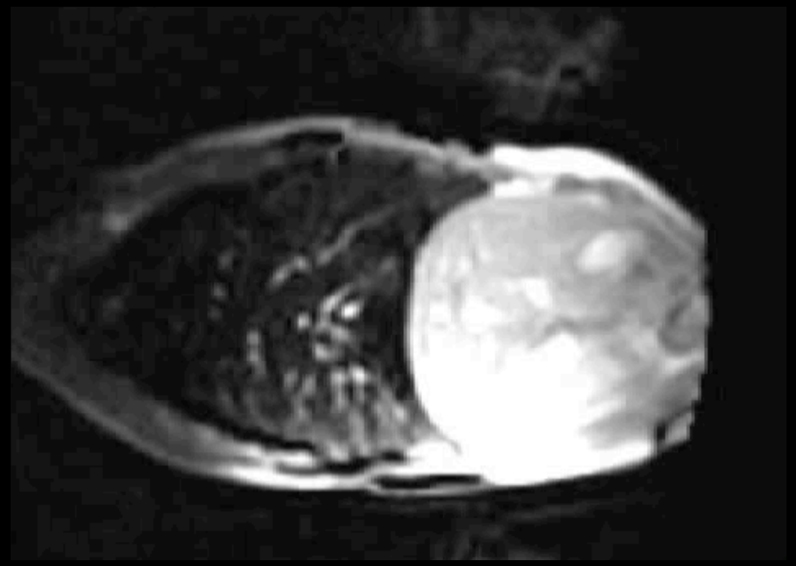
Spontaneous Ventilation



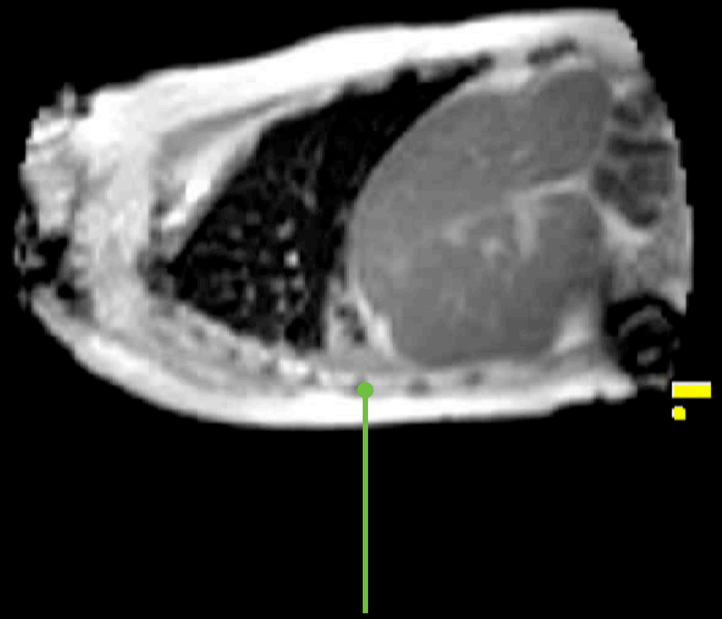
Anesthesia and NMBA

Atelectasis and General Anesthesia

Spontaneous Ventilation

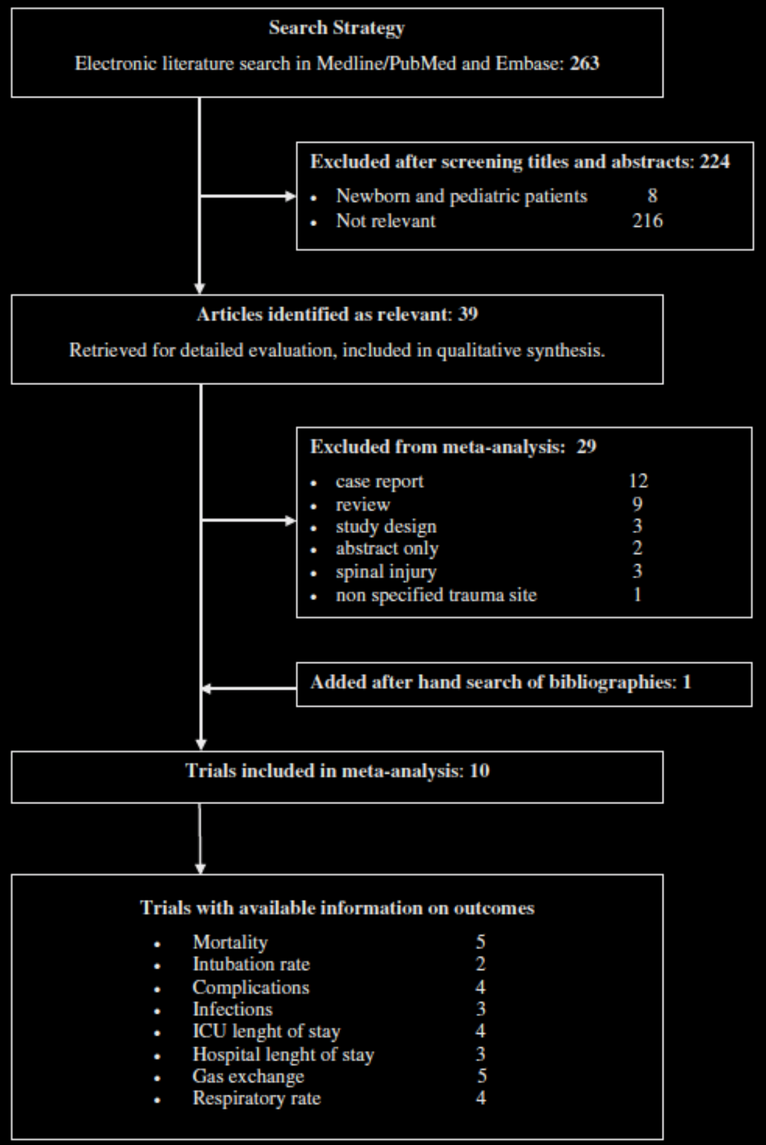


Anesthesia and NMBA



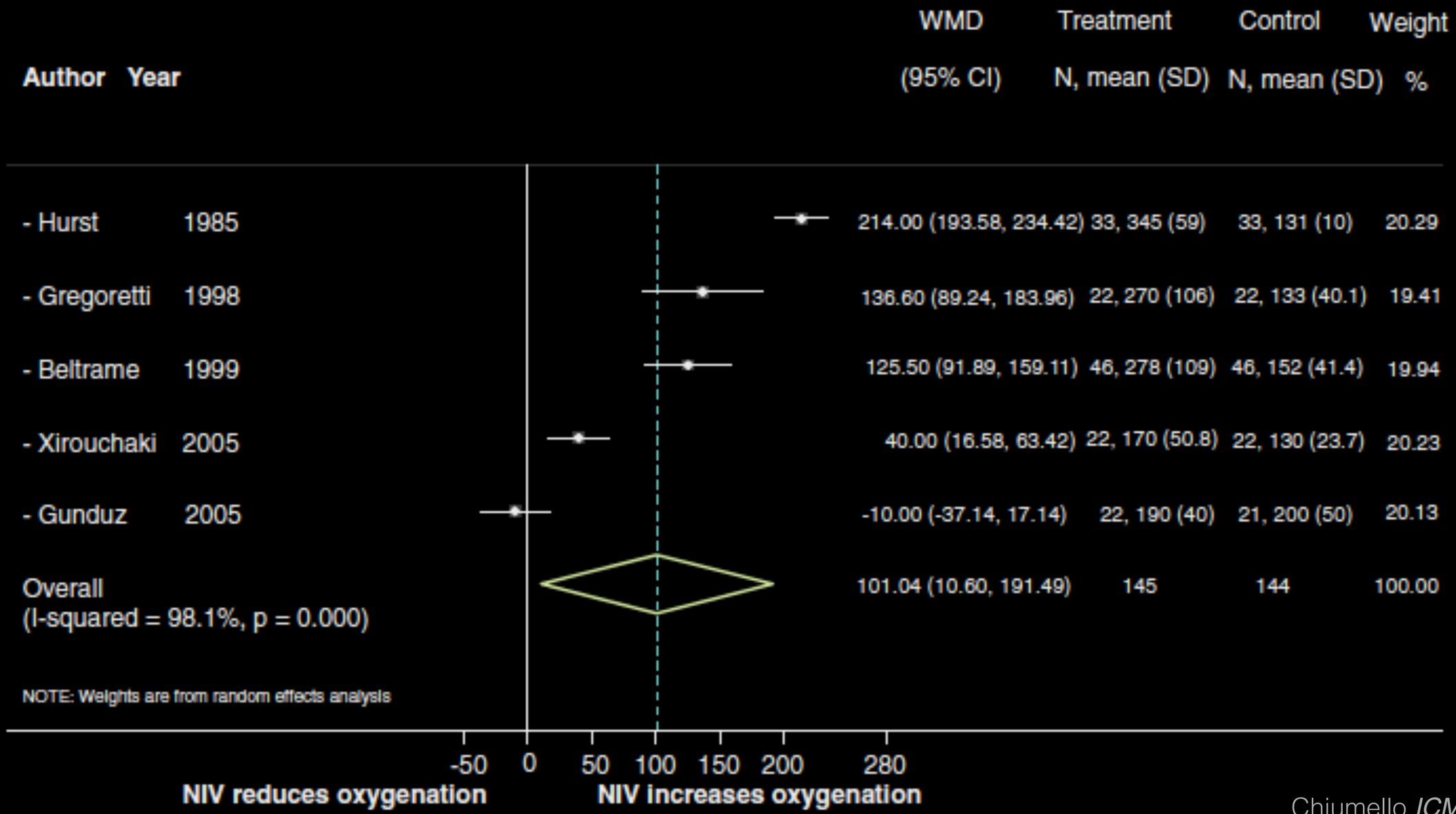
D. Chiumello
S. Coppola
S. Froio
C. Gregoretti
D. Consonni

Noninvasive ventilation in chest trauma: systematic review and meta-analysis



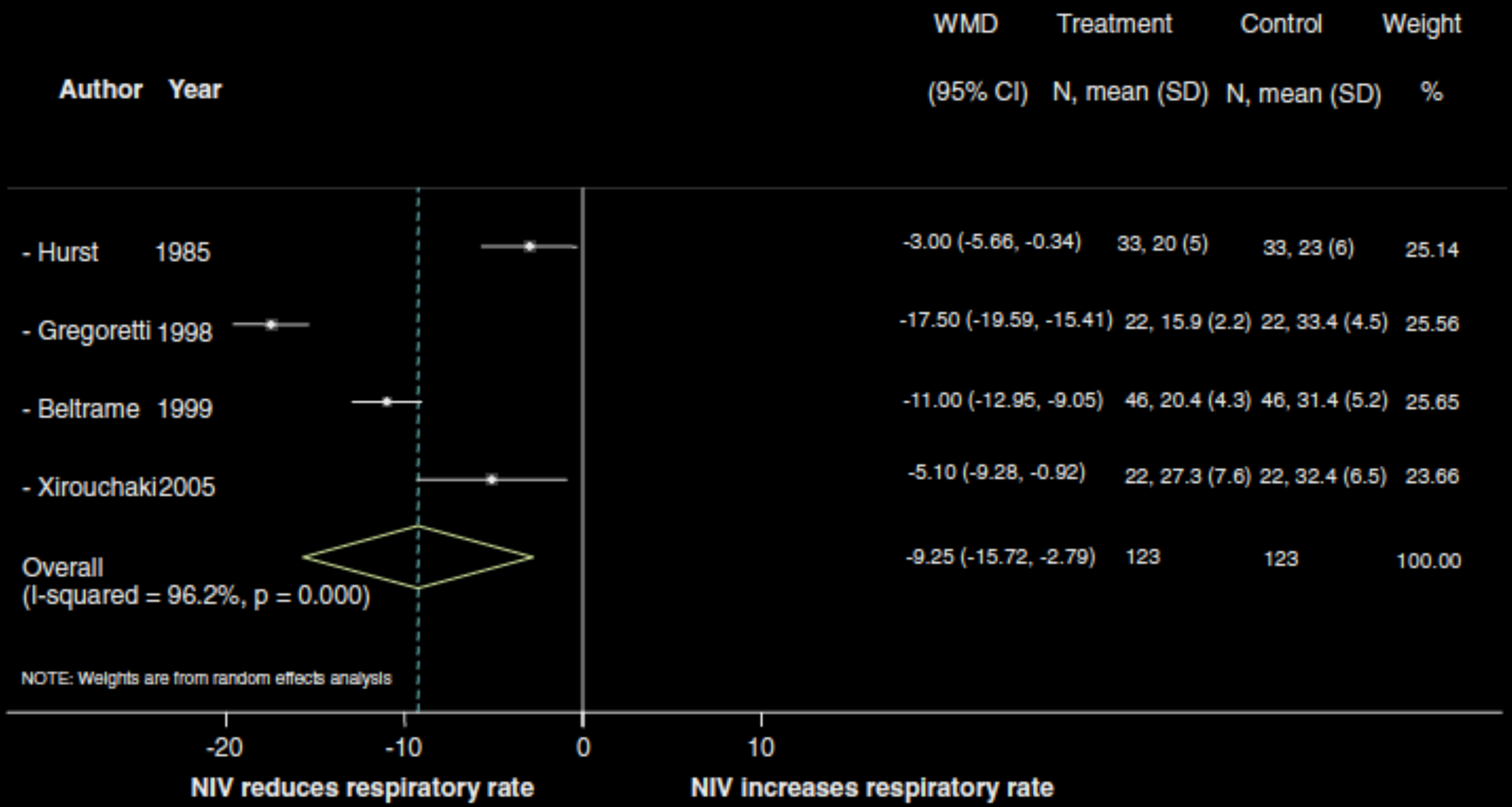
Chiumello *ICM* 2013

Oxygenation (P/F)



Chiumello *ICM* 2013

Respiratory rate



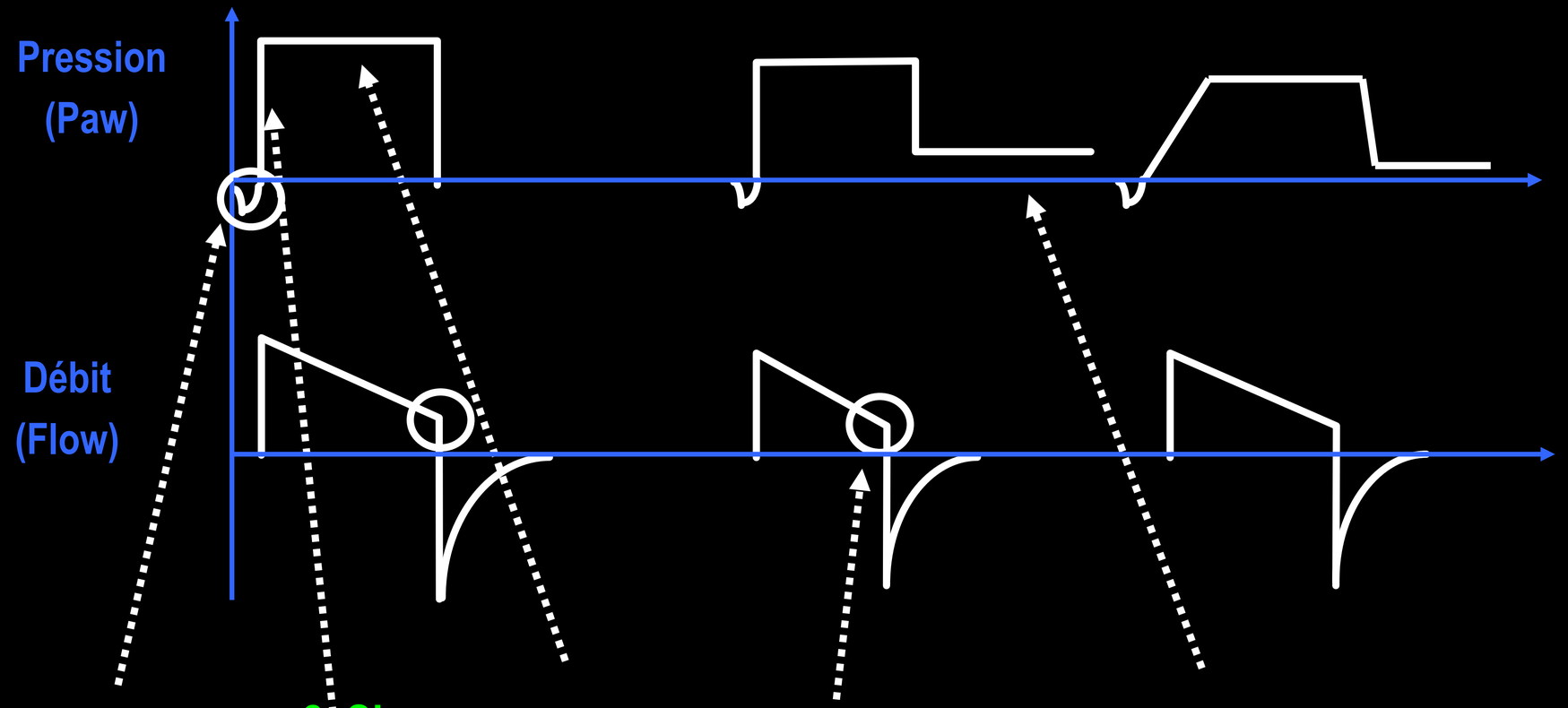
Chiumello *ICM* 2013

Chiumello *ICM* 2013

Early use of NIV decrease mortality in chest trauma patients

Quels réglages pour quels objectifs ?

NIV settings



1. Inspiratory Trigger

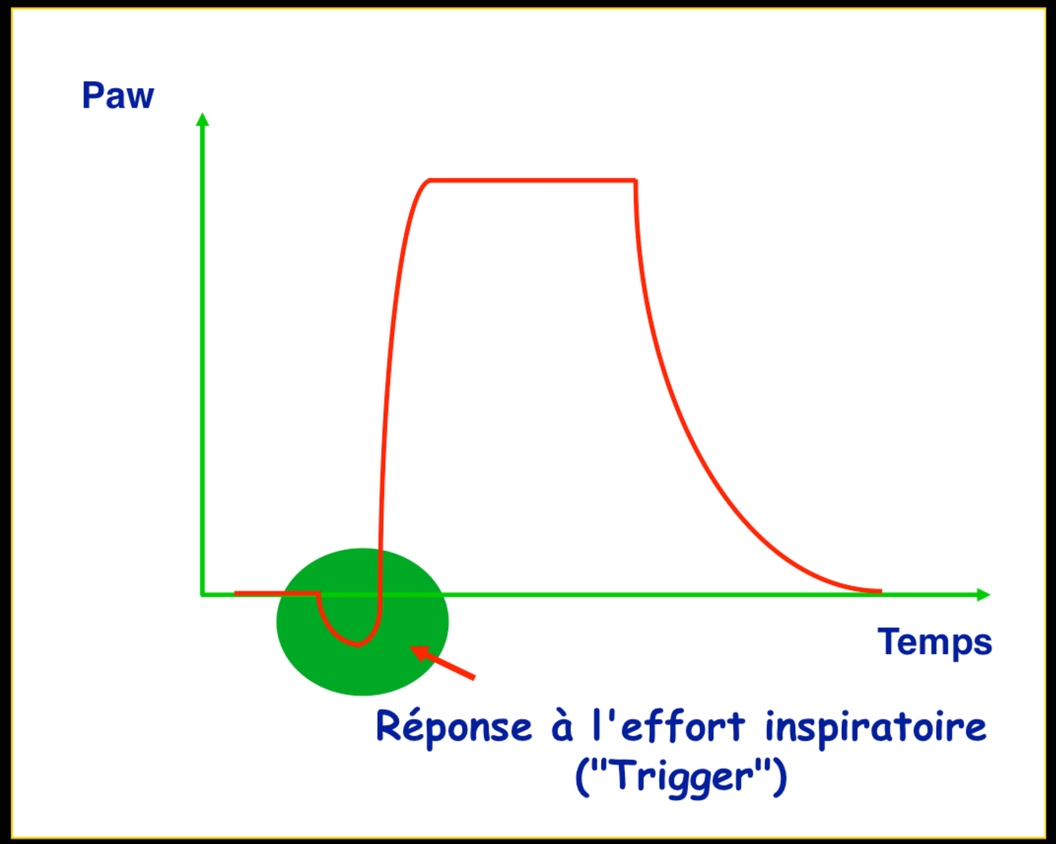
2. Shape

3.Pressure support level (PSV)

4. Expiratory cycling

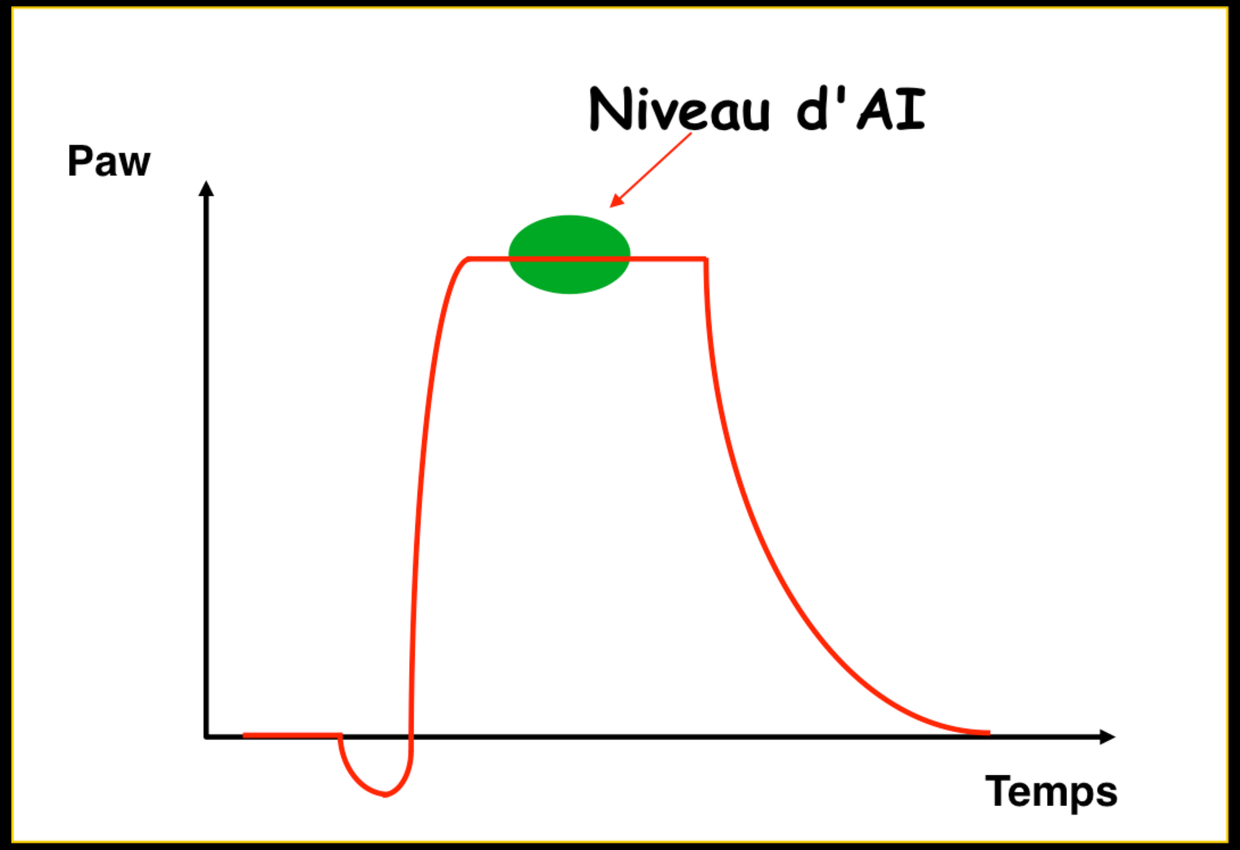
5. PEEP

Inspiratory trigger

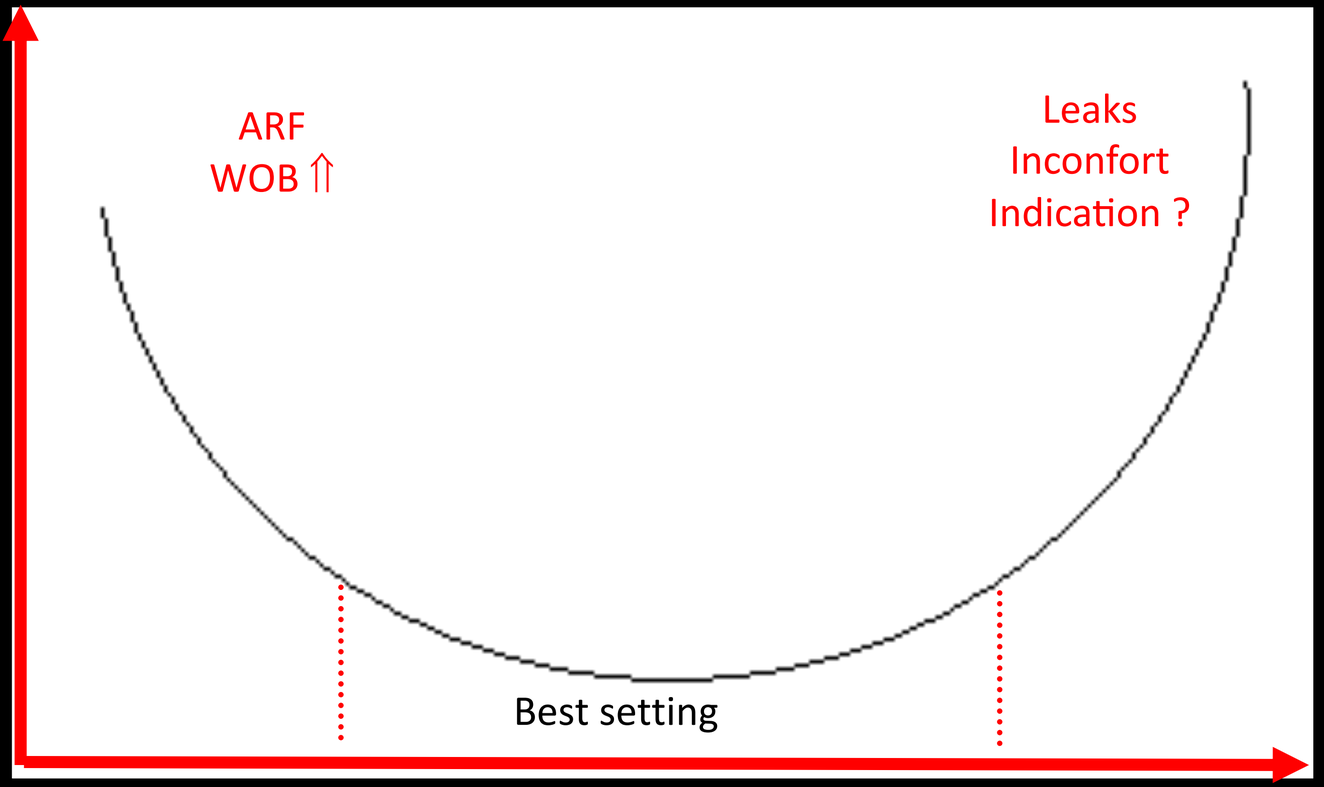


Flow ?... Pressure ?...

PSV level



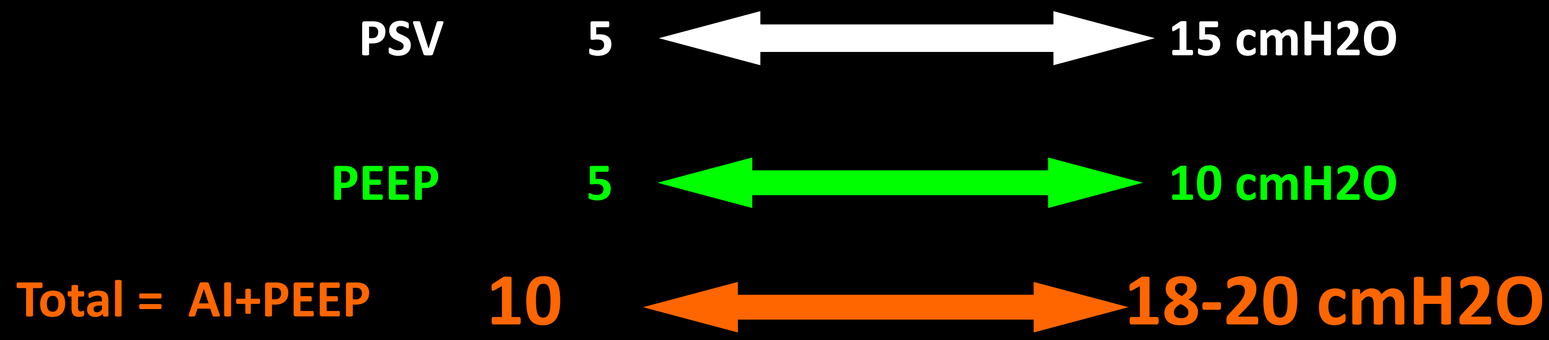
Which pressure level should be used ?



PSV 5 ⟷ 15 cmH2O

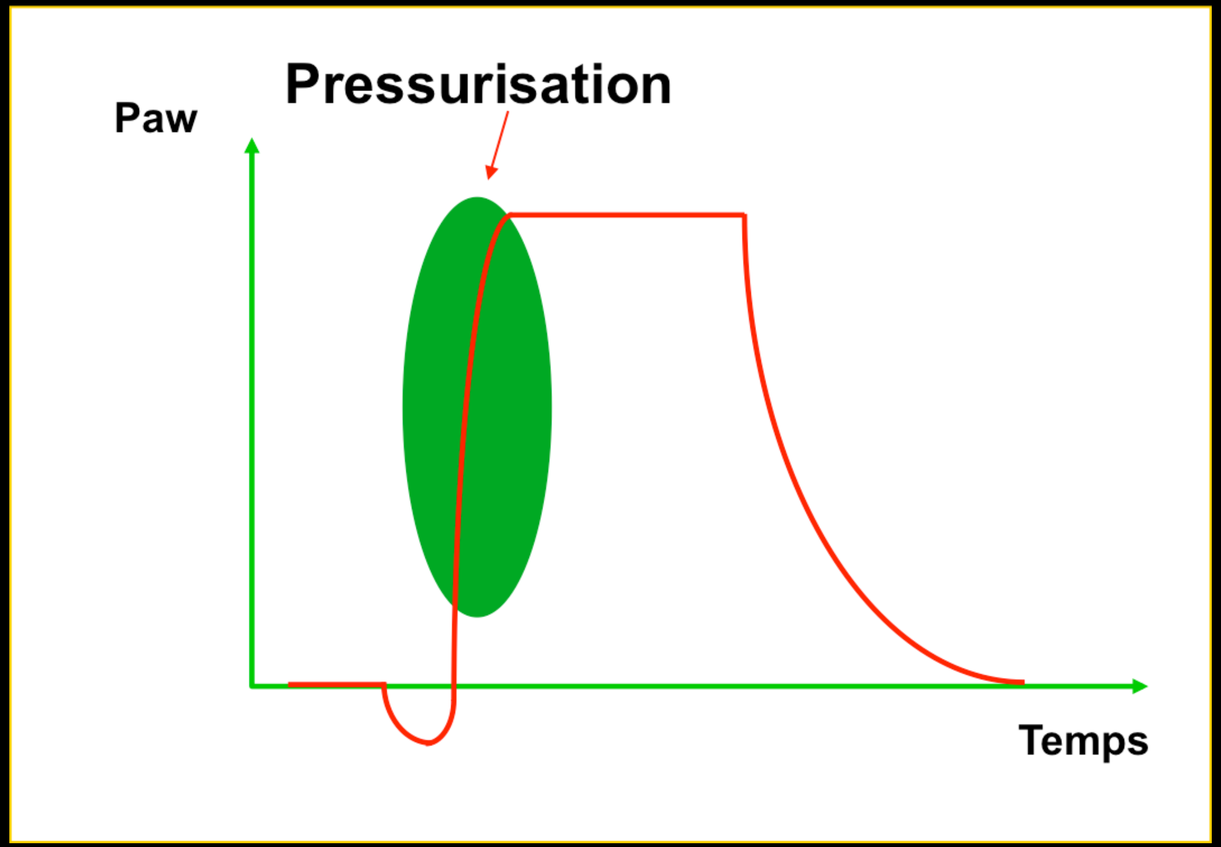
PEEP 5 ⟷ 10 cmH2O

Total = PSV+PEEP 10 ⟷ 18-20 cmH2O

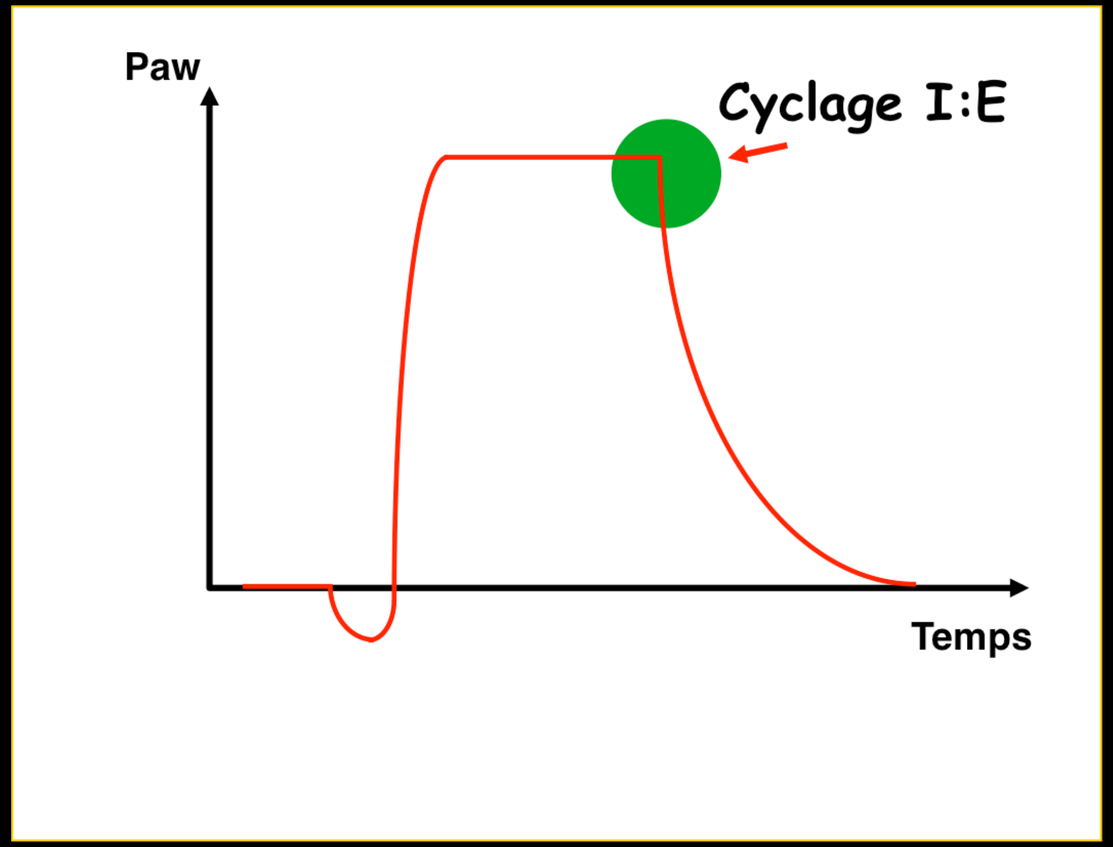


PEEP >> PSV (except COPD)

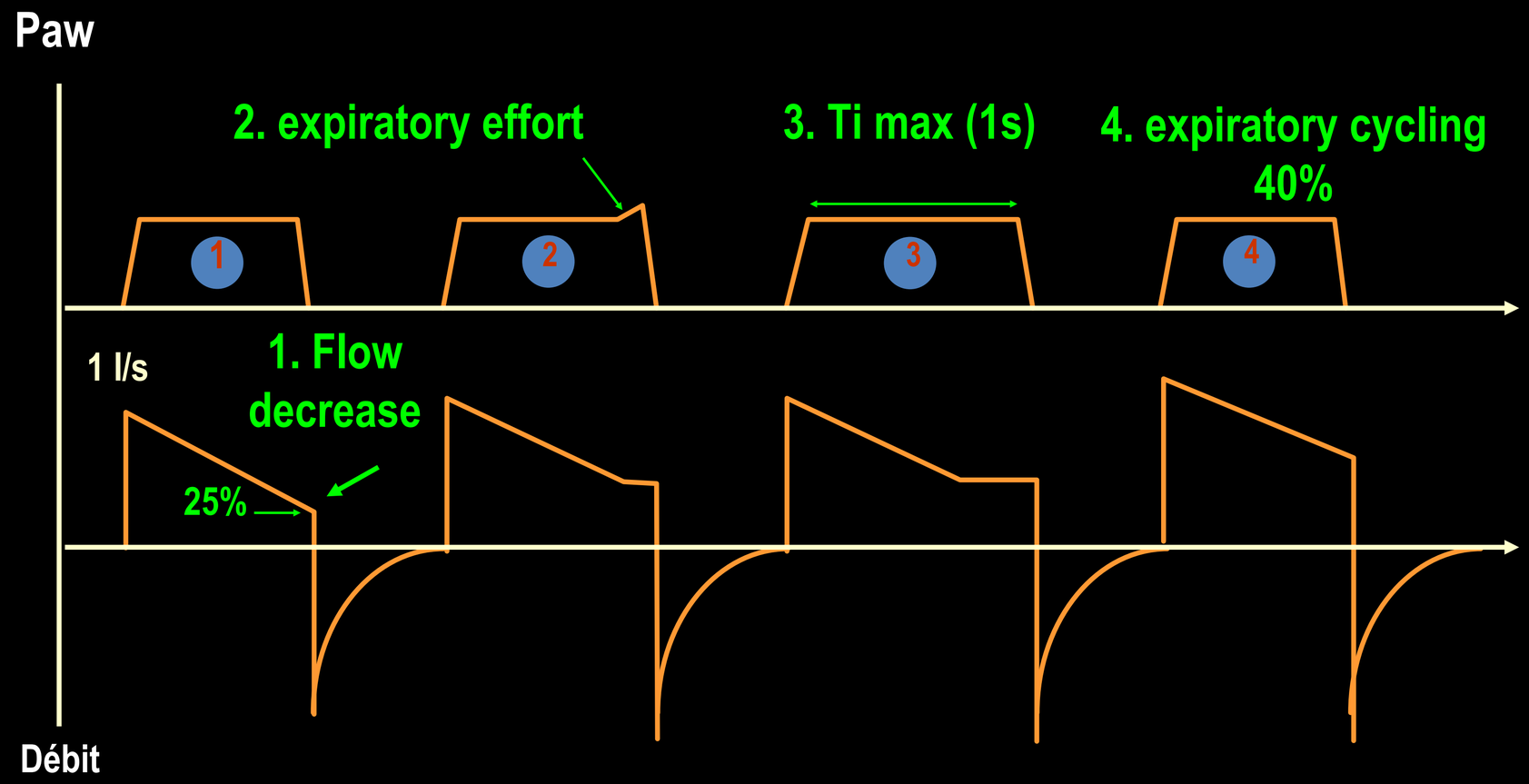
speed of pressurization



Expiratory cycling



Expiratory cycling



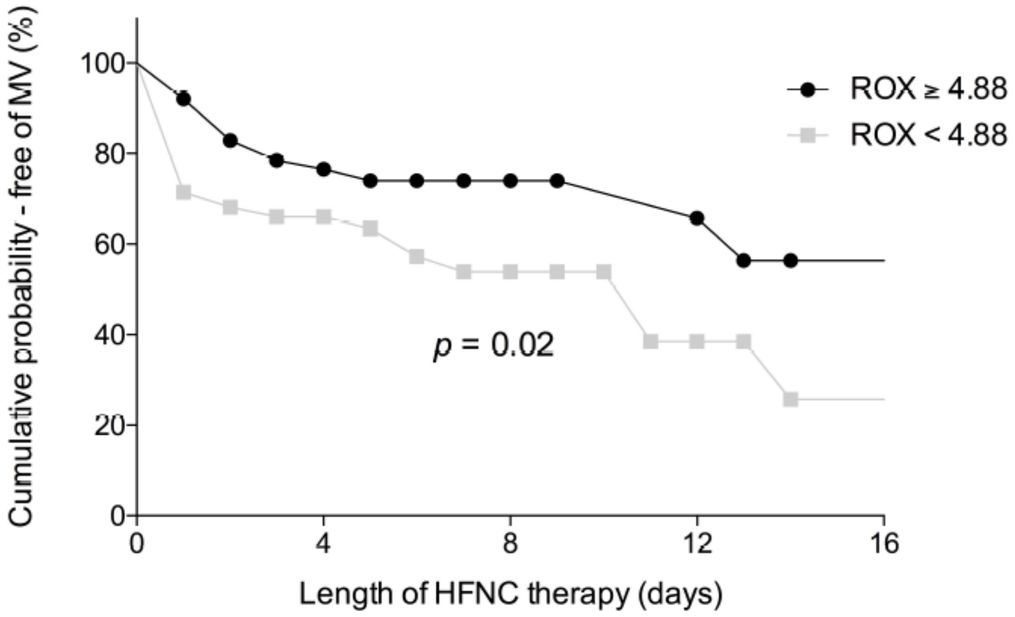
Eviter les échecs

Savoir s’arrêter !

An index combining respiratory rate and oxygenation to predict outcome of nasal high flow therapy

Oriol Roca[1,2], Berta Caralt[1,3], Jonathan Messika[4,5,6], Manuel Samper[7], Benjamin Sztrymf[8,9], Gonzalo Hernández[10], Marina García-de-Acilu[1], Jean-Pierre Frat[11,12,13], Joan R. Masclans[2,3,7], Jean-Damien Ricard[4,5,6]

$$ROX = SpO_2/FiO_2/RR$$



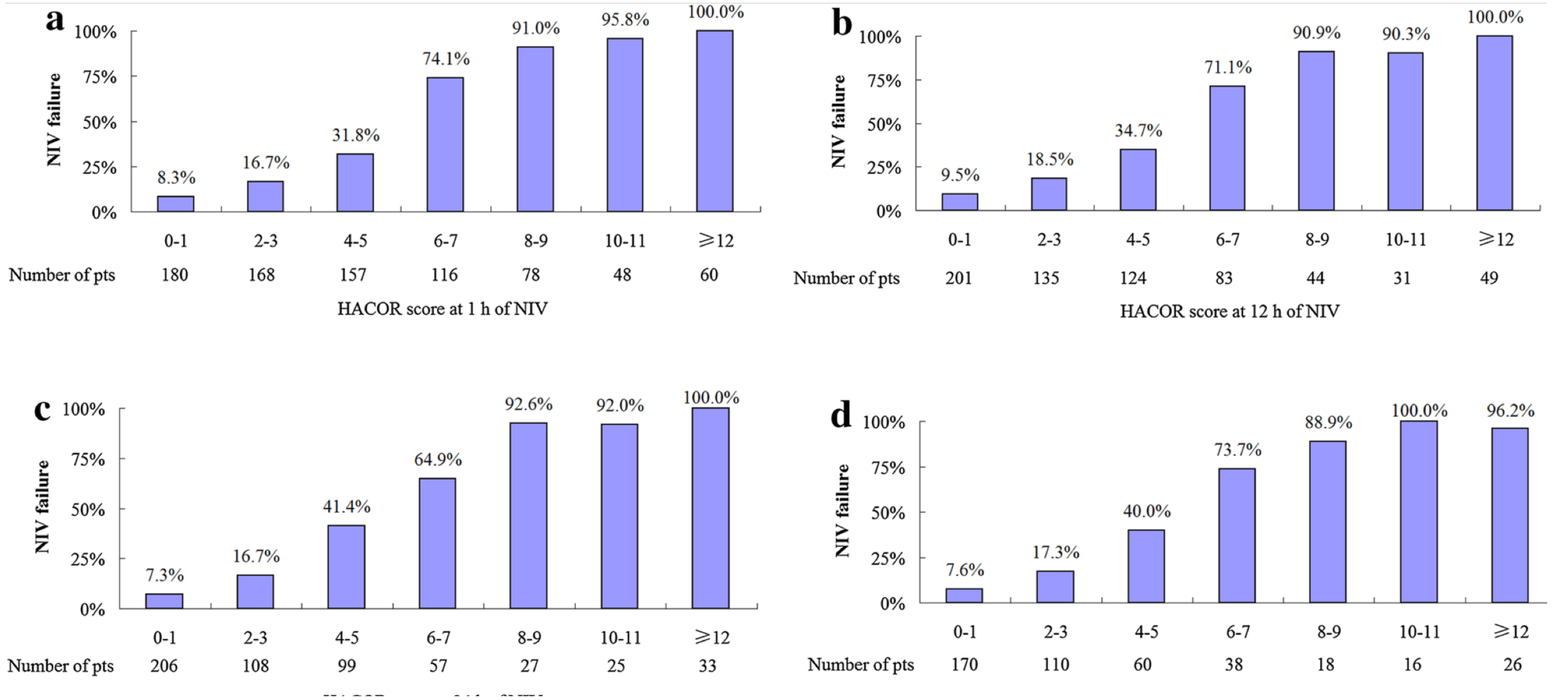
Survival proportions according to ROX index at 2h of HFNC

ORIGINAL

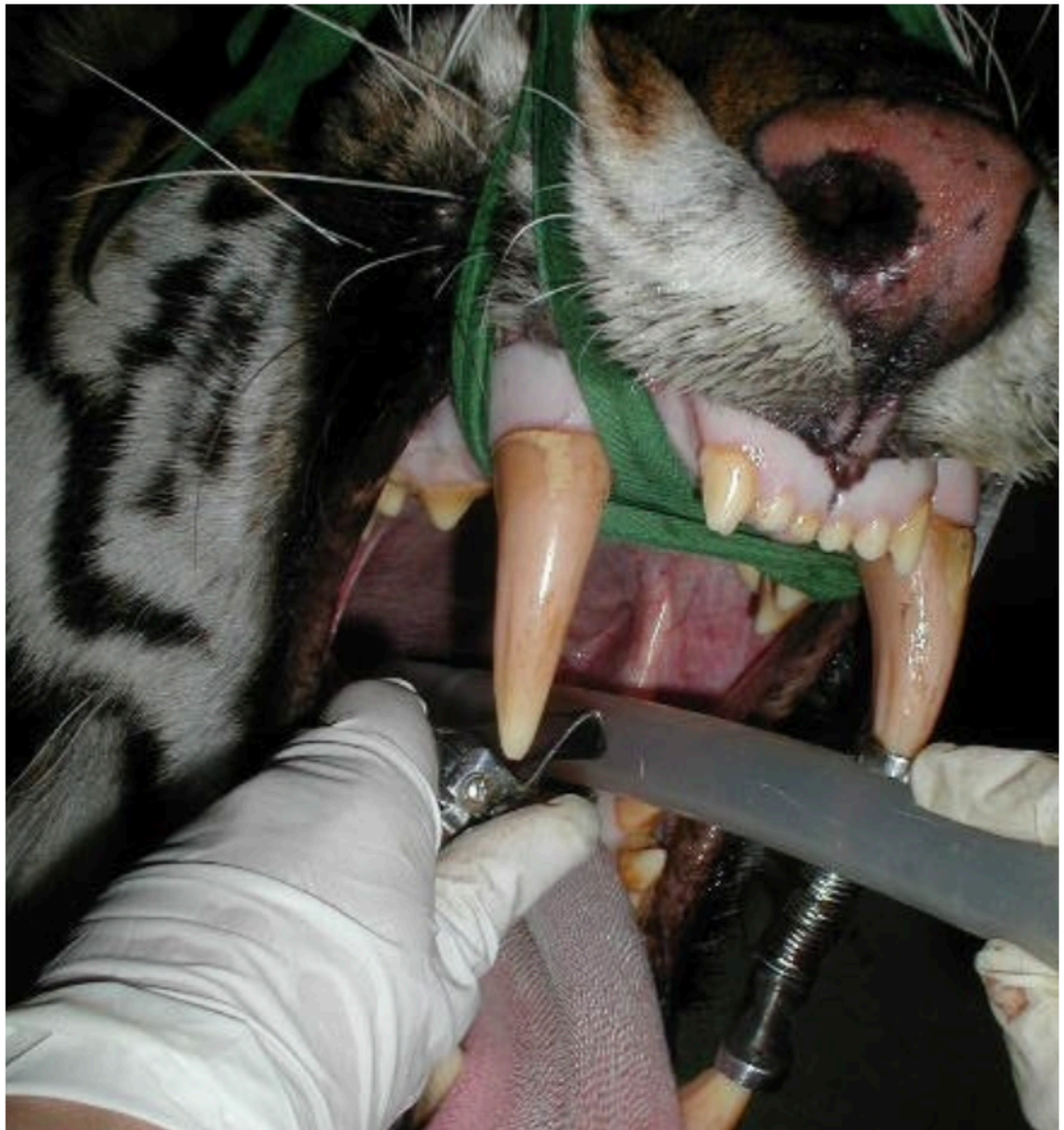
Assessment of heart rate, acidosis, consciousness, oxygenation, and respiratory rate to predict noninvasive ventilation failure in hypoxemic patients

Jun Duan*, Xiaoli Han, Linfu Bai, Lintong Zhou and Shicong Huang

HACOR



Sometimes intubation is required …



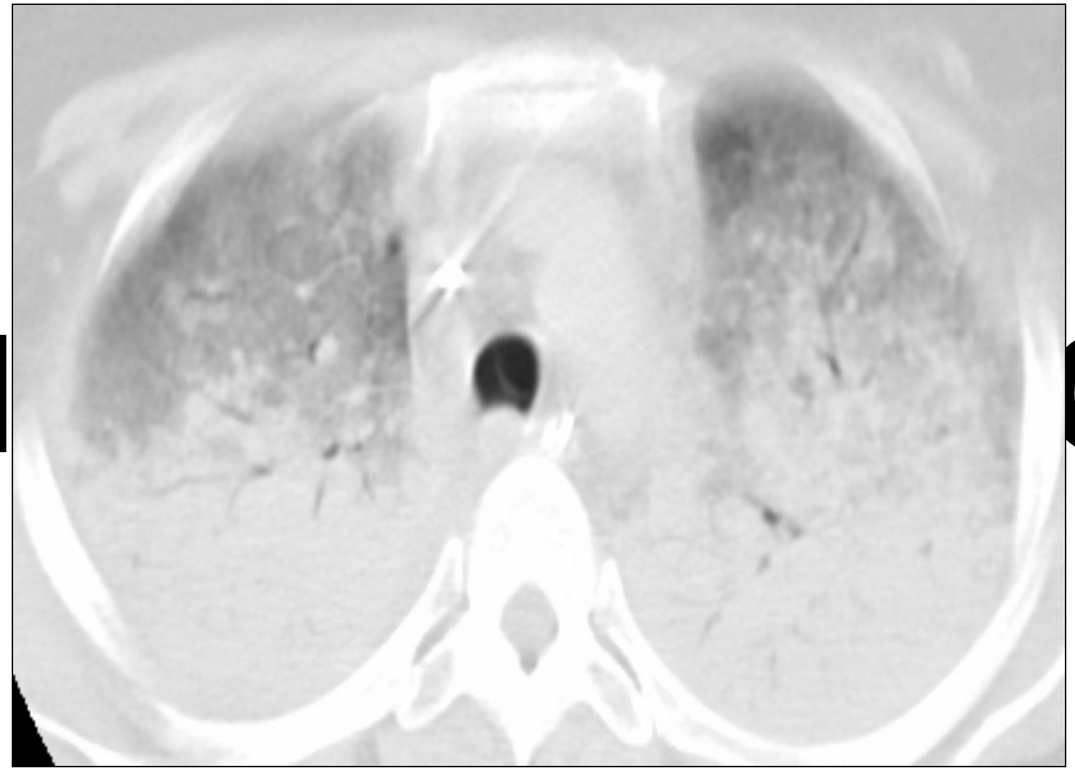
Traumatismes du thorax

Quel est le but de la ventilation ?

Ventilator-induced Lung Injury

Barotrauma **Biotrauma** **Volotrauma**

Atelectrauma

Contu  onaire

Ventilation protectrice

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

N Engl J Med 2013;369:2126-36.

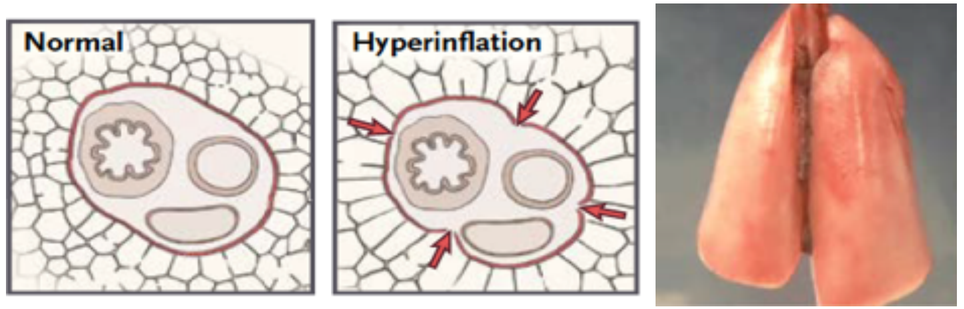
CRITICAL CARE MEDICINE

Simon R. Finfer, M.D., and Jean-Louis Vincent, M.D., Ph.D., *Editors*

Ventilator-Induced Lung Injury

Arthur S. Slutsky, M.D., and V. Marco Ranieri, M.D.

B. Ventilation at HIGH Lung Volume



Overdistention

Lower VT

6 ml/kg IBW

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

N Engl J Med 2013;369:2126-36.

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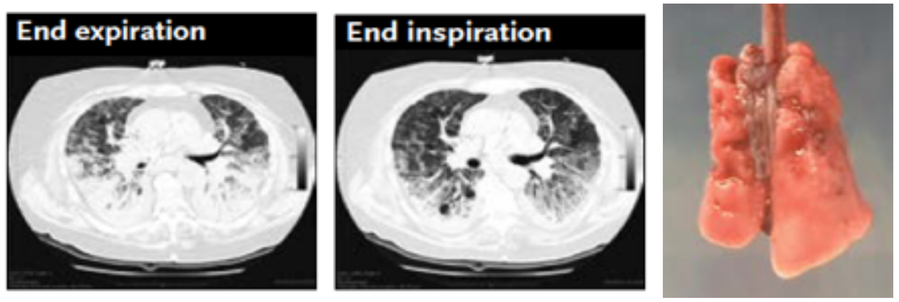
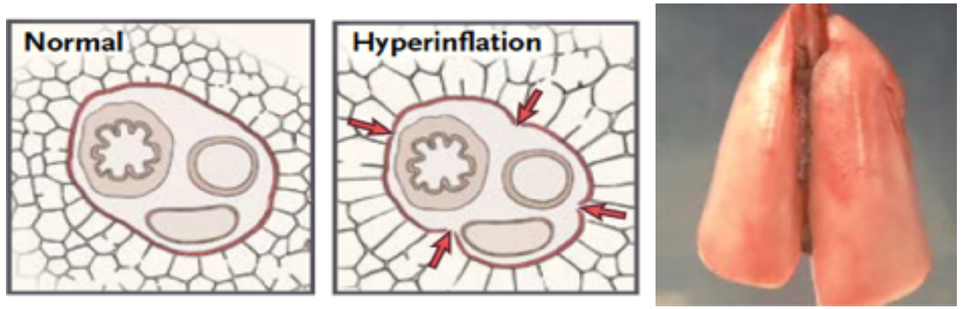
A. Ventilation at LOW Lung Volume



Atelectrauma

B. Ventilation at HIGH Lung Volume



Overdistention

Pplat < 30 cmH_20

PEP

The NEW ENGLAND JOURNAL of MEDICINE

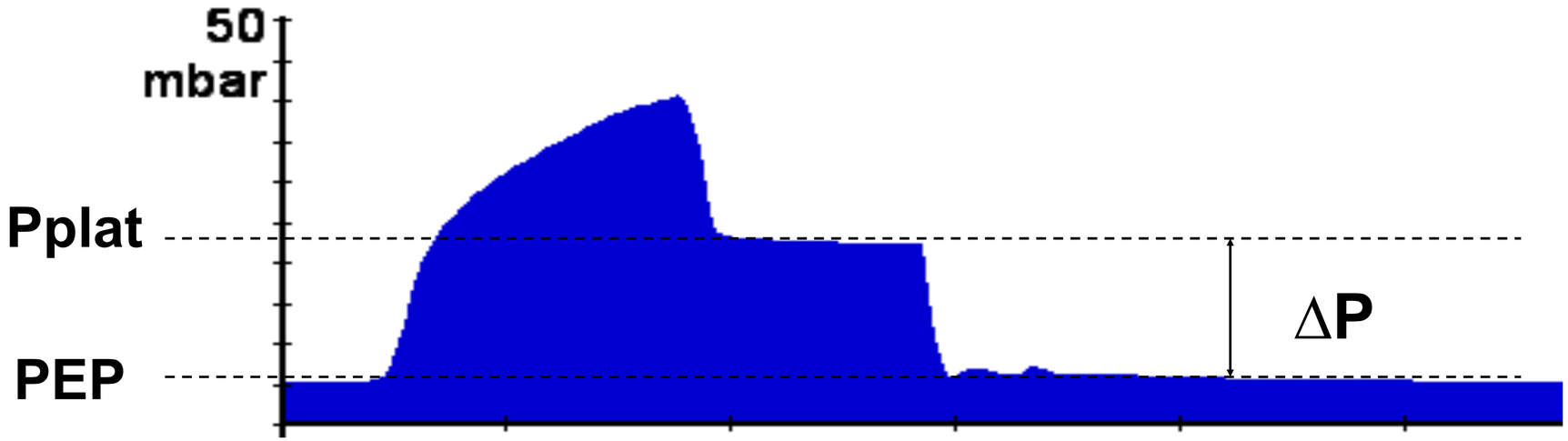
SPECIAL ARTICLE

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.

Driving Pressure : ΔP

(pression motrice)

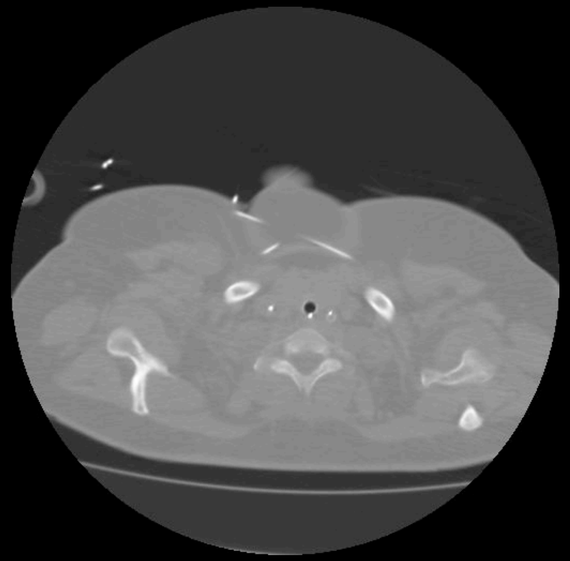


ΔP = Pplat-PEP

Manœuvres de recrutement

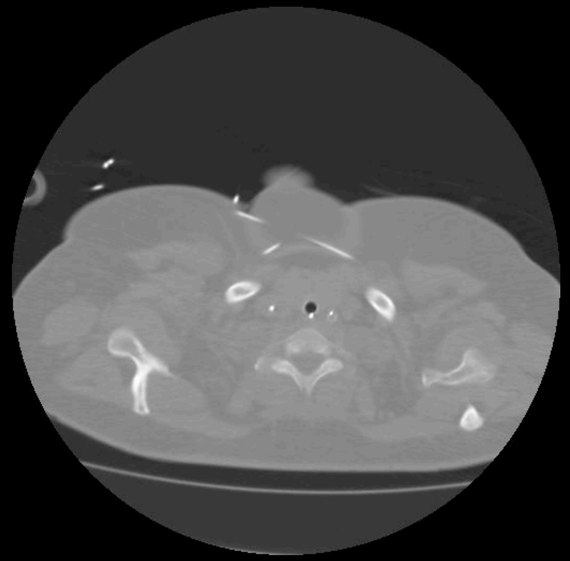
ZEEP

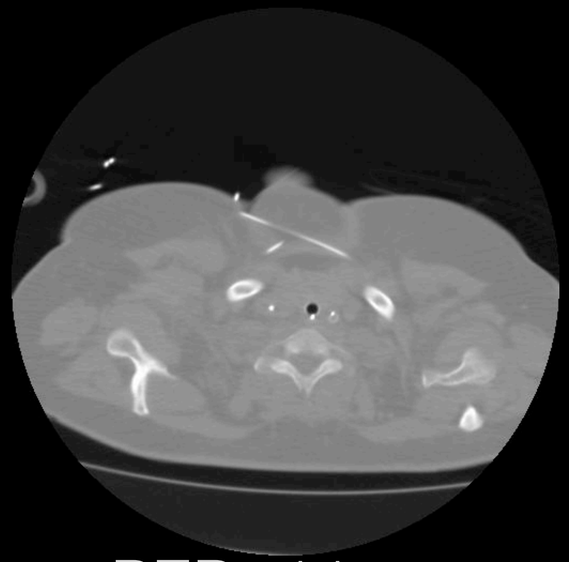
PaO_2= 171 mmHg



ZEEP

PaO_2= 171 mmHg





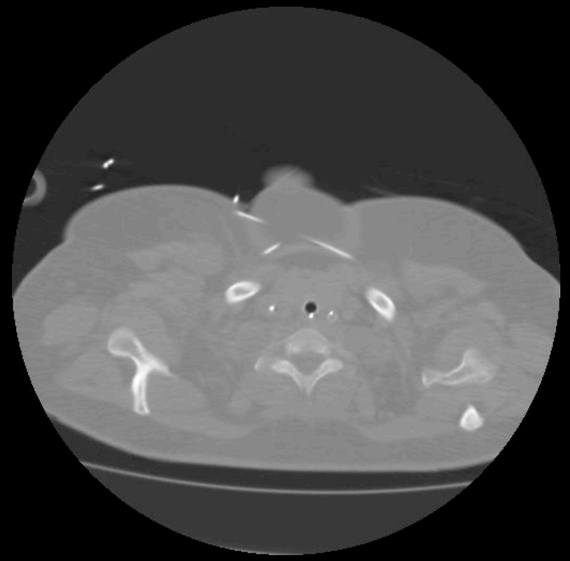
PEP=11

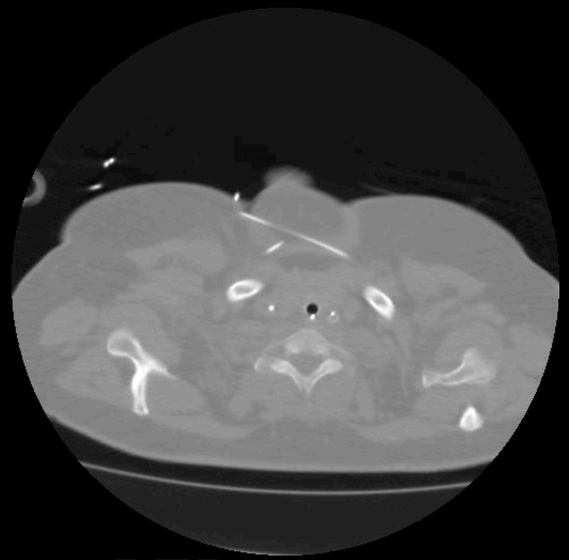
PaO_2= 171 mmHg

Constantin CCM 2011

ZEEP

PaO_2= 171 mmHg



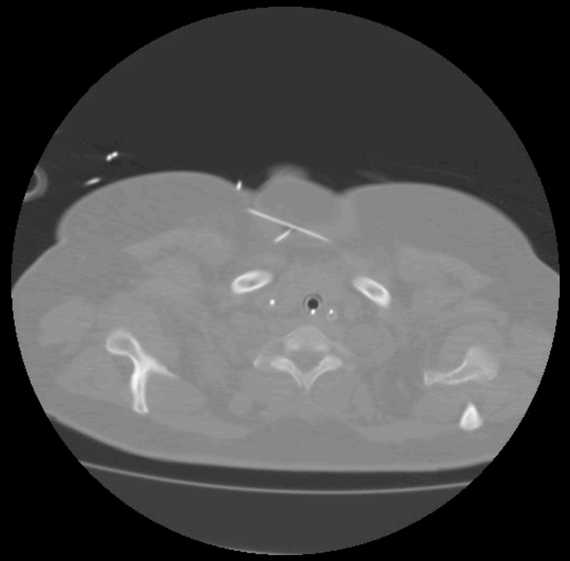


PEP=11

PaO_2= 171 mmHg

MRA

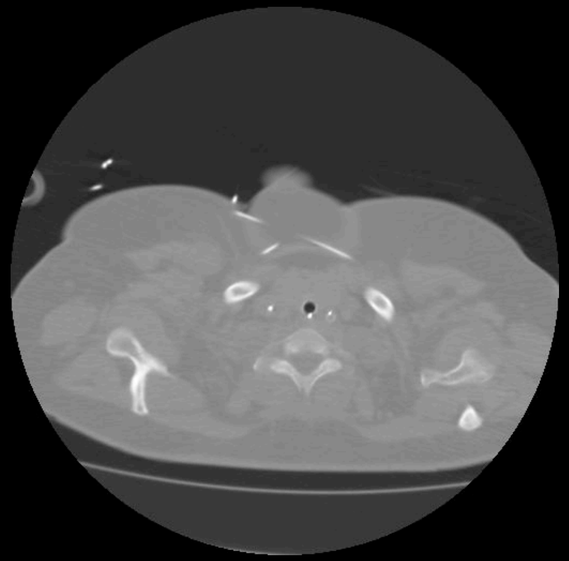
PaO_2= 344 mmHg



Constantin CCM 2011

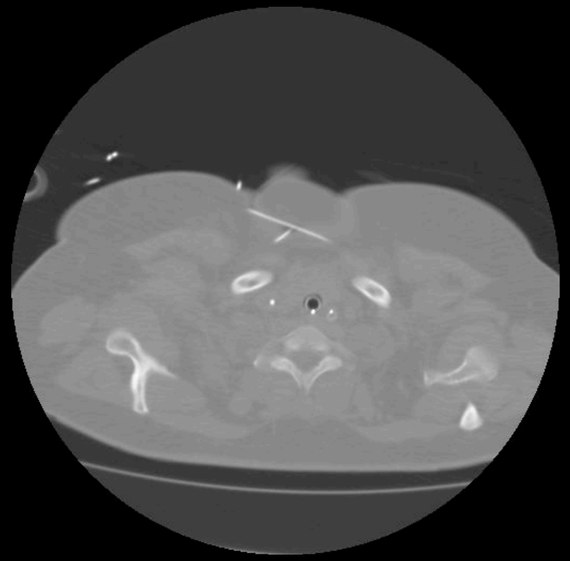
ZEEP

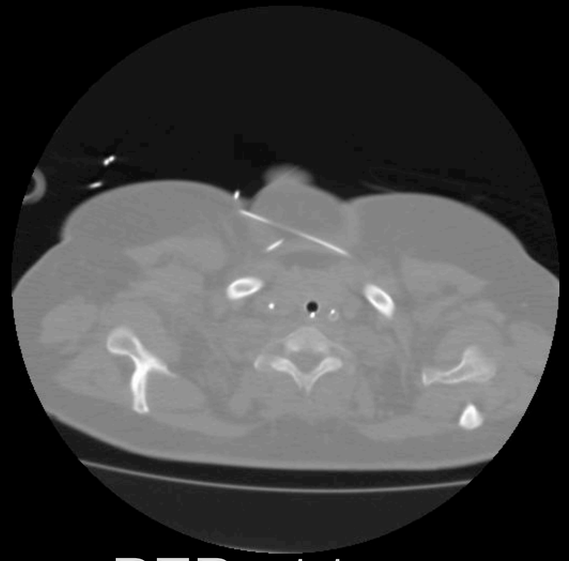
PaO_2= 171 mmHg



MRA

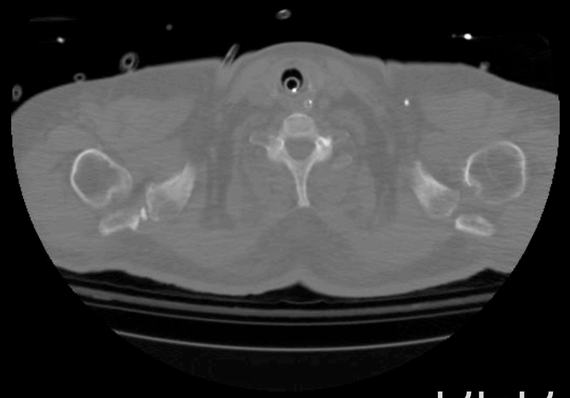
PaO_2= 344 mmHg





PEP=11

PaO_2= 171 mmHg



PEP=11

PaO_2= 340 mmHg

Constantin CCM 2011

Si...

Si unilatéral

Si Pneumothorax (drainé)

Si Hémothorax

Si …

ça ne change pas grand chose !

Faut-il faire « tourner » les patients ?

ARTICLE IN PRESS

JID: JINJ [m5G;November 19, 2019;13:38]

Injury xxx (xxxx) xxx

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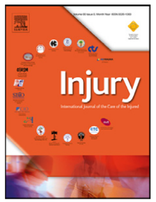

Continuous lateral rotational therapy in thoracic trauma––A matched pair analysis

Mark Schieren[a,*], Frank Wappler[a], Daniel Klodt[b], Samir G. Sakka[a], Rolf Lefering[c], Vera Jäcker[d], Jerome Defosse[a]

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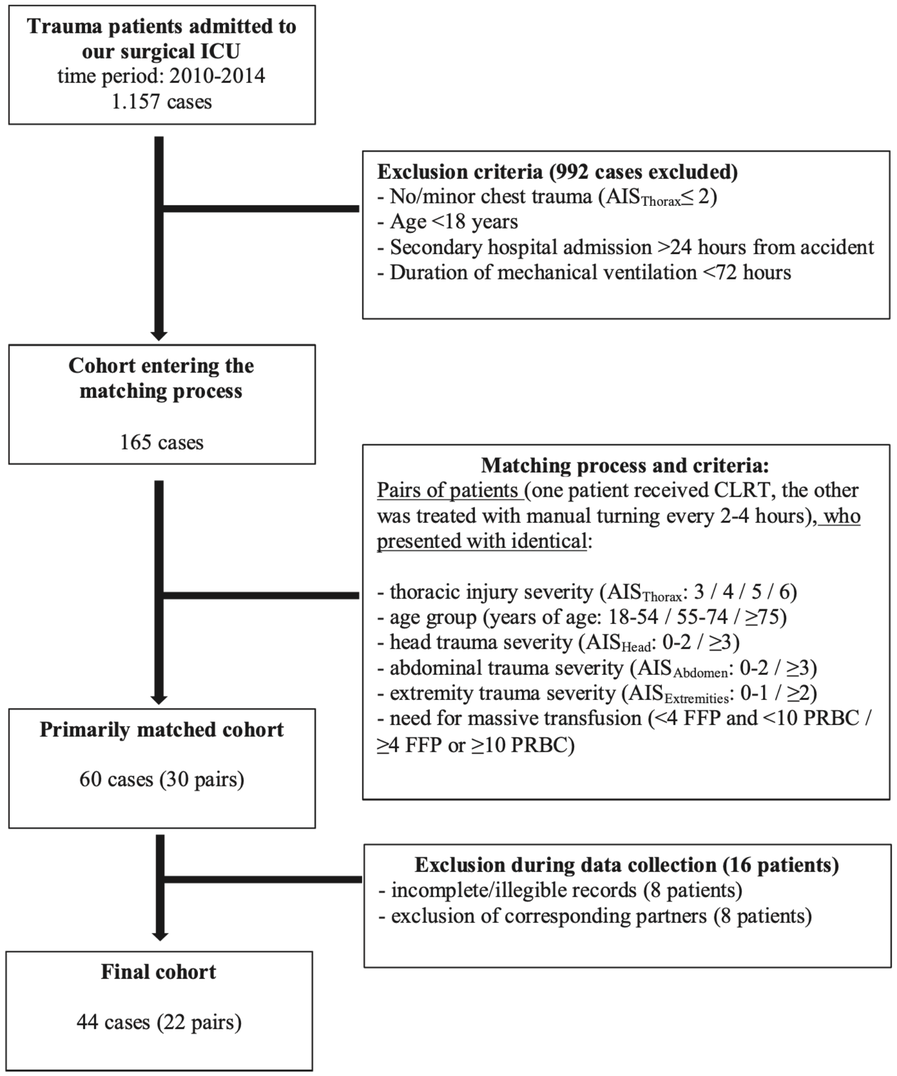

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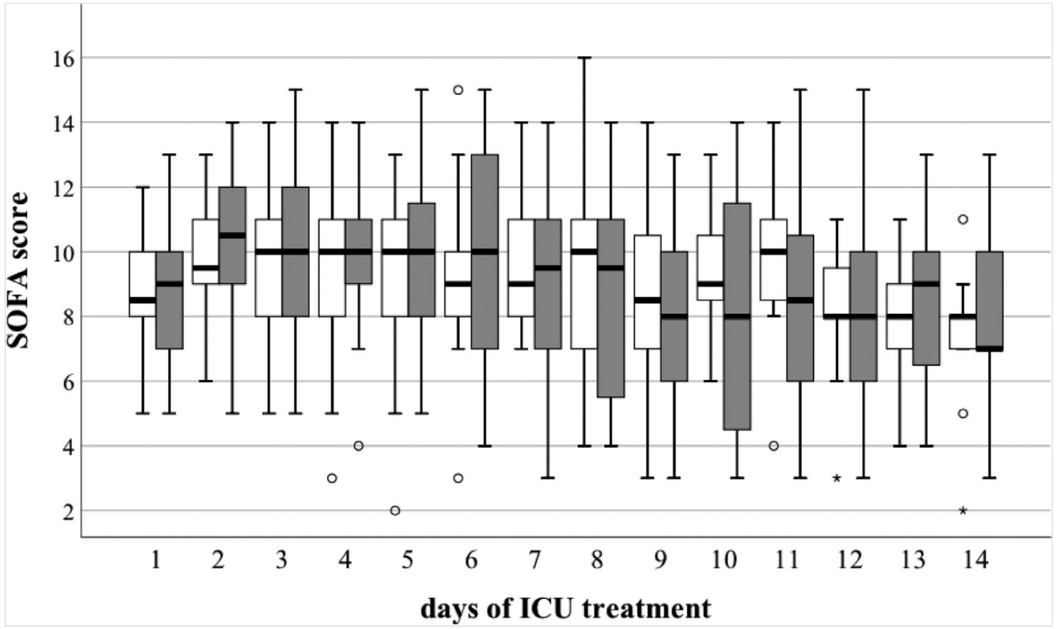
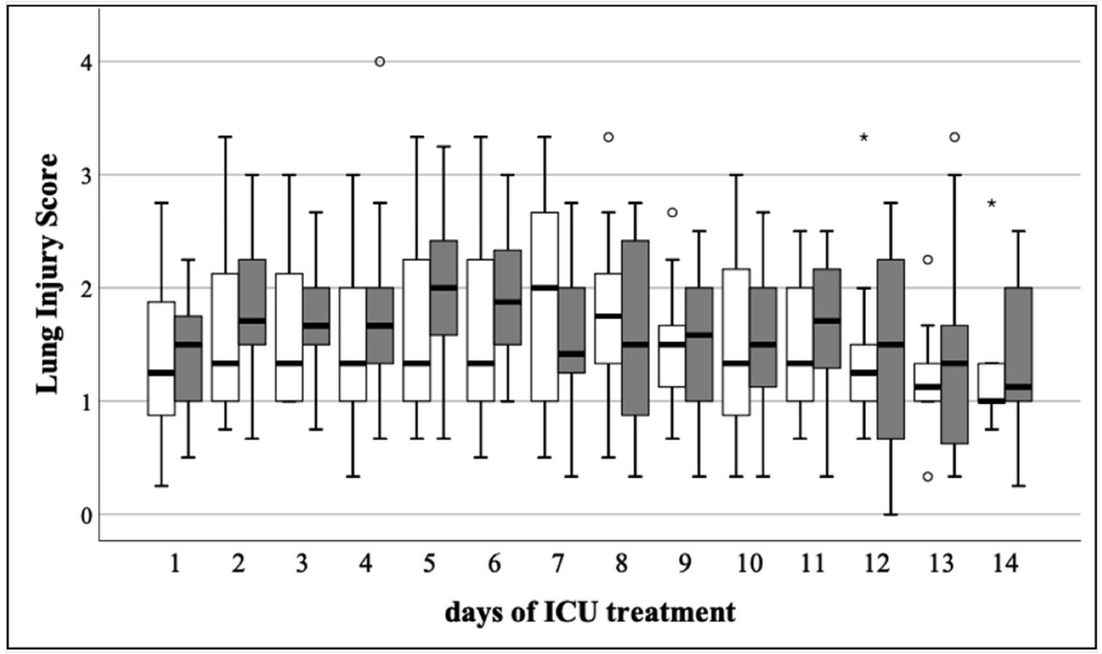
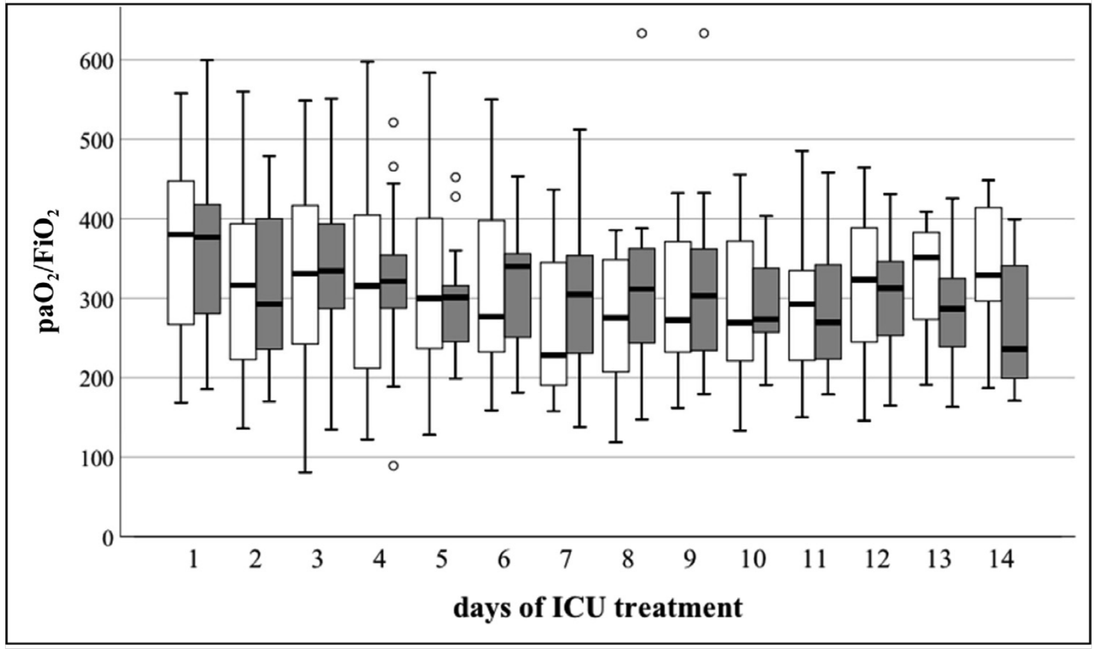
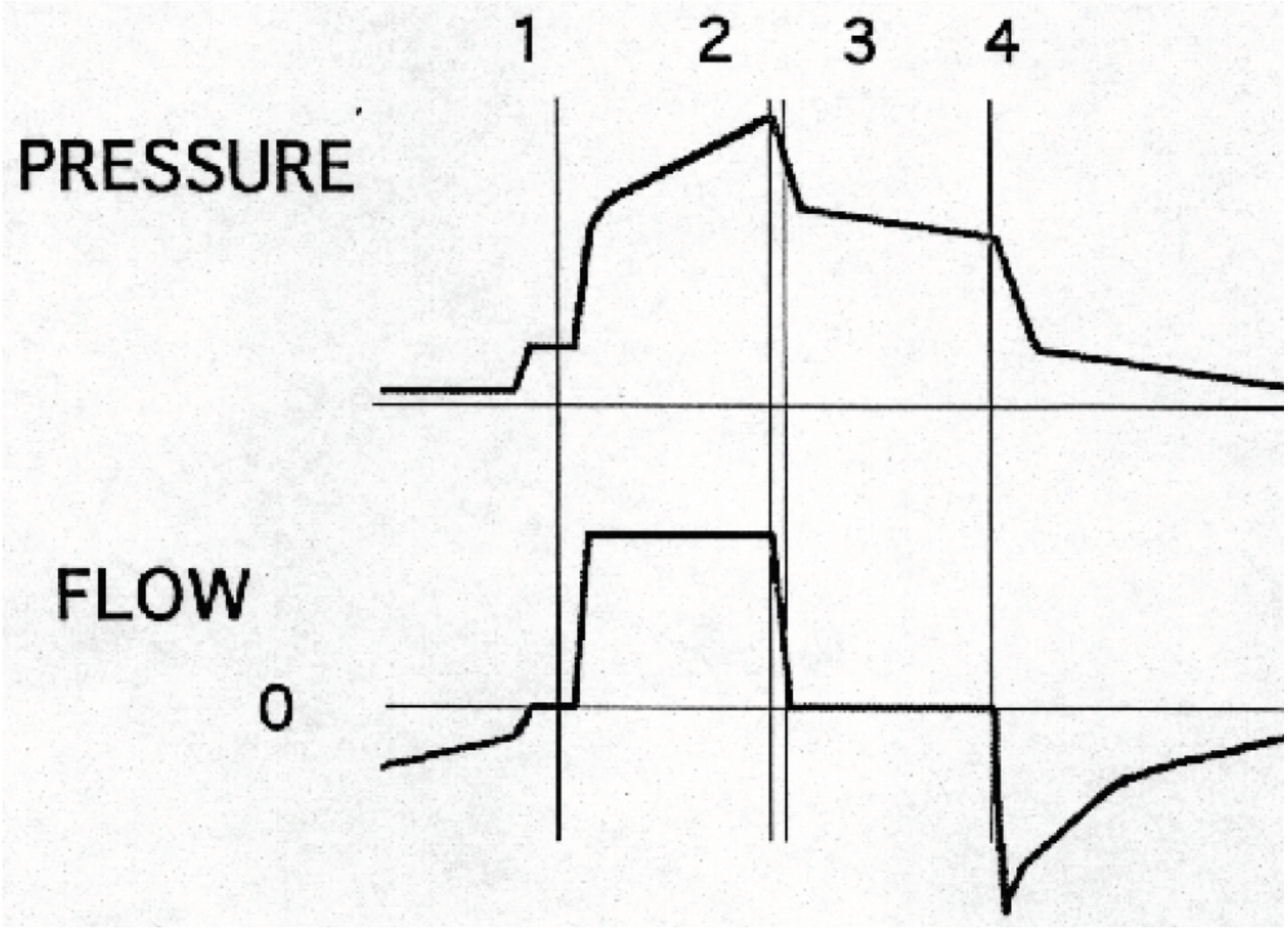




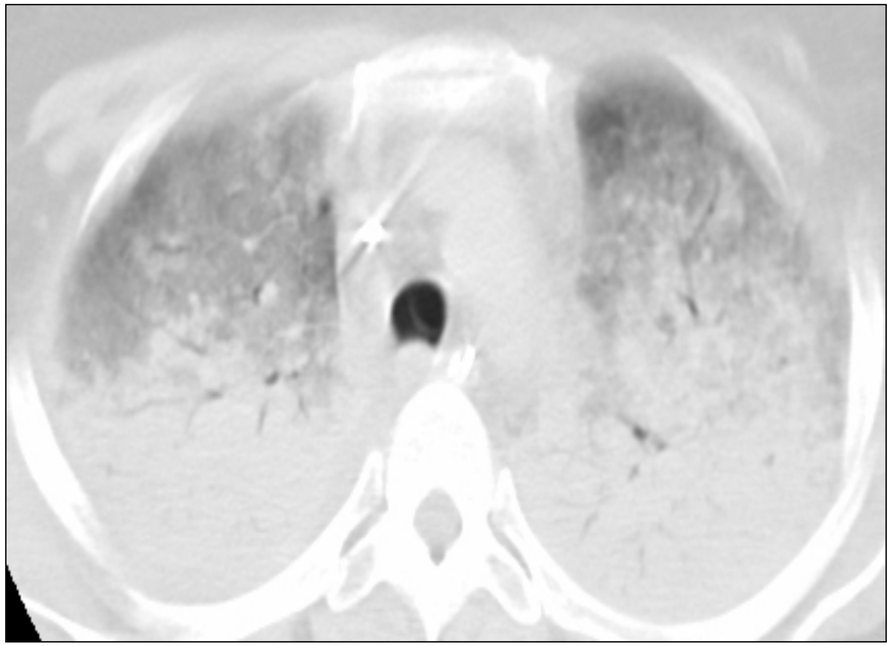


Pression contrôlée
ou
Volume contrôlé ?


1
2
3
4
PRESSURE
FLOW
0

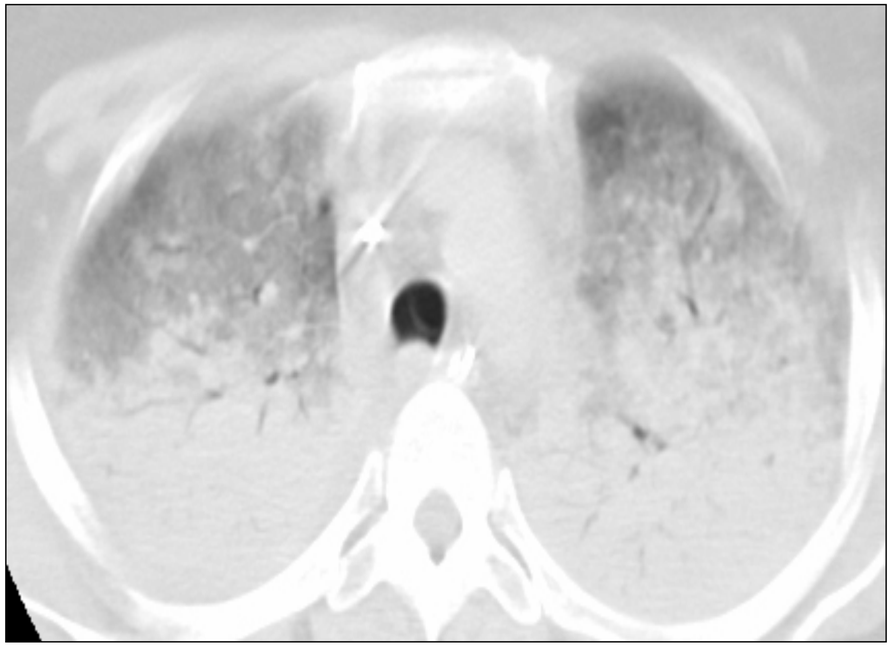
Si fistule broncho-pleurale ?

PC / VS-Ai



Et si le patient devient …

inventilable !



Compliance < 10 ml/cmH_2O

Hémoptysie massive

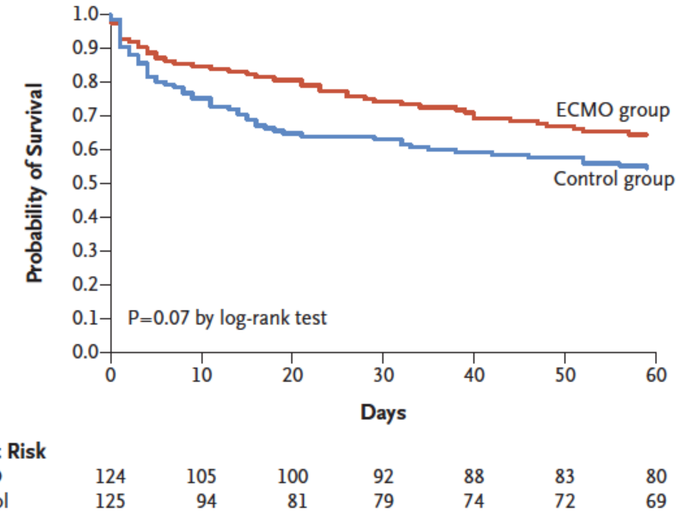
ECMO

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 24, 2018 VOL. 378 NO. 21

Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

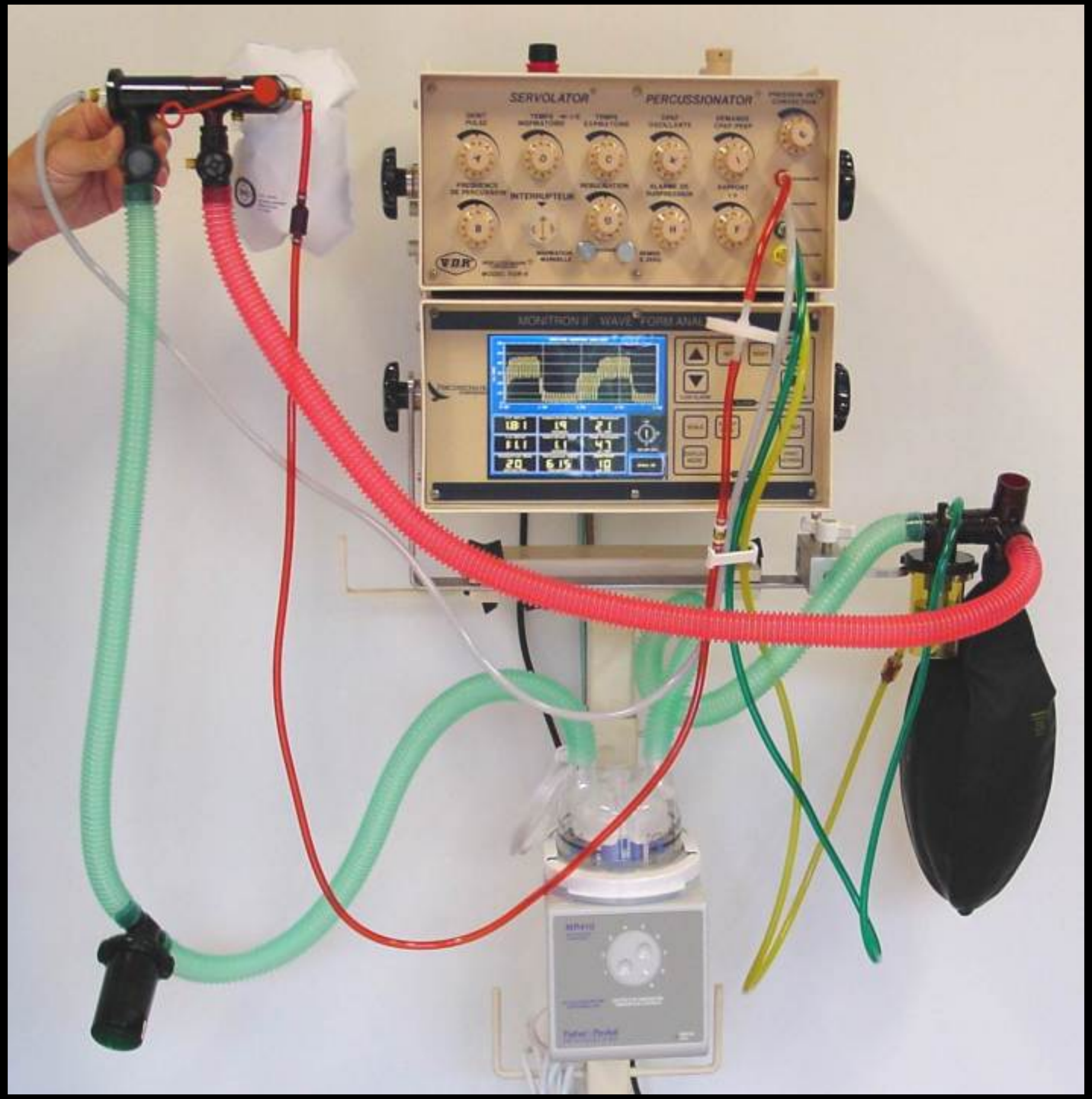
A. Combes, D. Hajage, G. Capellier, A. Demoule, S. Lavoué, C. Guervilly, D. Da Silva, L. Zafrani, P. Tirot, B. Veber, E. Maury, B. Levy, Y. Cohen, C. Richard, P. Kalfon, L. Bouadma, H. Mehdaoui, G. Beduneau, G. Lebreton, L. Brochard, N.D. Ferguson, E. Fan, A.S. Slutsky, D. Brodie, and A. Mercat, for the EOLIA Trial Group, REVA, and ECMONet*



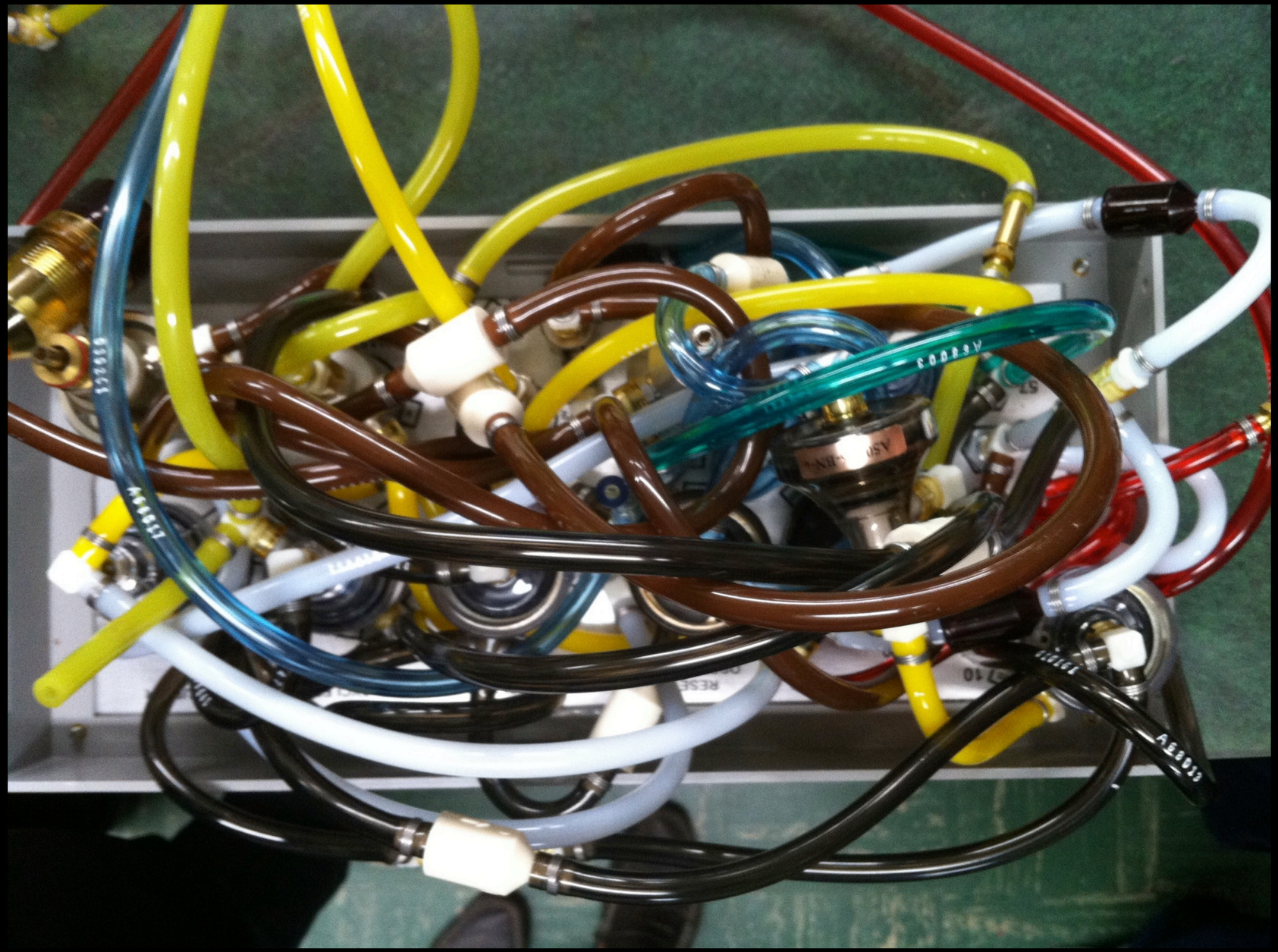
End Point	ECMO Group (N=124)	Control Group (N=125)	Relative Risk or Difference (95% CI)†	P Value
Primary end point: mortality at 60 days — no. (%)	44 (35)	57 (46)	0.76 (0.55 to 1.04)	0.09
Key secondary end point: treatment failure at 60 days — no. (%)‡	44 (35)	72 (58)	0.62 (0.47 to 0.82)	<0.001
Other end points				
Mortality at 90 days — no. (%)	46 (37)	59 (47)	−10 (−22 to 2)	
Median length of stay (interquartile range) — days				
In the ICU	23 (13–34)	18 (8–33)	5 (−1 to 10)	
In the hospital	36 (19–48)	18 (5–43)	18 (6 to 25)	
Median days free from mechanical ventilation (interquartile range)§	23 (0–40)	3 (0–36)	20 (−5 to 32)	
Median days free from vasopressor use (interquartile range)§	49 (0–56)	40 (0–53)	9 (0 to 51)	
Median days free from renal-replacement therapy (interquartile range)§	50 (0–60)	32 (0–57)	18 (0 to 51)	
Prone position — no. (%)¶	82 (66)	113 (90)	−24 (−34 to −14)	
Recruitment maneuvers — no. (%)¶	27 (22)	54 (43)	−21 (−32 to −10)	
Inhaled nitric oxide or prostacyclin — no. (%)¶	75 (60)	104 (83)	−23 (−33 to −12)	
Glucocorticoids — no. (%)¶	80 (65)	82 (66)	−1 (−13 to 11)	

Qui utilise l’ECMO ?

High frequency percussive ventilation ?


SERVOLATOR
PERCUSSIONATOR
INTERRUPTEUR


PULSATILE FLOWRATE
INCREASE
INSPIRATORY TIME
I/E
EXPIRATORY TIME
OSCILLATORY CPAP/PEEP
DEMAND CPAP/PEEP
MANUAL INSP.
PUSH
MODEL VDR-4



Inspiratory time (I)

Low frequency : expiratory time(E)

PEEP

PEEP on demand

<u>Flow</u>

second inspiration

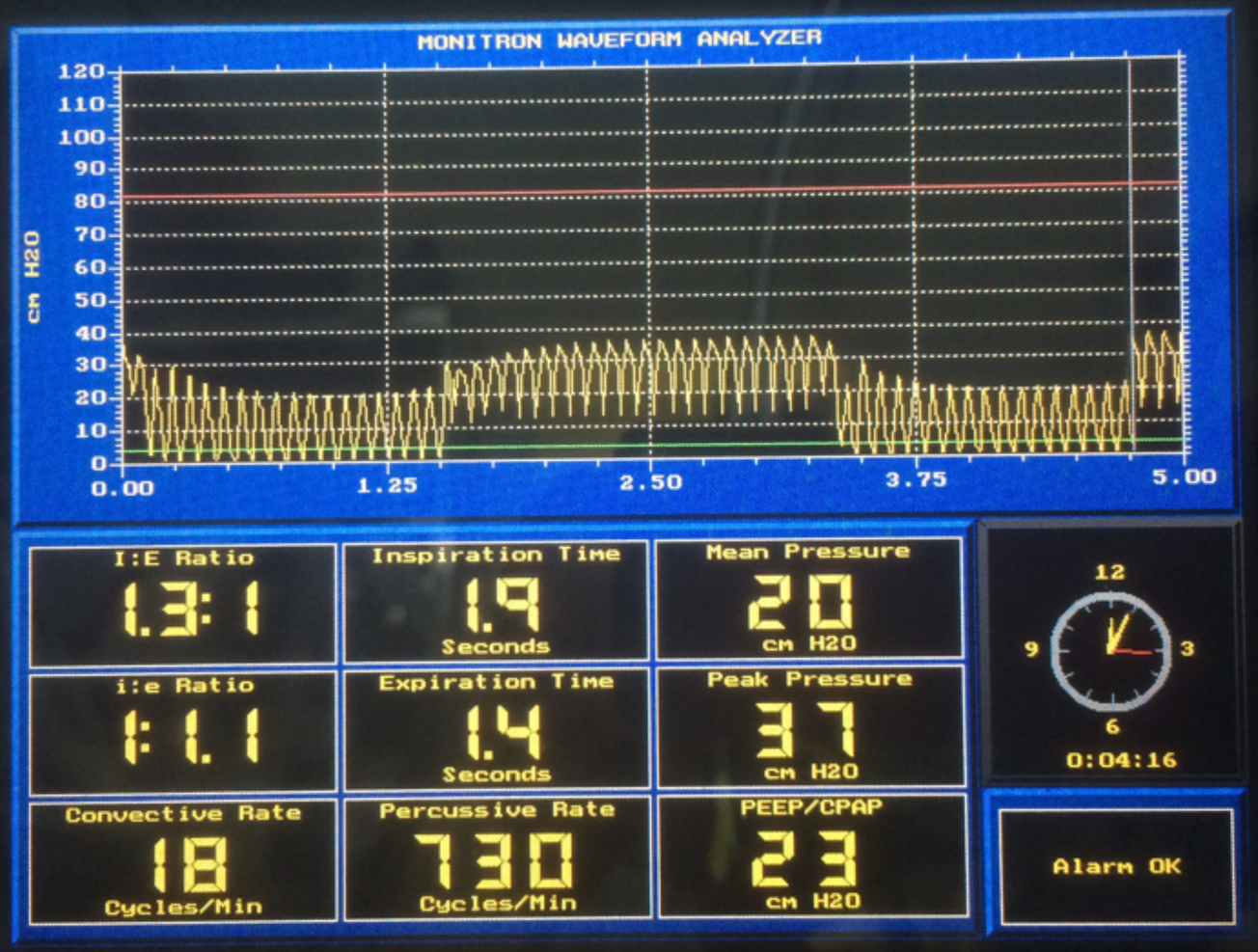
Connections

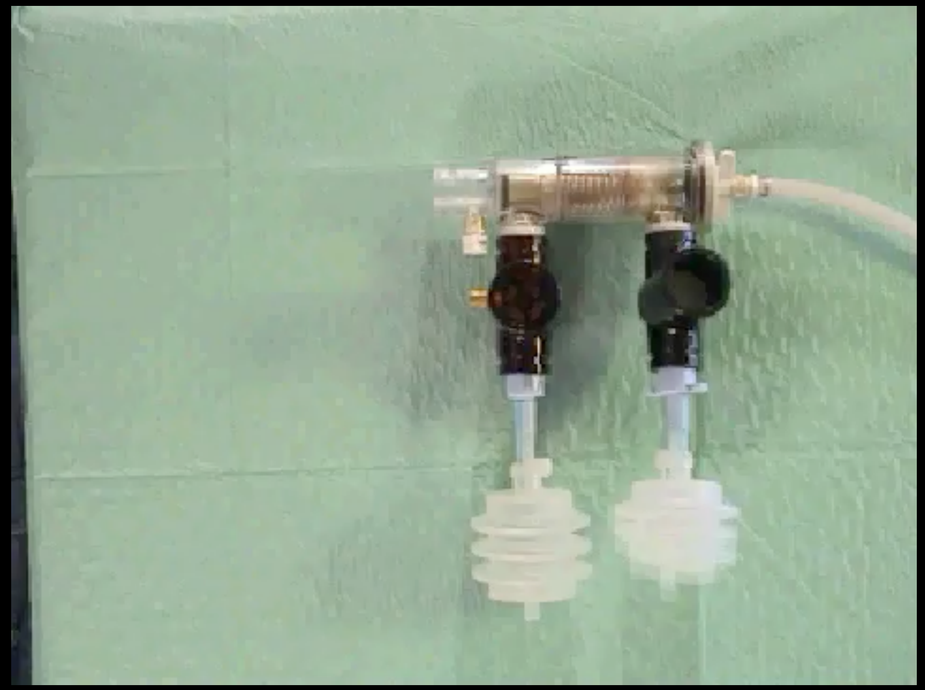
On/Off

on/off Nébulisation

High frequency rate :

I/E High frequency


MONITRON WAVEFORM ANALYZER
cm H2O
120
110
100
90
80
70
60
50
40
30
20
10
0
0.00
1.25
2.50
3.75
5.00
I:E Ratio
1.3:1
Inspiration Time
1.9
Seconds
Mean Pressure
20
cm H2O
i:e Ratio
1:1.1
Expiration Time
1.4
Seconds
Peak Pressure
37
cm H2O
Convective Rate
18
Cycles/Min
Percussive Rate
730
Cycles/Min
PEEP/CPAP
23
cm H2O
12
9
3
6
0:04:16
Alarm OK



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Respiratory Physiology & Neurobiology 142 (2004) 81–91
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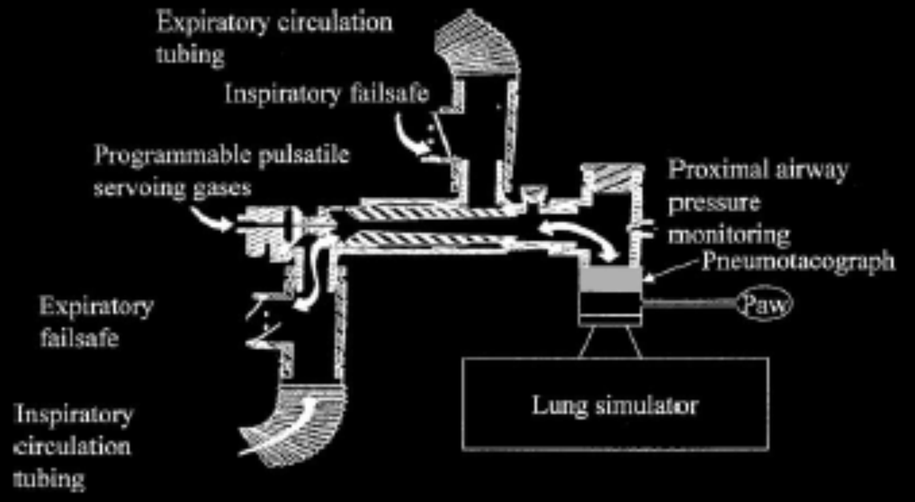
Effects of mechanical load on flow, volume and pressure delivered by high-frequency percussive ventilation☆

U. Lucangelo [a,*], V. Antonaglia [a], W.A. Zin [b], L. Fontanesi [a], A. Peratoner [a], F.M. Bird [c], A. Gullo [a]

[a] Department of Perioperative Medicine, Intensive Care and Emergency, Cattinara Hospital, Trieste University School of Medicine, Strada di Fiume 447, I-34139 Trieste, Italy
[b] Carlos Chagas Filho Institute of Biophysics, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
[c] Bird Institute of Biomedical Technology, Sandpoint, Idaho, USA

Accepted 14 April 2004



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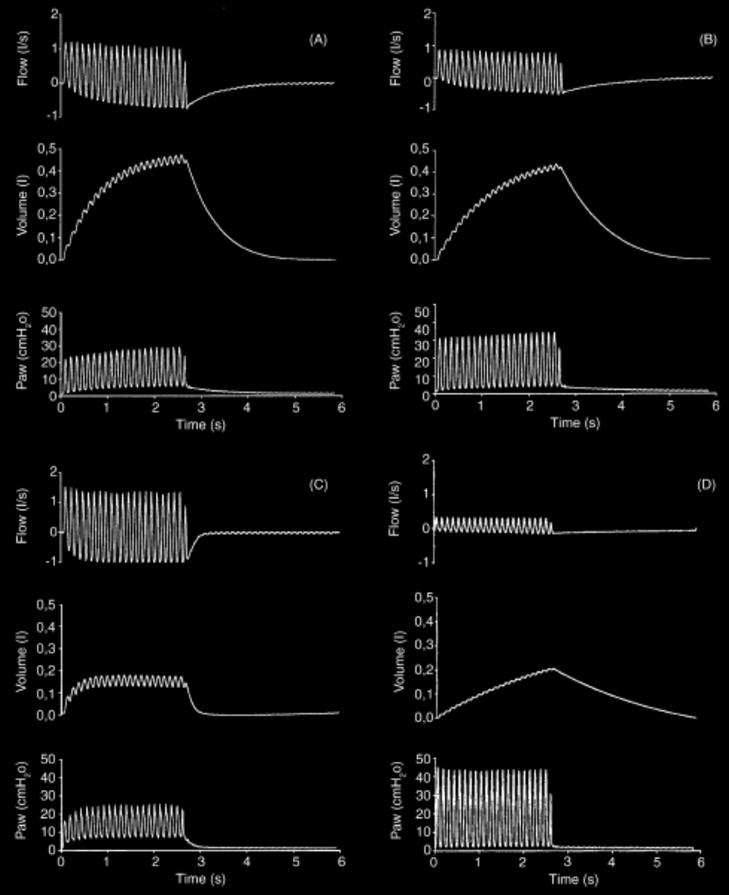
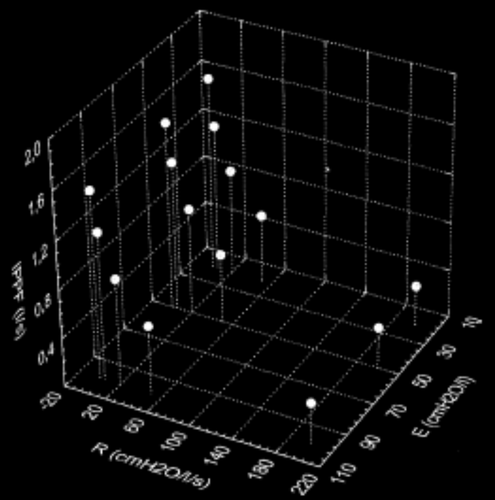


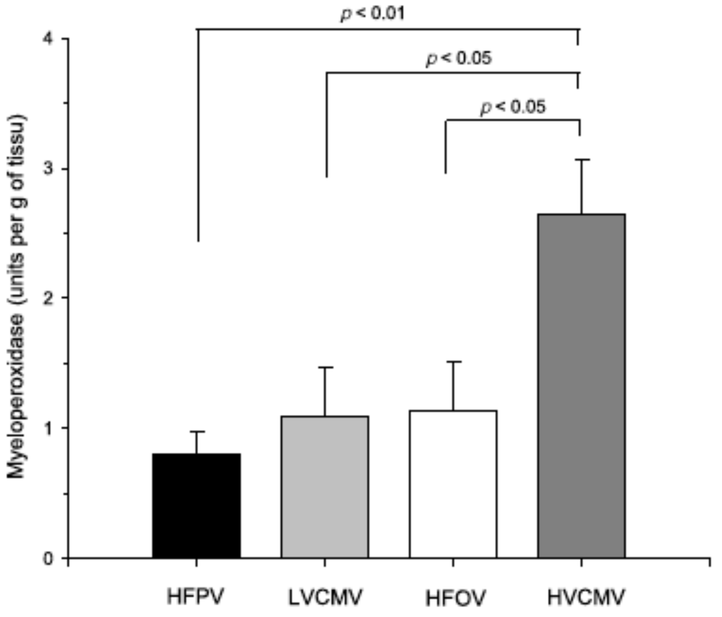


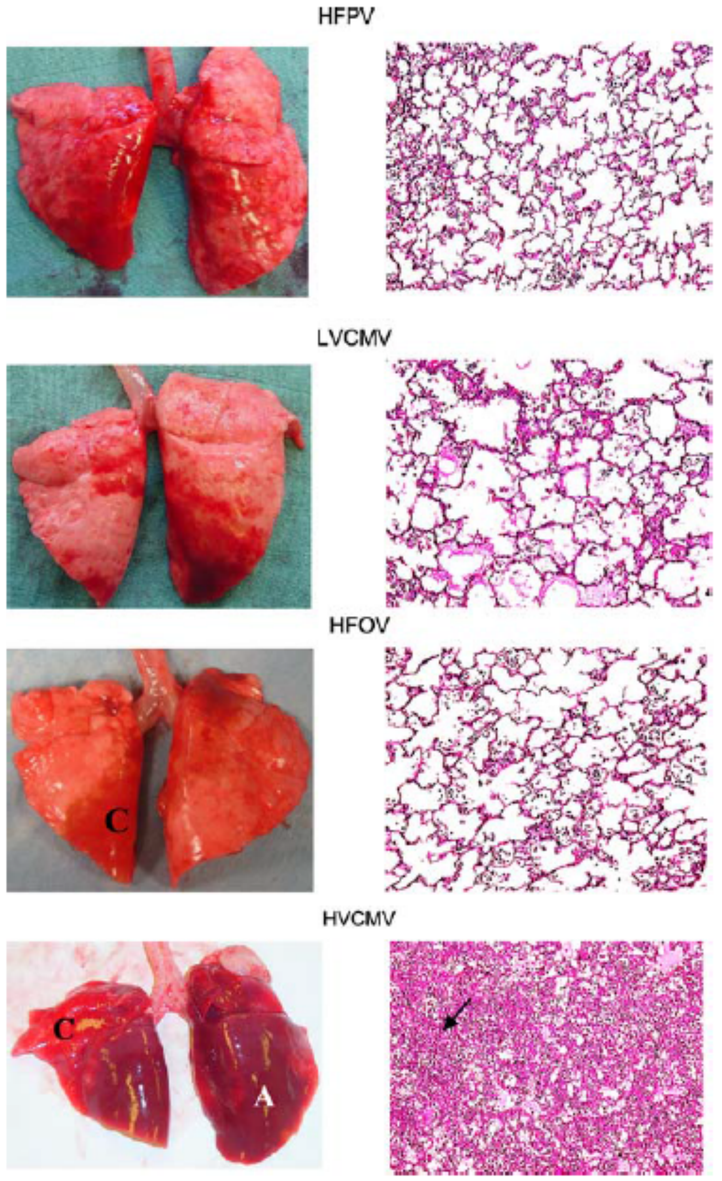
Intensive Care Med (2008) 34:91–100
DOI 10.1007/s00134-007-0848-z

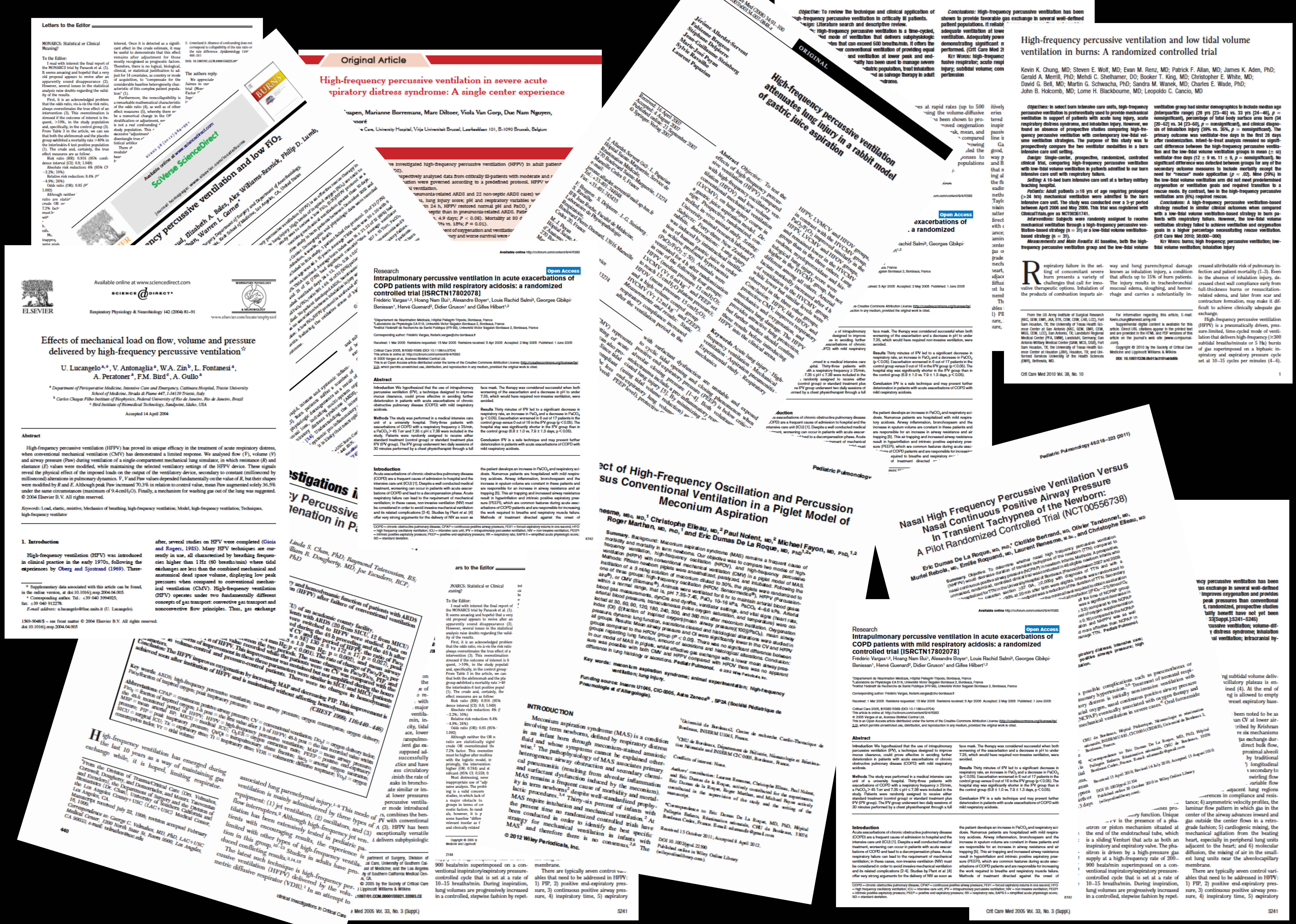
ORIGINAL

Jérôme Allardet-Servent
Fabienne Bregeon
Stéphane Delpierre
Jean-Guillaume Steinberg
Marie-José Payan
Sylvie Ravailhe
Laurent Papazian

High-frequency percussive ventilation attenuates lung injury in a rabbit model of gastric juice aspiration







Effects of mechanical load on flow, volume and pressure delivered by high-frequency percussive ventilation
Intrapulmonary percussive ventilation in acute exacerbations of COPD patients with mild respiratory acidosis: a randomized controlled trial [ISRCTN17802078]
High-frequency percussive ventilation and low tidal volume ventilation in burns: A randomized controlled trial
High-frequency percussive ventilation in severe acute respiratory distress syndrome: A single center experience
High-frequency percussive ventilation attenuates lung injury in a rabbit model of gastric juice aspiration
Nasal High Frequency Percussive Ventilation Versus Nasal Continuous Positive Airway Pressure in Transient Tachypnea of the Newborn: A Pilot Randomized Controlled Trial (NCT00556738)

High-frequency percussive ventilation and low tidal volume ventilation in burns: A randomized controlled trial

Crit Care Med 2010 Vol. 38, No. 10

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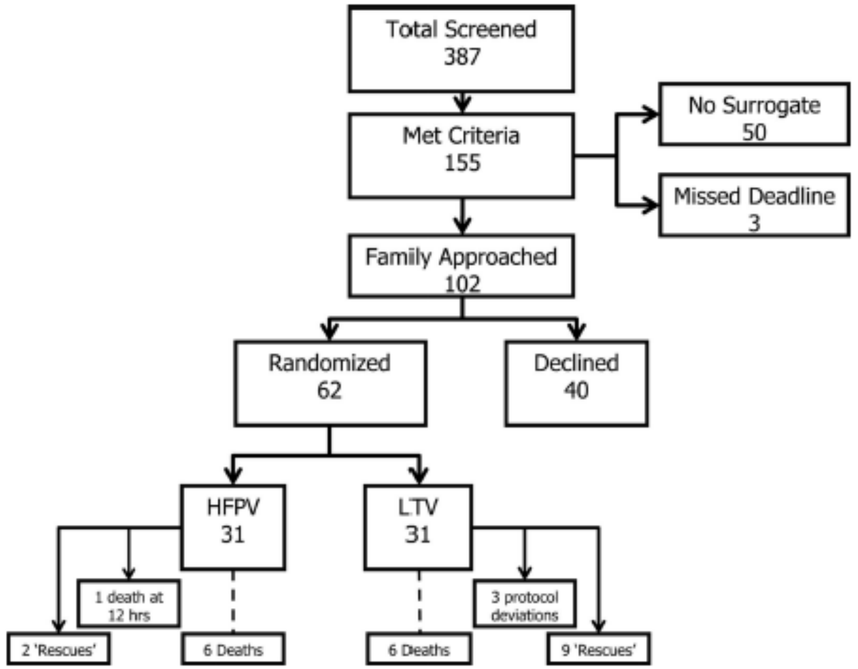

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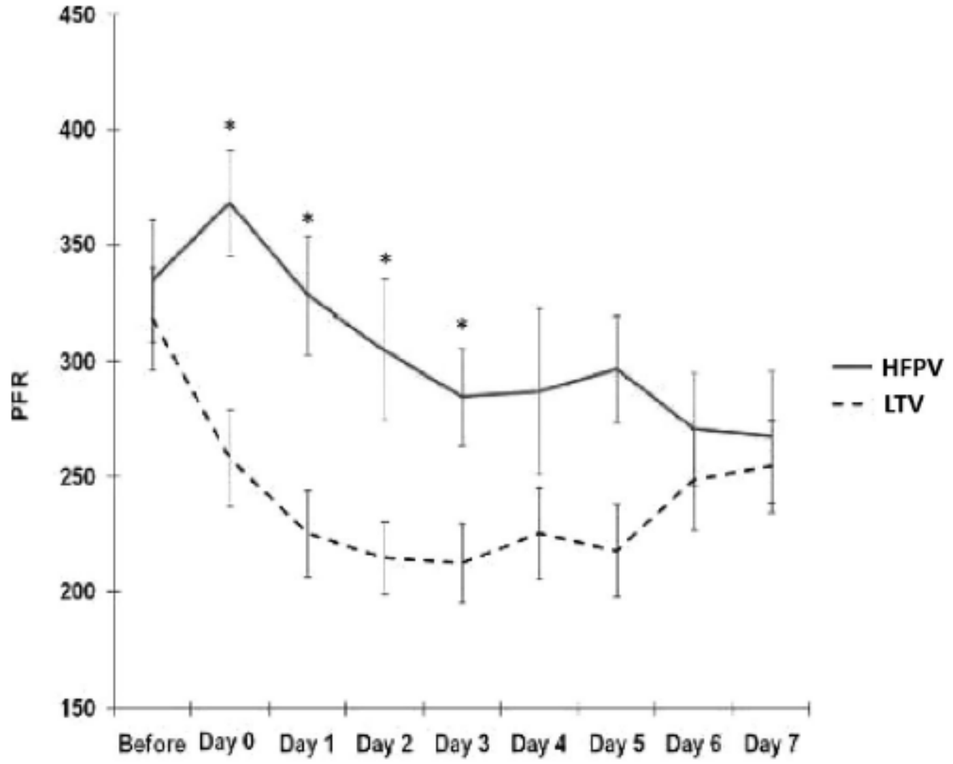
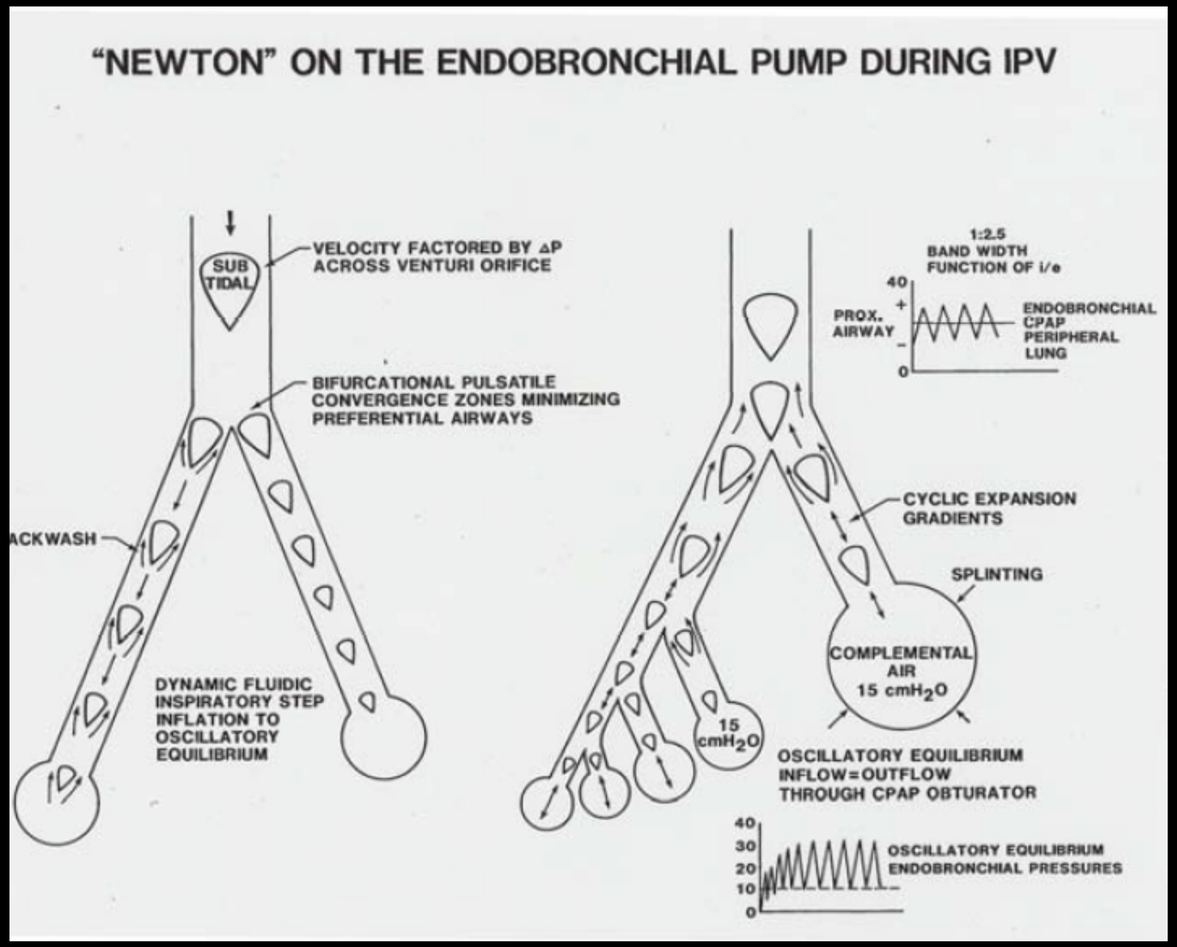
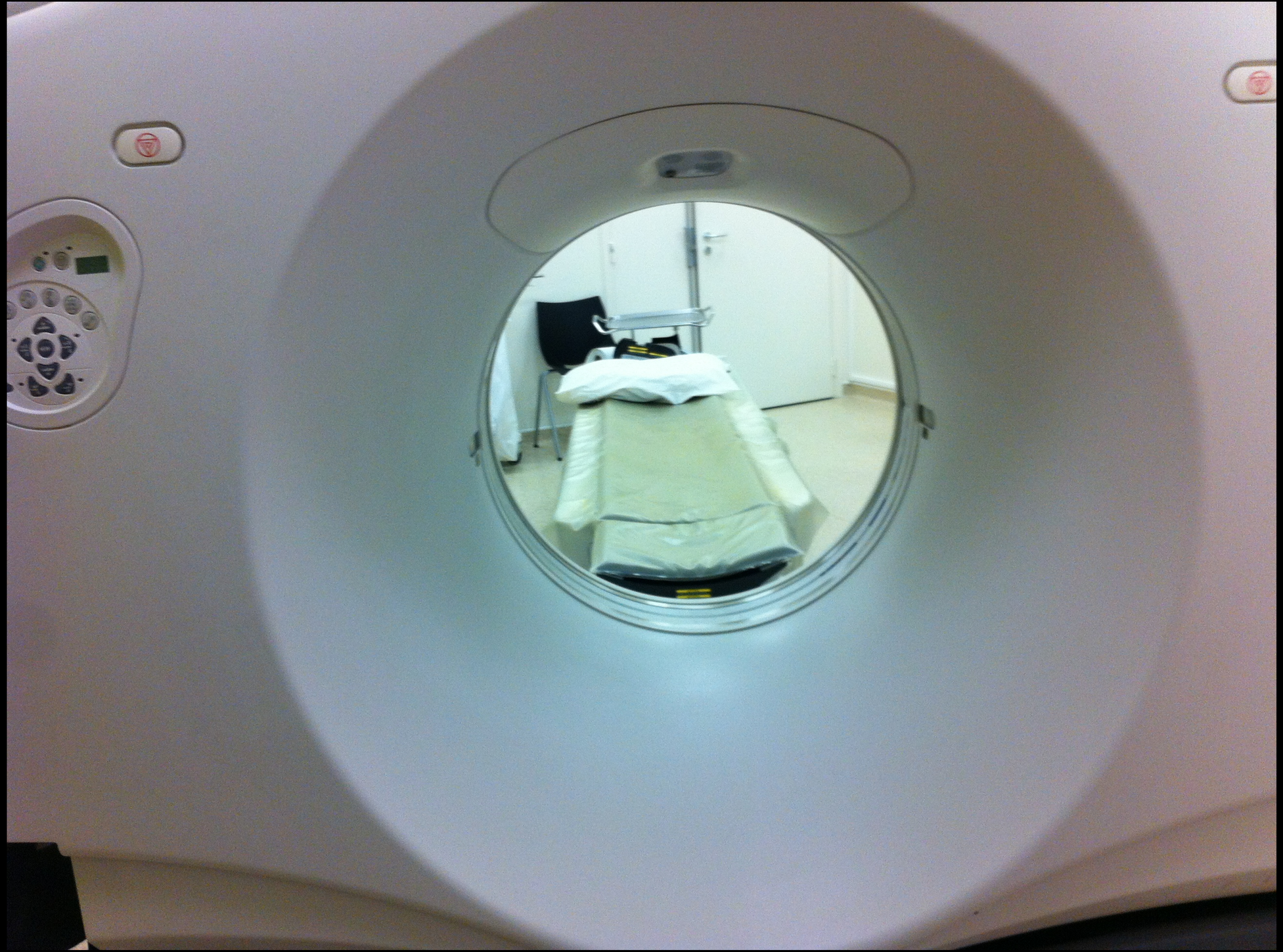
	HFPV (n = 31)	LTV (n = 31)	*p*
Ventilator-free days[a]	129	119	NS
Days free from nonpulmonary organ failure[a]	1511	1510	NS
Death, no. (%)	6 (19)	6 (19)	NS
Rescue, no. (%)	2 (6)	9 (29)	.02
VAP, no. (%)	10 (32)	16 (52)	NS
VATB, no. (%)	2 (6)	0	NS
Barotrauma, no. (%)	0 (0)	4 (13)	.04



"NEWTON" ON THE ENDOBRONCHIAL PUMP DURING IPV





Godet et al. Critical Care (2018) 22:3
DOI 10.1186/s13054-017-1924-6

Critical Care

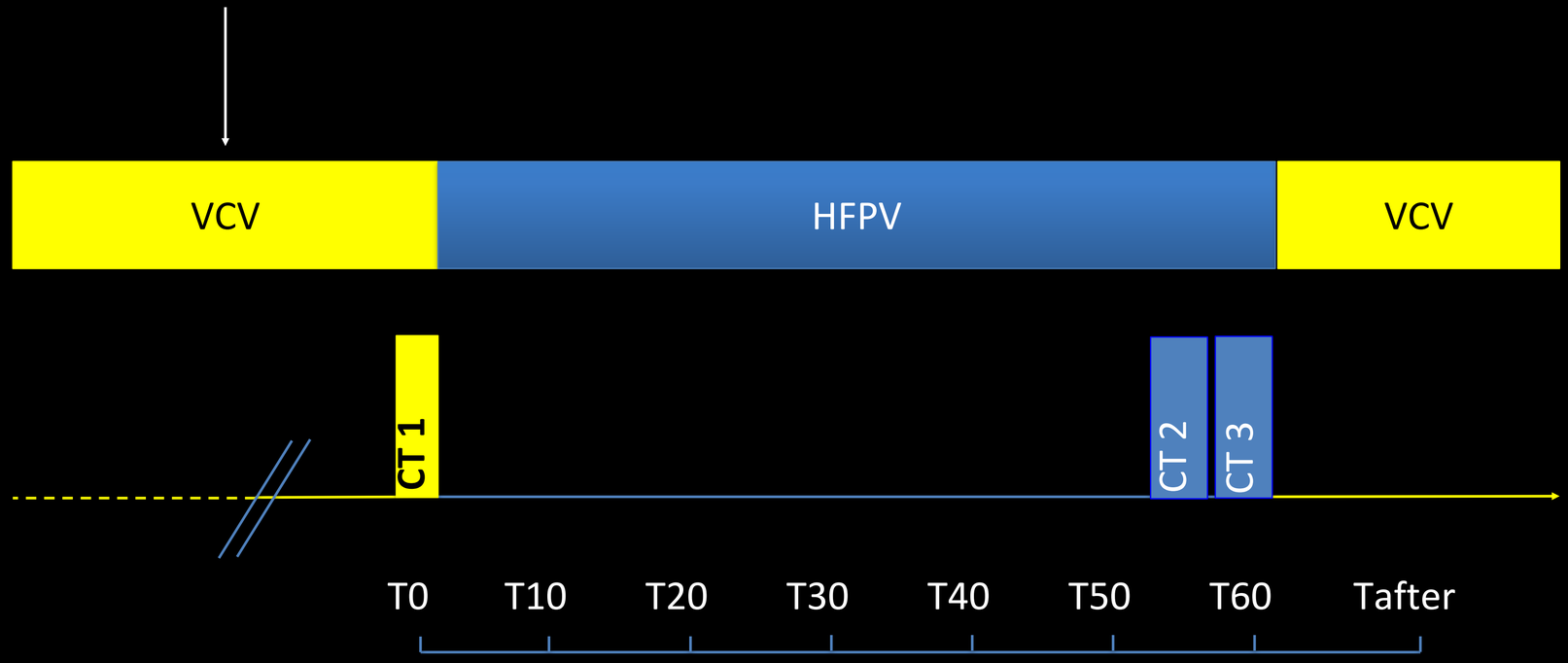
RESEARCH Open Access

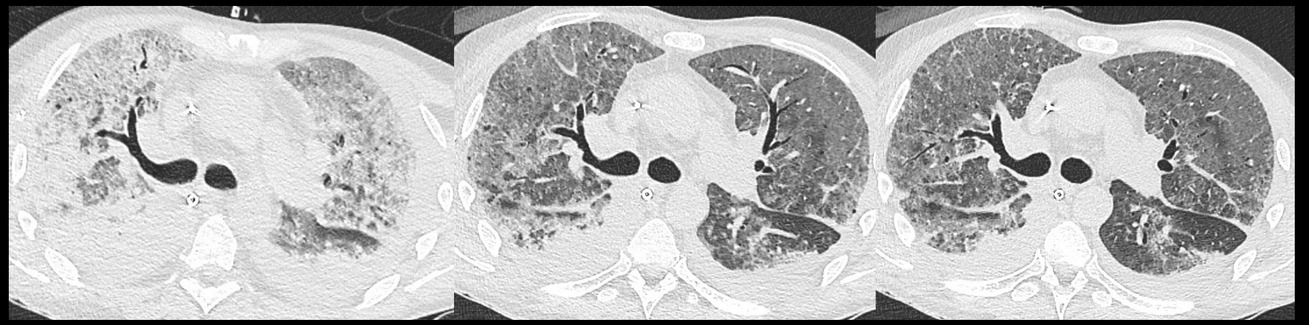
High frequency percussive ventilation increases alveolar recruitment in early acute respiratory distress syndrome: an experimental, physiological and CT scan study

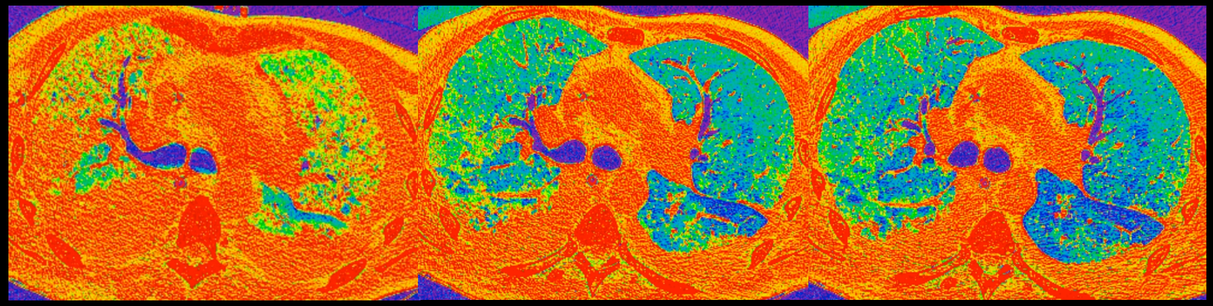
Thomas Godet[1,2], Matthieu Jabaudon[1,2], Raïko Blondonnet[1,2], Aymeric Tremblay[3], Jules Audard[1,2], Benjamin Rieu[1], Bruno Pereira[4], Jean-Marc Garcier[5], Emmanuel Futier[1,2] and Jean-Michel Constantin[1,2*]

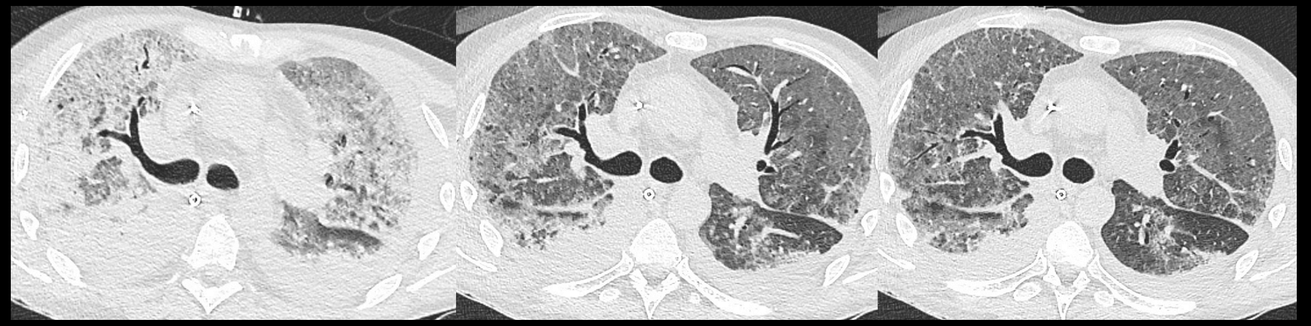
Patient number	Etiology	Comorbidity	IBW (kg)	ARDS onset (h)	FiO_2 (%)	PaO_2/FiO_2 (mmHg)	PEEP (cmH2O)	Tidal volume (mL/kg IBW)	Compliance ($mL.cmH_2O^{-1}$)	Pplat (cmH2O)	ARDS phenotype
1	Infectious Pneumonia	Acute leukemia	63	18	50	154	8	7.6	20	33	NF
2	Infectious Pneumonia	Myelofibrosis	70	6	100	127	16	5.9	25	33	NF
3	Infectious Pneumonia	Acute leukemia	55	24	70	109	18	5.8	21	33	NF
4	Infectious Pneumonia		47	4	100	75	12	5.7	13	28	NF
5	Infectious Pneumonia	Acute leukemia	54	10	60	145	13	6.3	18	31	NF
6	Aspiration	Cardiac arrest	73	4	100	50	12	5 .8	17	30	NF
7	Aspiration	Gastrectomy	77	12	100	80	18	5.5	20	28	NF
8	Viral pneumonia		64	6	70	113	20	7.4	18	32	NF
Median			63.5	8.0	85	111	14.5	5.9	19.0	31.5	
IQR			(55.0–70.8)	(5.5–13.5)	(68–100)	(79–132)	(12.0–18.0)	(5.8–6.6)	(17.8–20.3)	(29.5–33.0)	

VT 6mL/kg; PEEP Express after RM

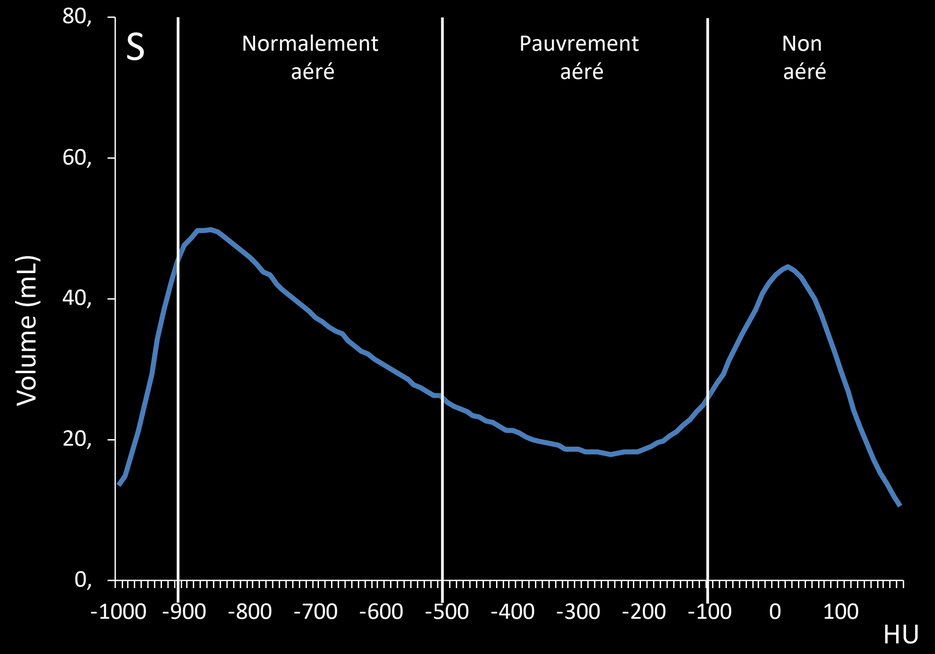




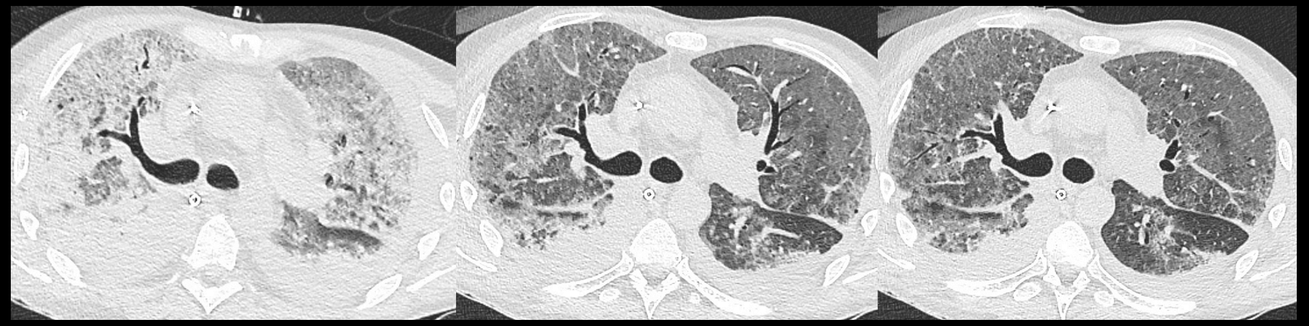




Non-focal



Ventilation conventionnelle optimisée



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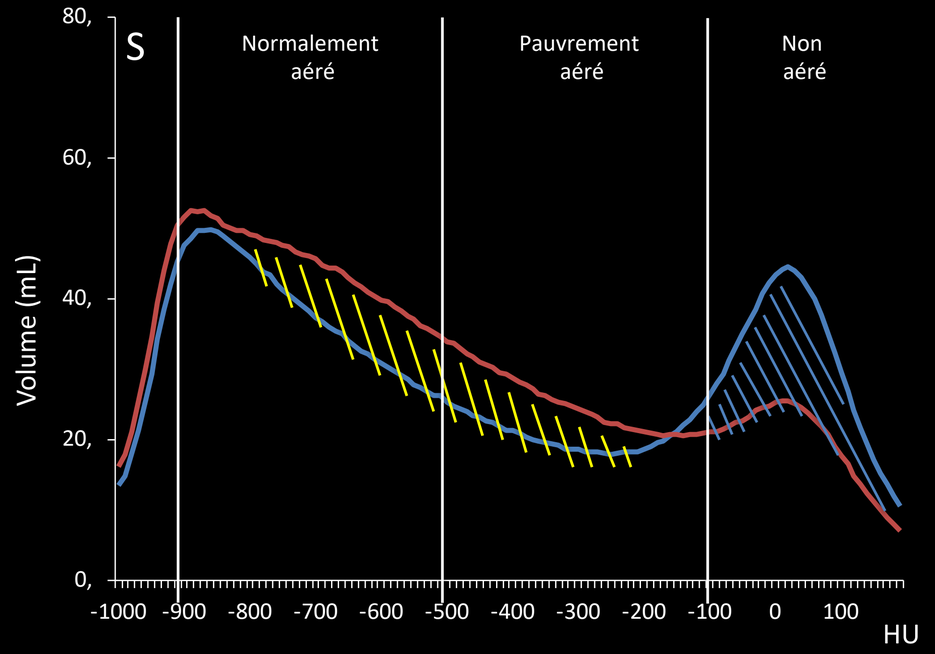
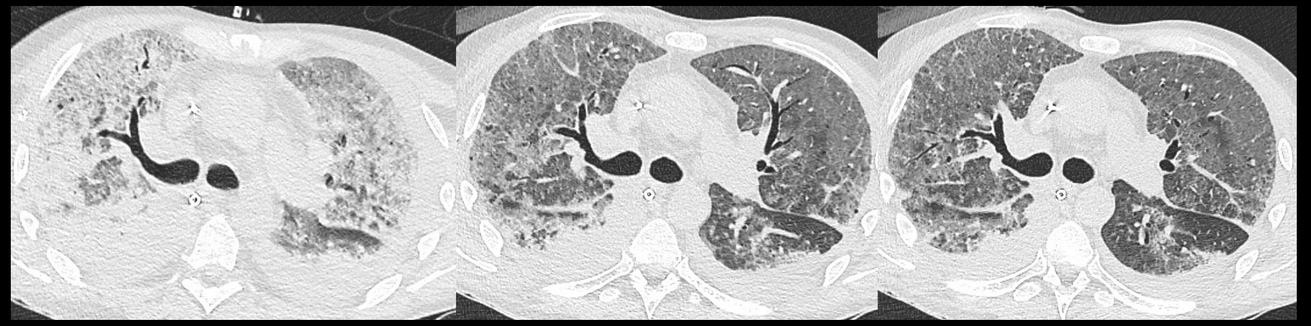


Ventilation conventionnelle optimisée

VPHF pause télé-expiratoire



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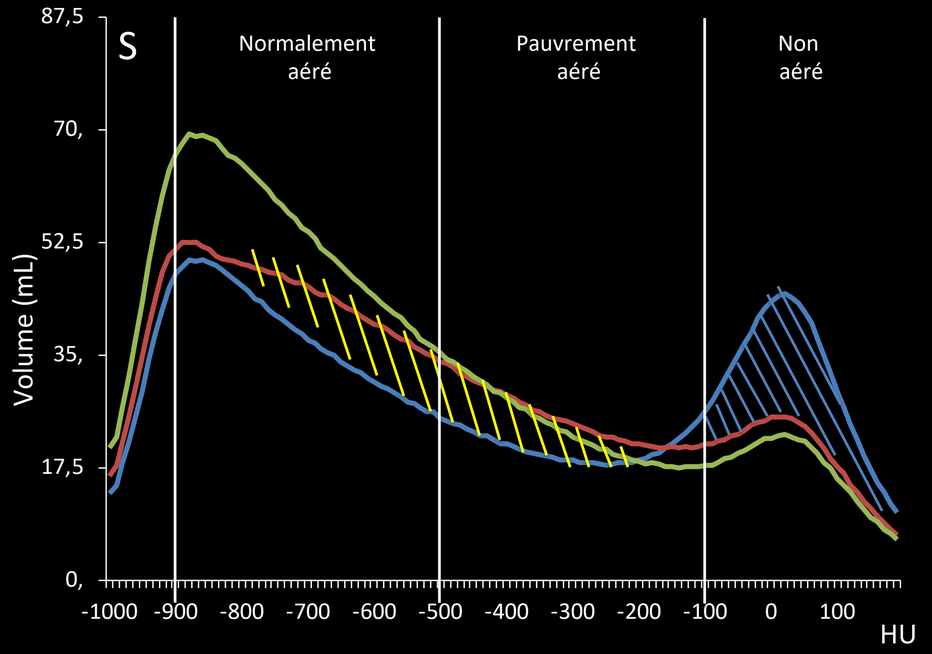
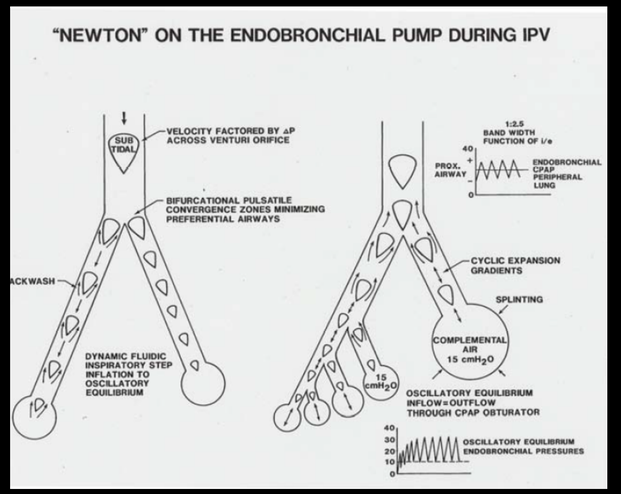
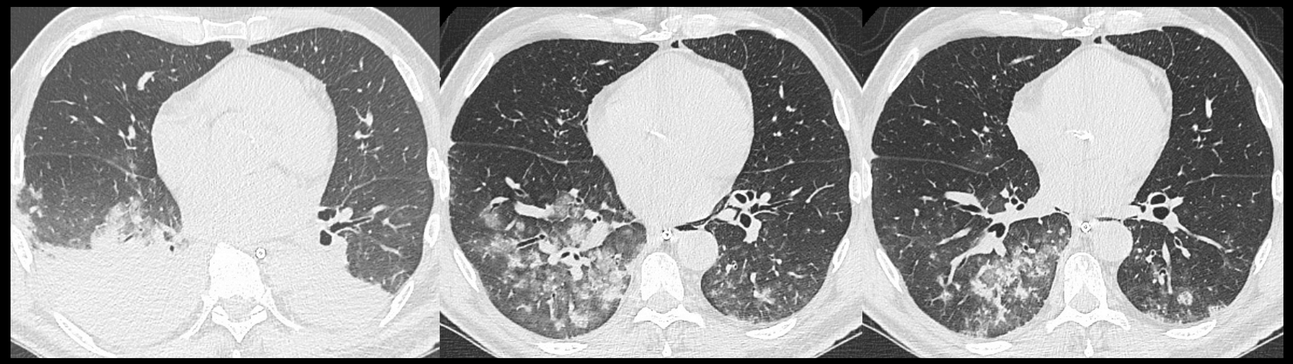


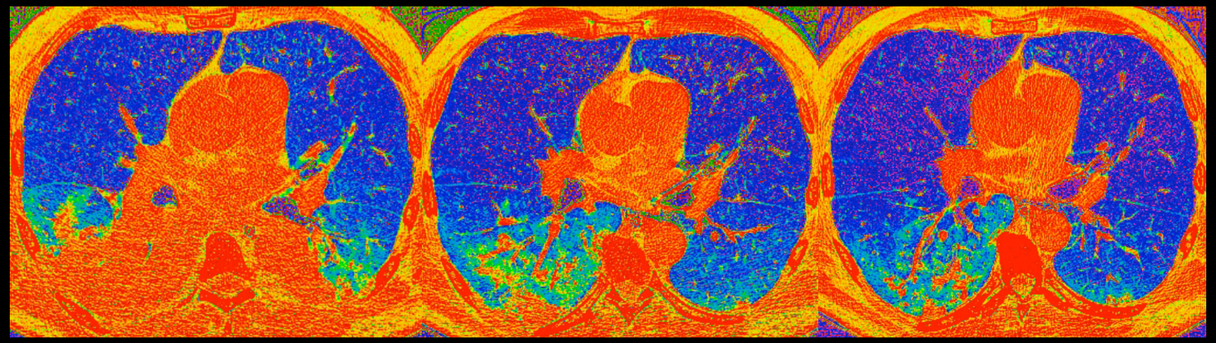


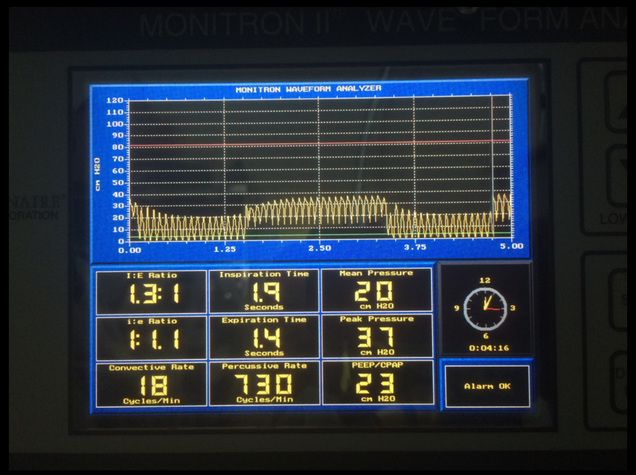
Ventilation conventionnelle optimisée

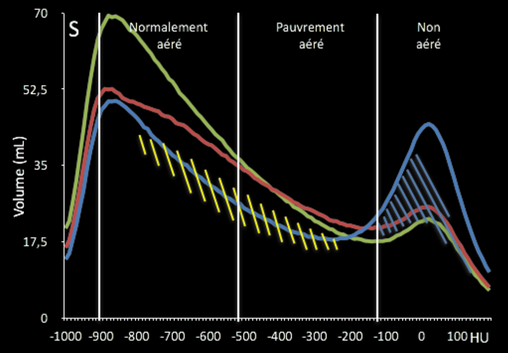
VPHF pause télé-expiratoire

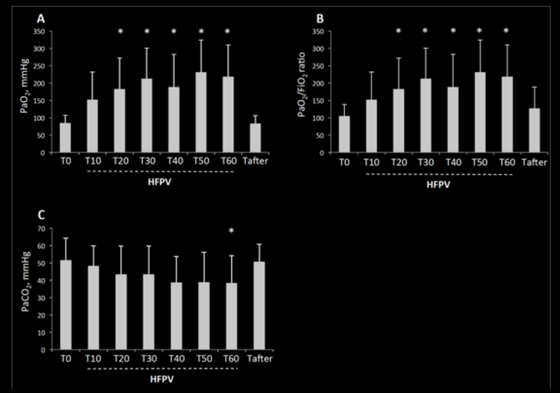
VPHF pause télé-inspiratoire

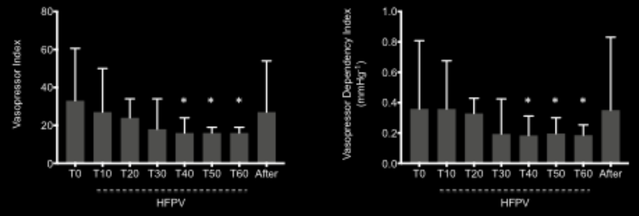





MONITRON WAVEFORM ANALYZER
cm H2O
I:E Ratio
1:3:1
Inspiration Time
1.9
Seconds
Mean Pressure
20
cm H2O
i:e Ratio
1:1.1
Expiration Time
1.4
Seconds
Peak Pressure
37
cm H2O
Convective Rate
18
Cycles/Min
Percussive Rate
730
Cycles/Min
PEEP/CPAP
23
cm H2O
0:04:16
Alarm OK


S
Normalement aéré
Pauvrement aéré
Non aéré
Volume (mL)
70
52,5
35
17,5
0
-1000 -900 -800 -700 -600 -500 -400 -300 -200 -100 0 100 HU


A
B
C
PaO2, mmHg
PaO2/FiO2 ratio
PaCO2, mmHg
T0 T10 T20 T30 T40 T50 T60 Tafter
HFPV

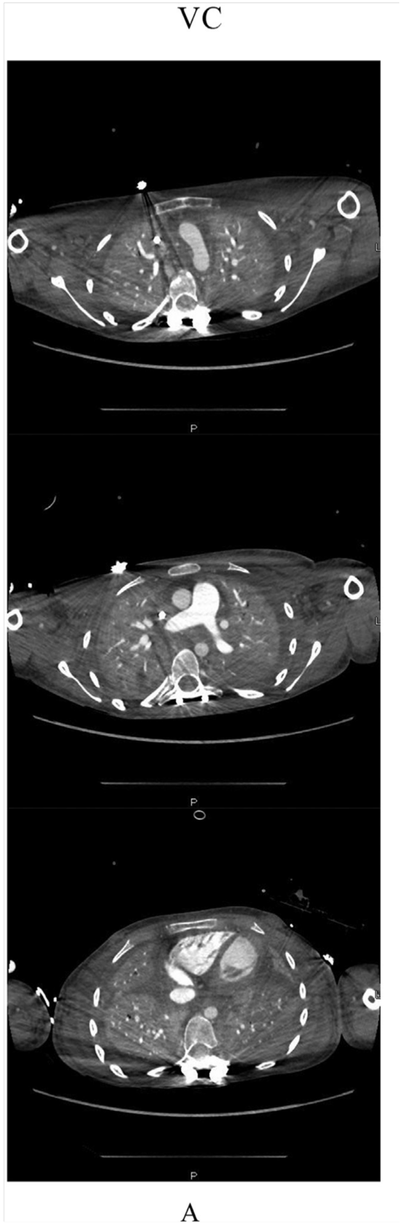

Vasopressor Index
Vasopressor Dependency Index (mmHg-1)
T0 T10 T20 T30 T40 T50 T60 After
HFPV

ELSEVIER
SFAR
Société Française d'Anesthésie et de Réanimation

Letter to the editor

High-frequency percussive ventilation as a rescue therapy for ARDS patients under ECMO: About a case

after, he developed severe ARDS ($PaO_2/FiO_2 < 100$ mmHg) with positive end-expiratory pressure (PEEP) of 10 cmH_2O. The administration of a neuromuscular blocking agent was started. Chest X-ray showed bilateral opacities. Plateau pressure was between 35 and 42 cmH_2O with tidal volume (TV) of 5.5 $mL.kg^{-1}$



Conclusion

ALR + VNI
Ventilation protectrice
Eviter le derecrutement
HFPV ?

Merci de votre attention ...