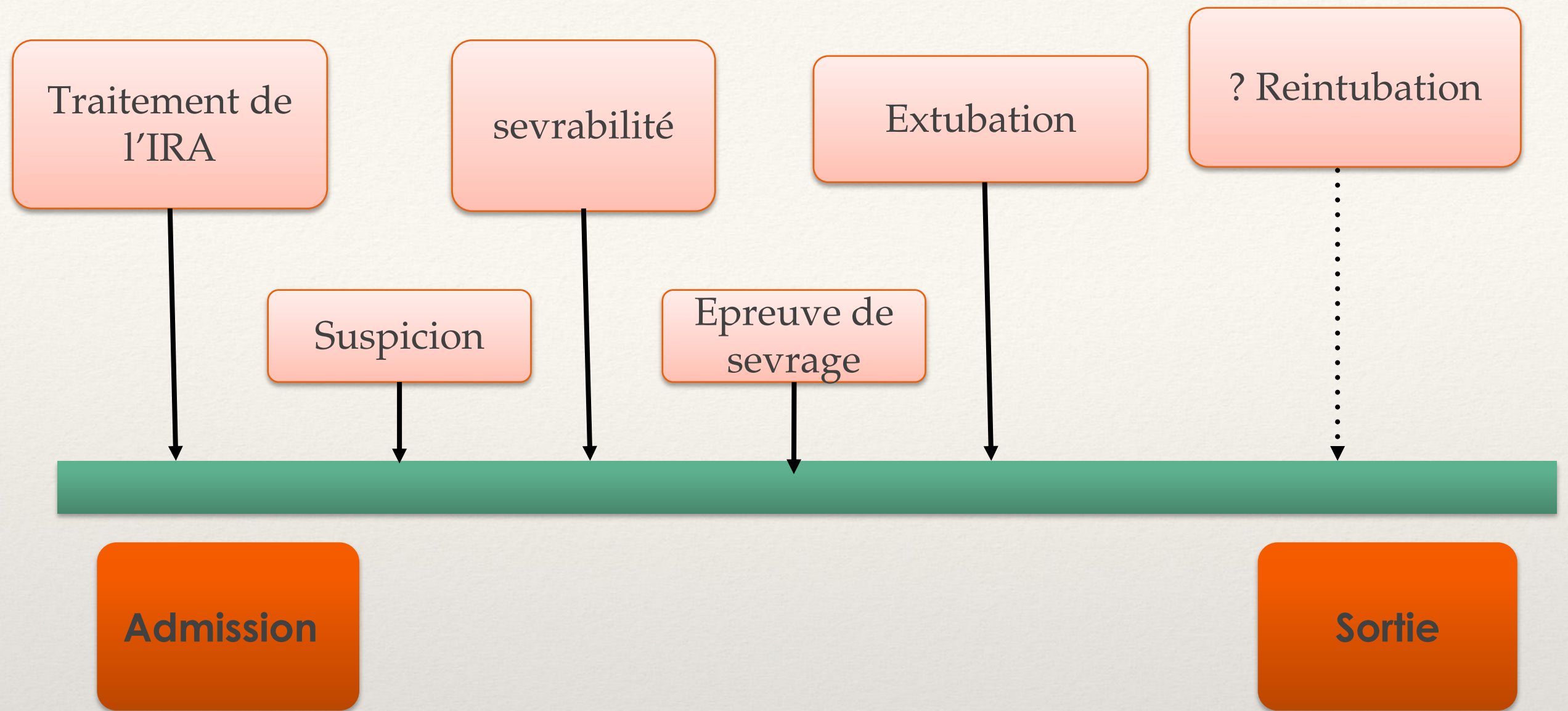
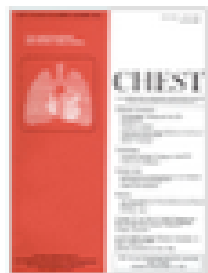




les échecs de sevrage d'origine cardiaque

Pr Souheil Elatrous



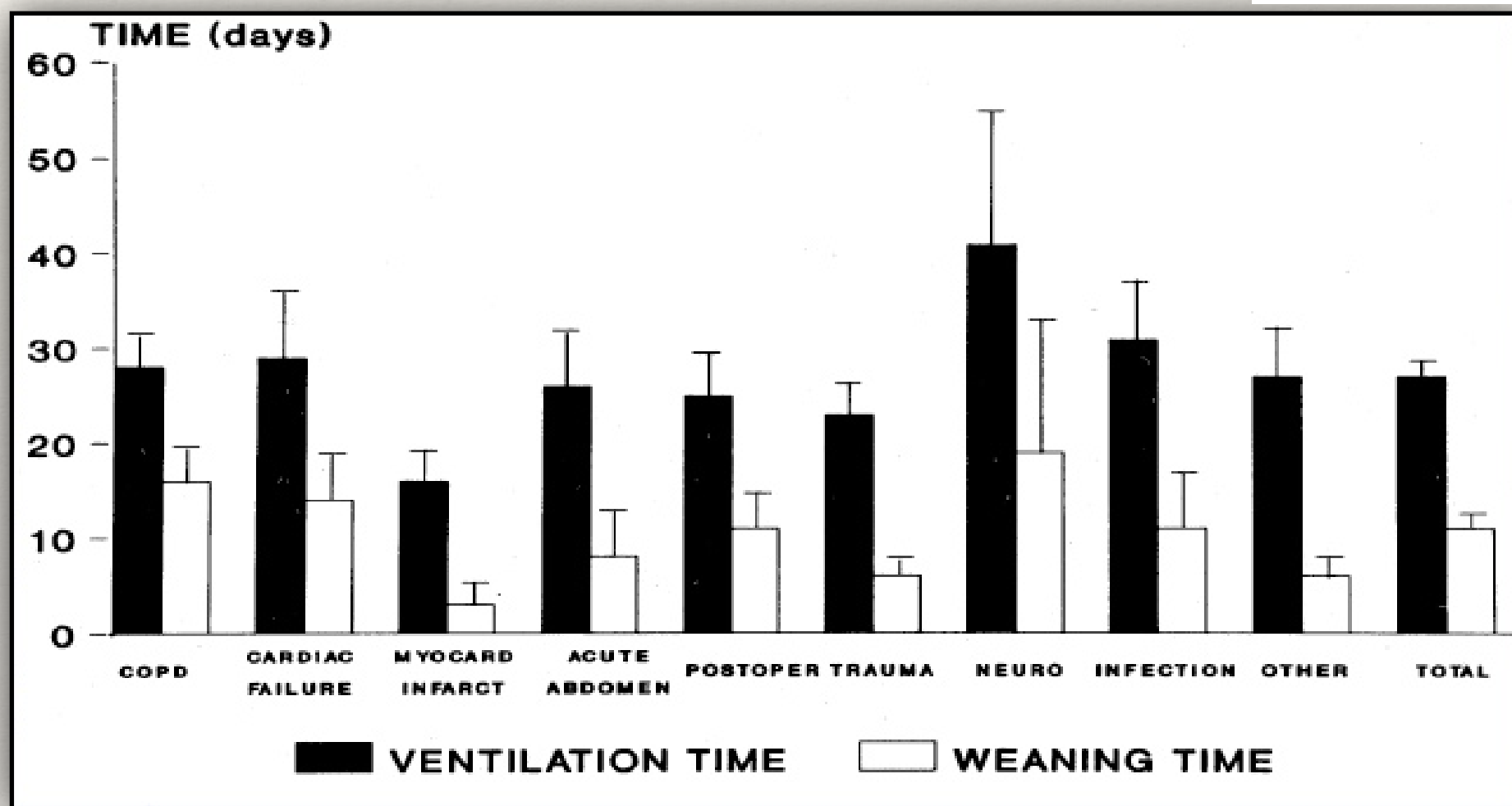


Modes of Mechanical Ventilation and Weaning*

A National Survey of Spanish Hospitals

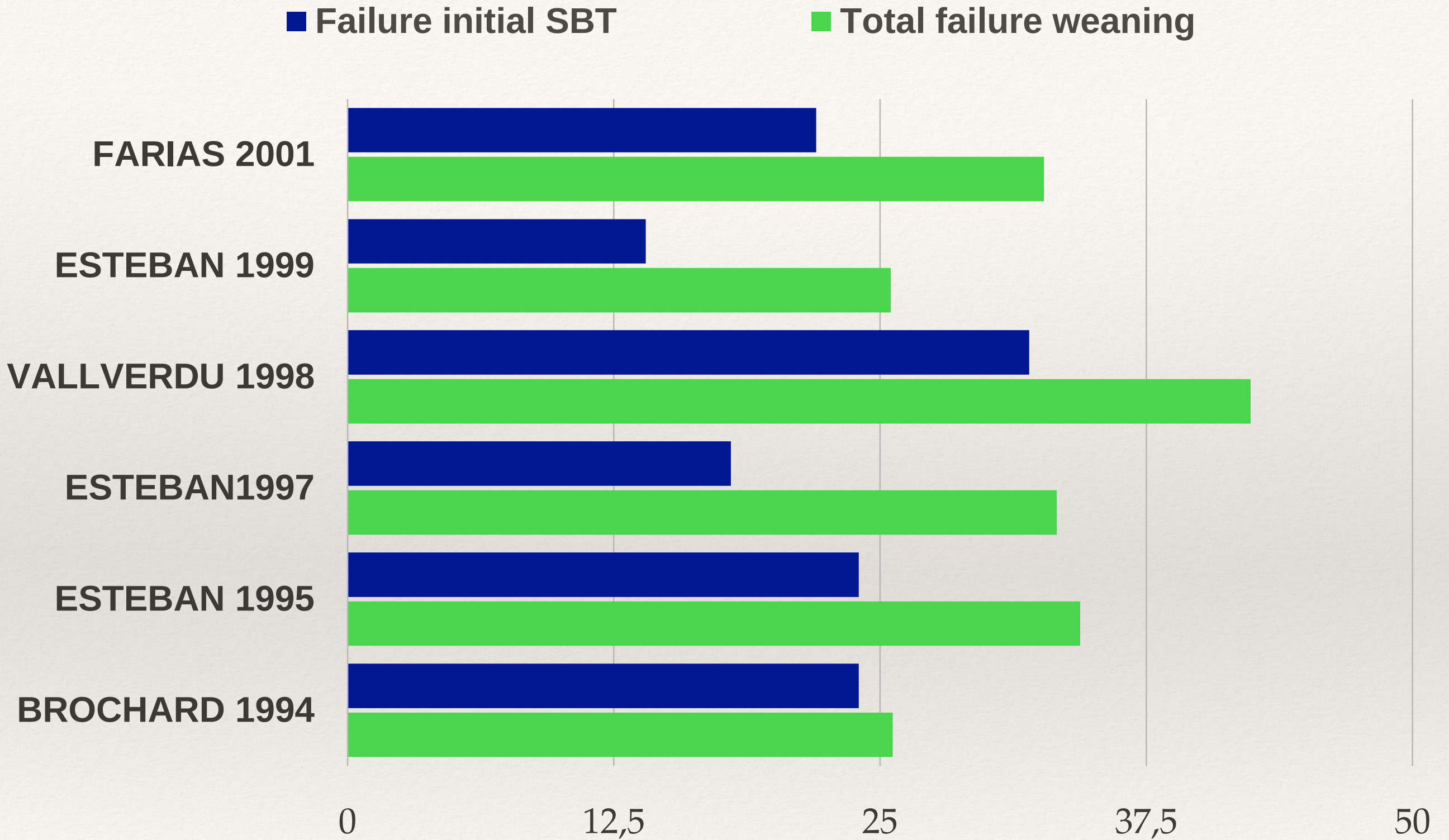
Andrés Esteban, MD, PhD; Inmaculada Alía, MD; Jordi Ibañez, MD; Salvador Benito, MD, PhD, FCCP; Martin J. Tobin, MD, FCCP; and the Spanish Lung Failure Collaborative Group†

(Chest 1994; 106:1188-93)



**Sevrage : 41 % de la durée totale de la ventilation
59 % chez le BPCO**

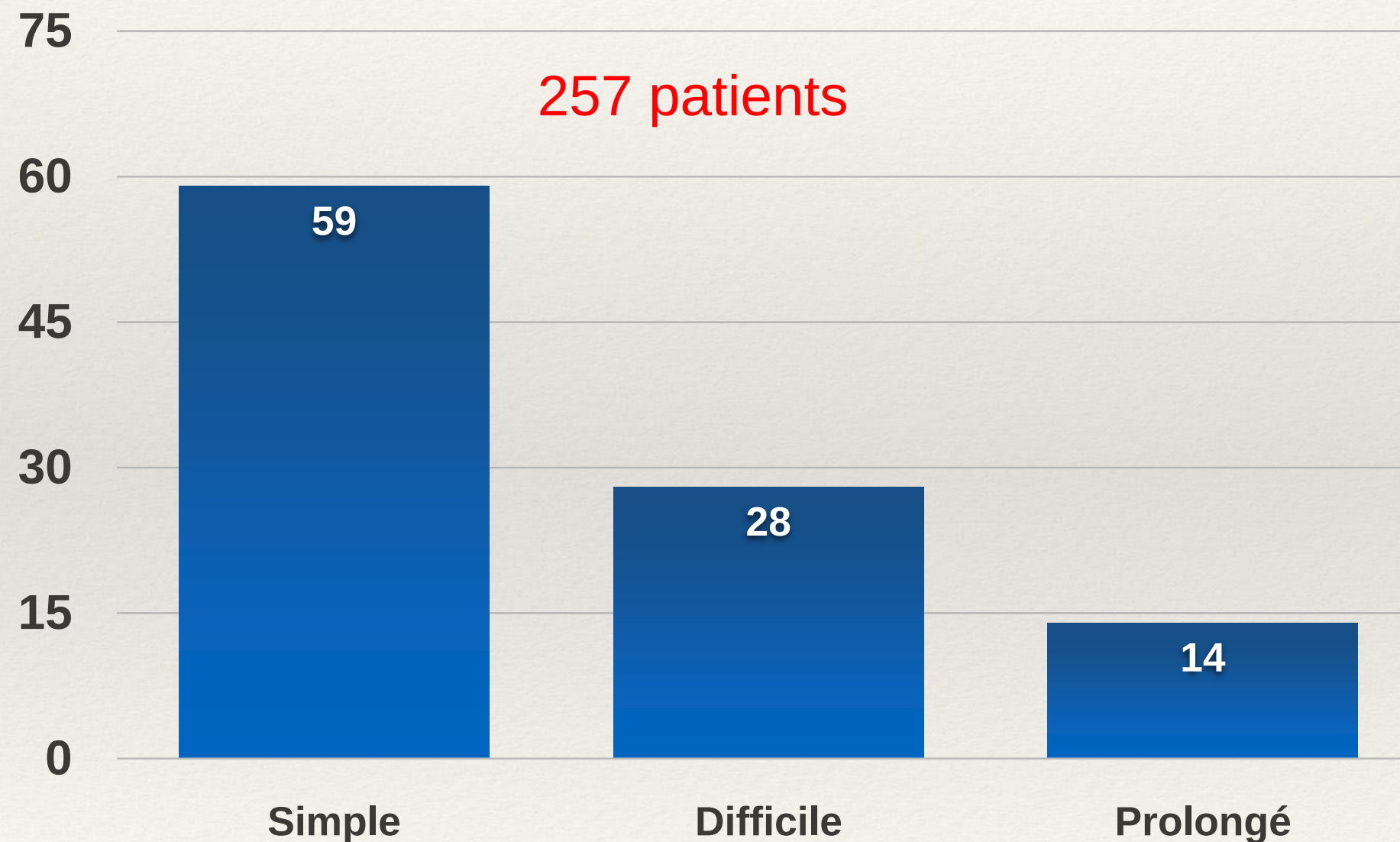
Incidence des échecs de sevrage





Incidence and outcome of weaning from mechanical ventilation according to new categories

G-C. Funk*, **S. Anders***, **M-K. Breyer***, **O.C. Burghuber***, **G. Edelmann***, **W. Heindl***,
G. Hinterholzer[†], **R. Kohansal***, **R. Schuster⁺**, **A. Schwarzmaier-D'Assie[§]**,
A. Valentin[§] and **S. Hartl***



Epidemiology of weaning outcome according to a new definition.

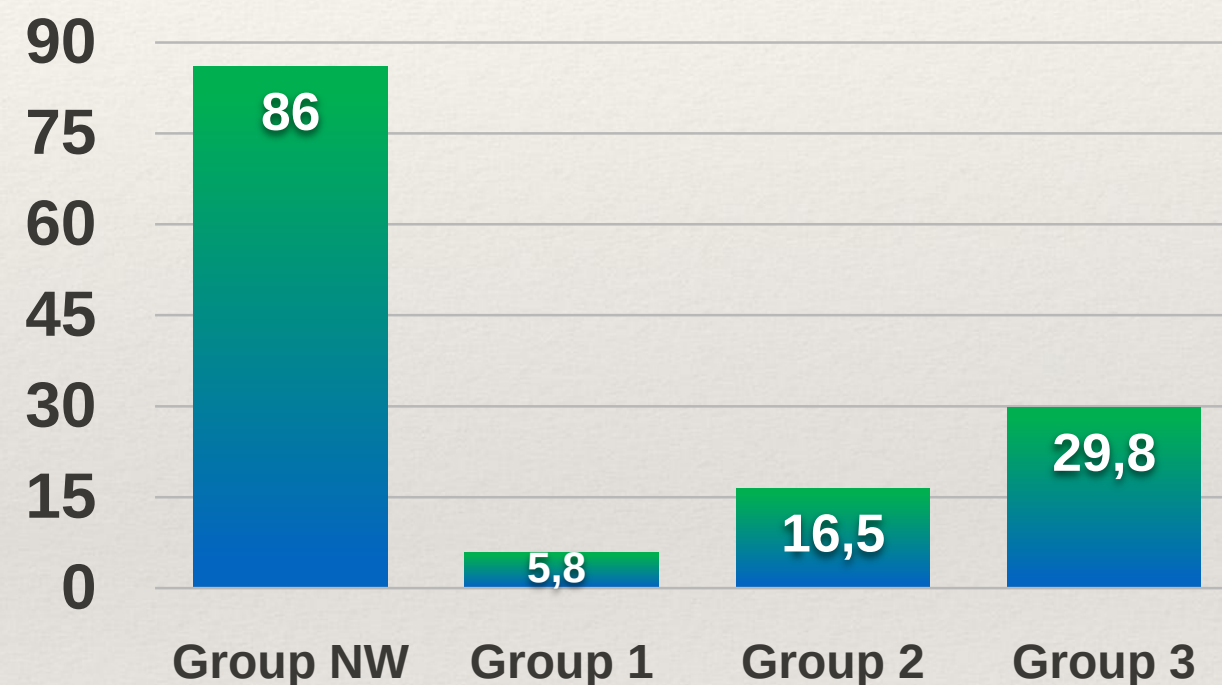
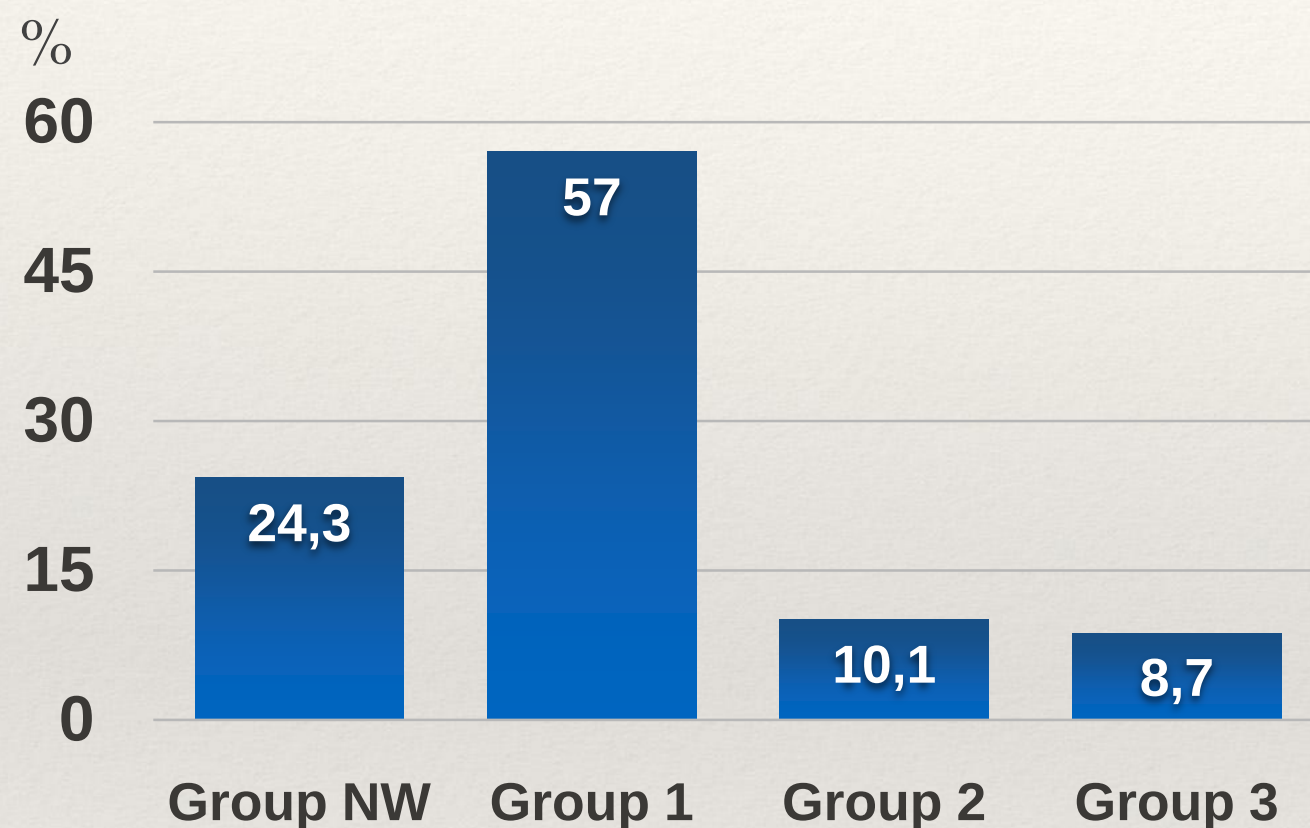
The WIND study

Gaëtan Béduneau¹ (MD) *; Tàì Pham² (MD) *; Frédérique Schortgen³ (MD); Lise Piquilloud⁴

Sevrage

2709 patients

Mortalité



38,3%
Non Sevrés

Les causes d'échec de sevrage

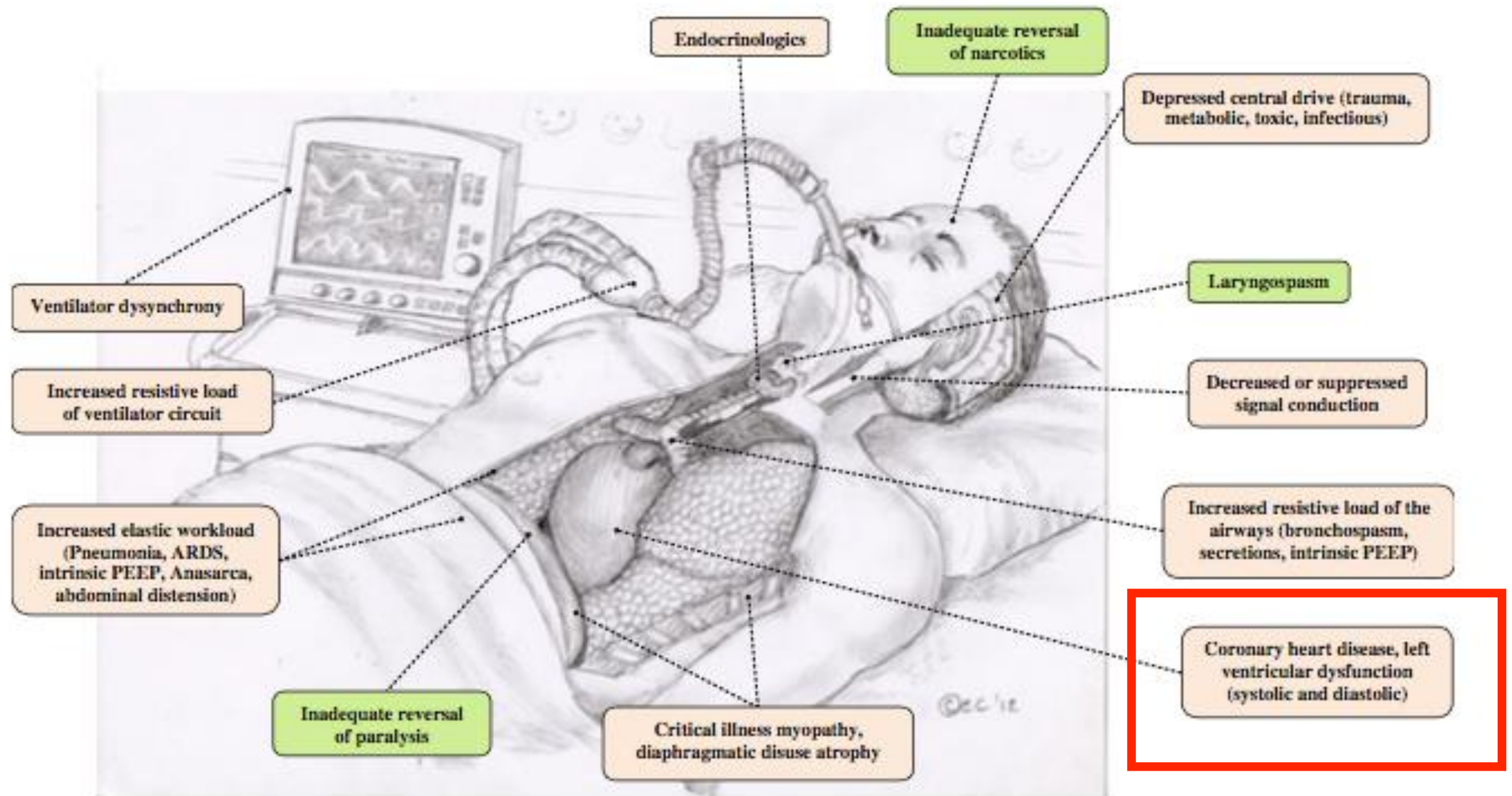
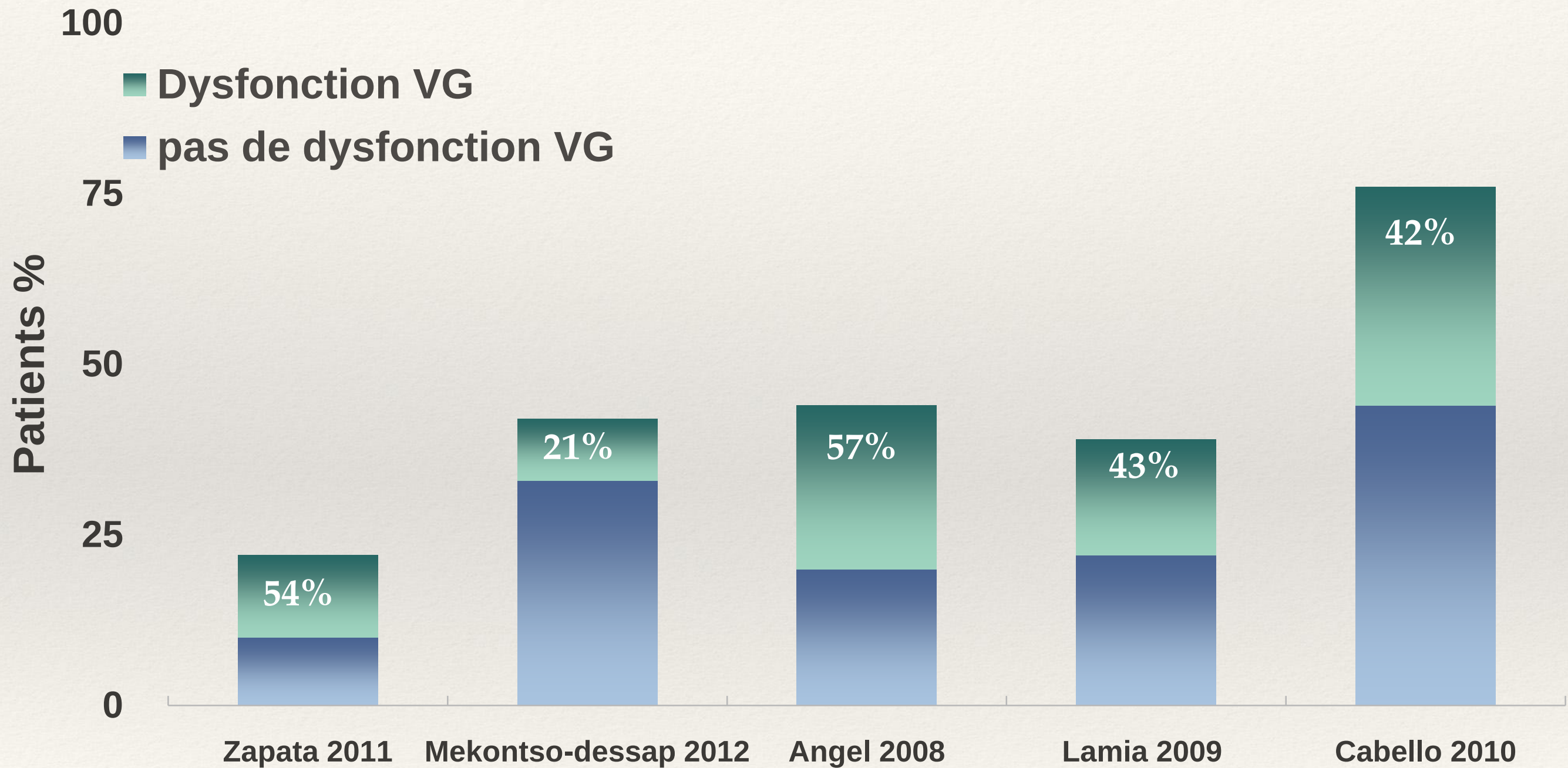


Fig. 1 Synoptic illustration of reasons contributing to weaning/extubation failure in anaesthetized and critically ill patients.
■ anaesthetized, ■ critically ill

Prevalence de la dysfonction VG lors des échecs de sevrage

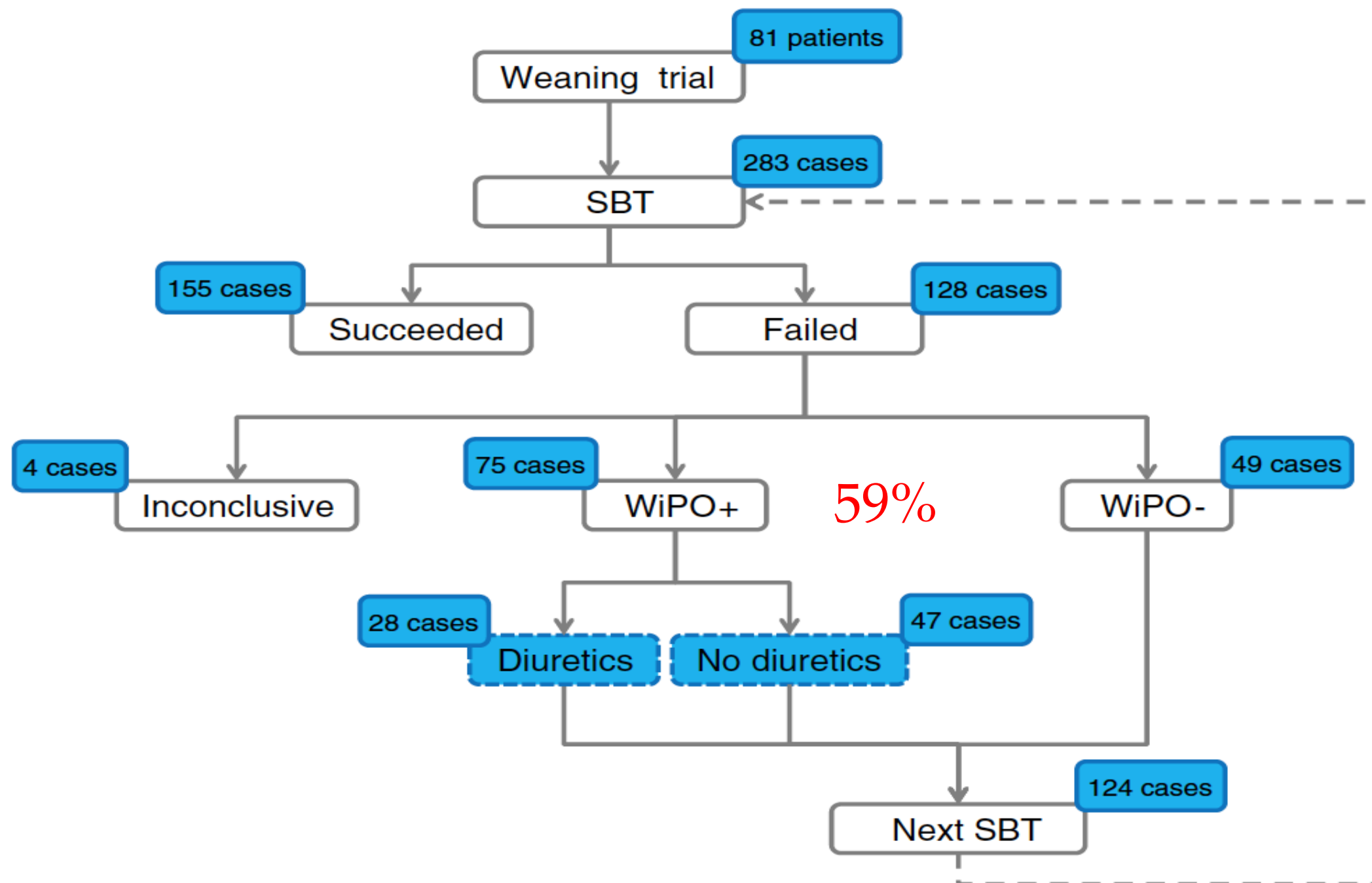




Cardiac dysfunction induced by weaning from mechanical ventilation: incidence, risk factors, and effects of fluid removal

Jinglun Liu^{1,2,3,4†}, Feng Shen^{1,2,3,5†}, Jean-Louis Teboul^{1,2,3}, Nadia Anguel^{1,2,3}, Alexandra Beurton^{1,2,3}, Nadia Bezaz^{1,2,3}, Christian Richard^{1,2,3} and Xavier Monnet^{1,2,3*}

Liu et al. *Critical Care* (2016) 20:369

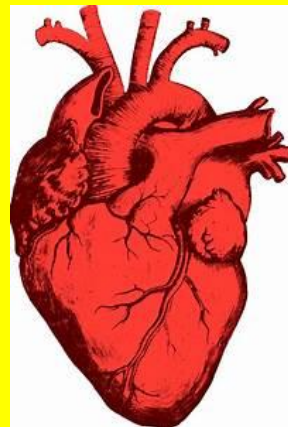


Ventilation mécanique

Sevrage

40% de la durée de
ventilation mécanique

40 % des patients vont avoir
un sevrage difficile ou prolongé

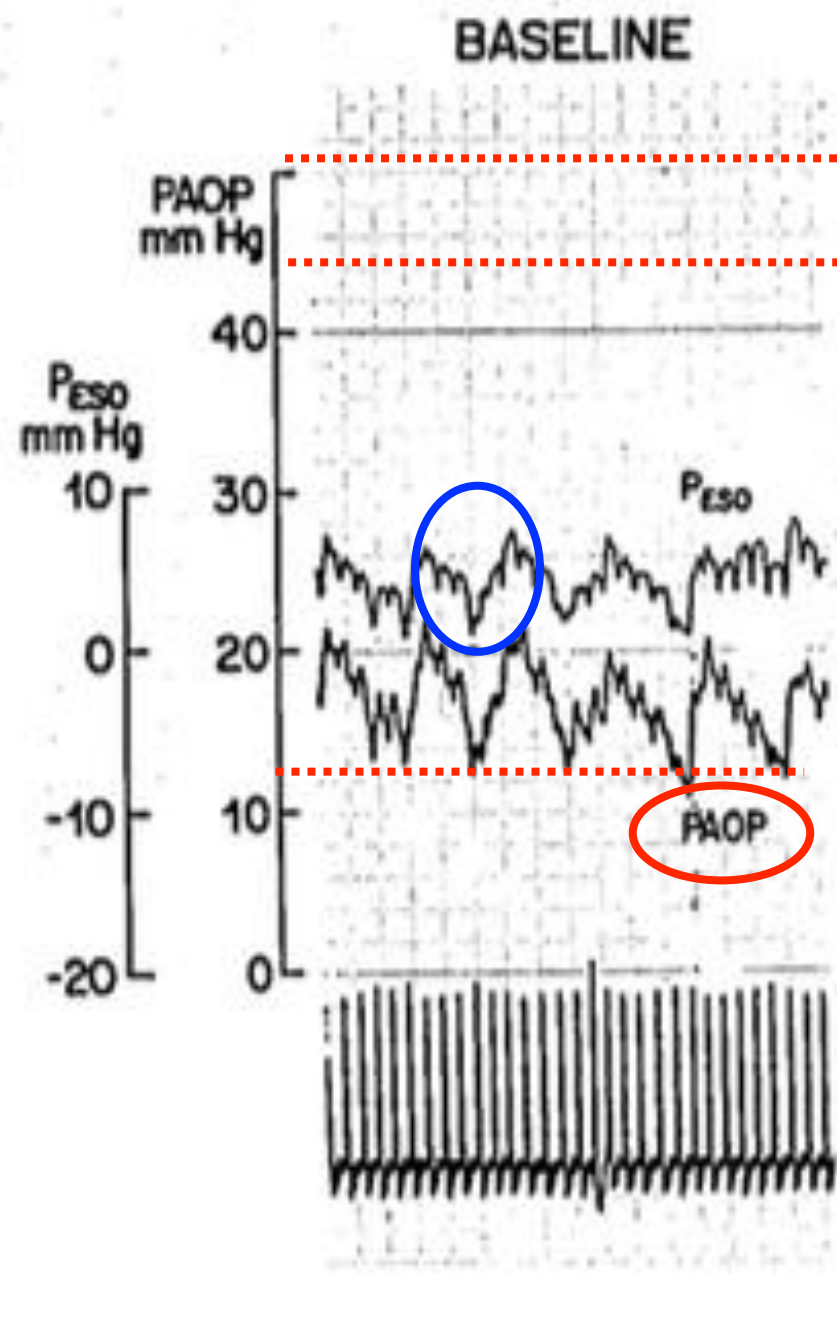


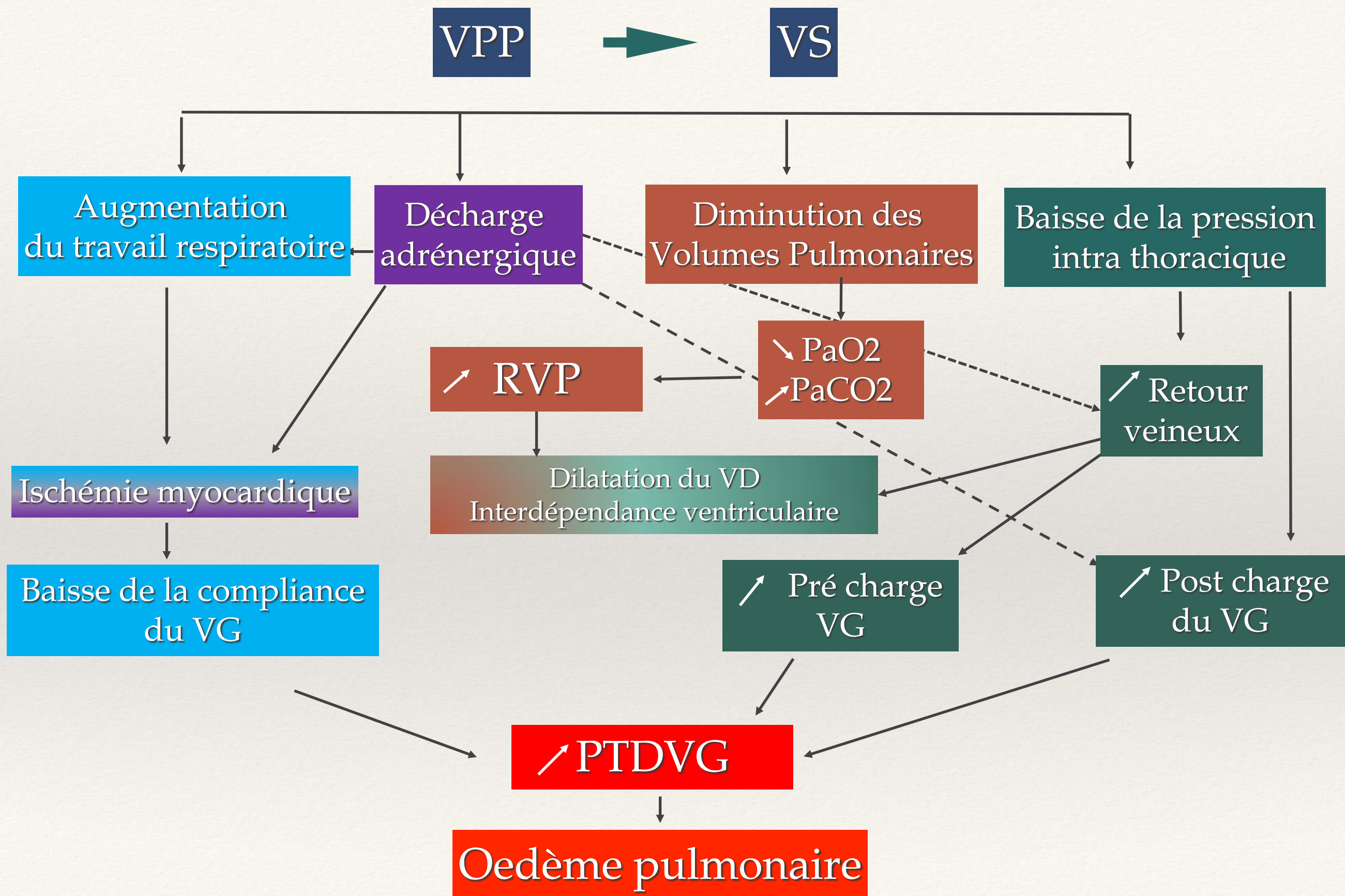
40 - 60% ont un sevrage
difficile d'origine cardiaque

Mécanisme de la dysfonction
cardiaque liée au sevrage ?

Acute Left Ventricular Dysfunction during Unsuccessful Weaning from Mechanical Ventilation

Francois Lemaire, M.D.,* Jean-Louis Teboul, M.D.,† Luc Cinotti, M.D.,‡ Guillen Giotto, M.D.,§
Fekri Abrouk, M.D.,§ Gabriel Steg, M.D.,§ Isabelle Macquin-Mavier, M.D.,¶ Warren M. Zapol, M.D.**





Patients à haut risque

RESEARCH

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Cardiac dysfunction induced by weaning from mechanical ventilation: incidence, risk factors, and effects of fluid removal

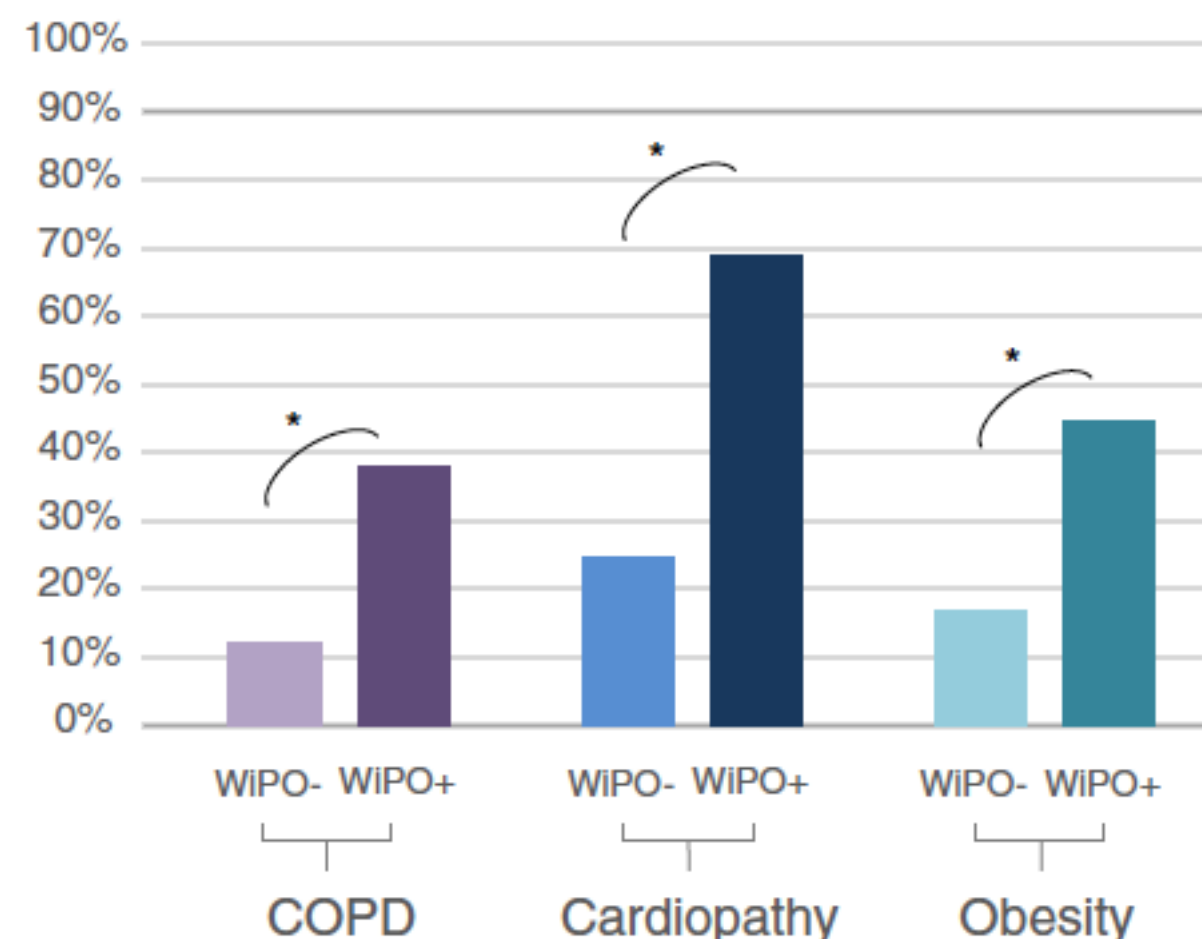
Jinglun Liu^{1,2,3,4†}, Feng Shen^{1,2,3,5†}, Jean-Louis Teboul^{1,2,3}, Nadia Anguel^{1,2,3}, Alexandra Beurton^{1,2,3}, Nadia Bezaz^{1,2,3}, Christian Richard^{1,2,3} and Xavier Monnet^{1,2,3*}

Table 2 Summary of the results of forward logistic regression with the occurrence of at least one episode of weaning-induced pulmonary oedema as the dependent variable

Explaining variable	Odds ratio (95 % CI)	P value
Previous COPD	8.7 (2.0–37.3)	0.003
Previous structural cardiopathy	4.5 (1.4–14.1)	0.001
Obesity	3.6 (1.2–12.6)	0.03

CI confidence interval, COPD chronic obstructive pulmonary disease

Prevalence



Modalité de sevrage et révélation
d'œdème pulmonaire de sevrage

Belén Cabello
Arnaud W. Thille
Ferran Roche-Campo
Laurent Brochard
Francisco J. Gómez
Jordi Mancebo

Physiological comparison of three spontaneous breathing trials in difficult-to-wean patients

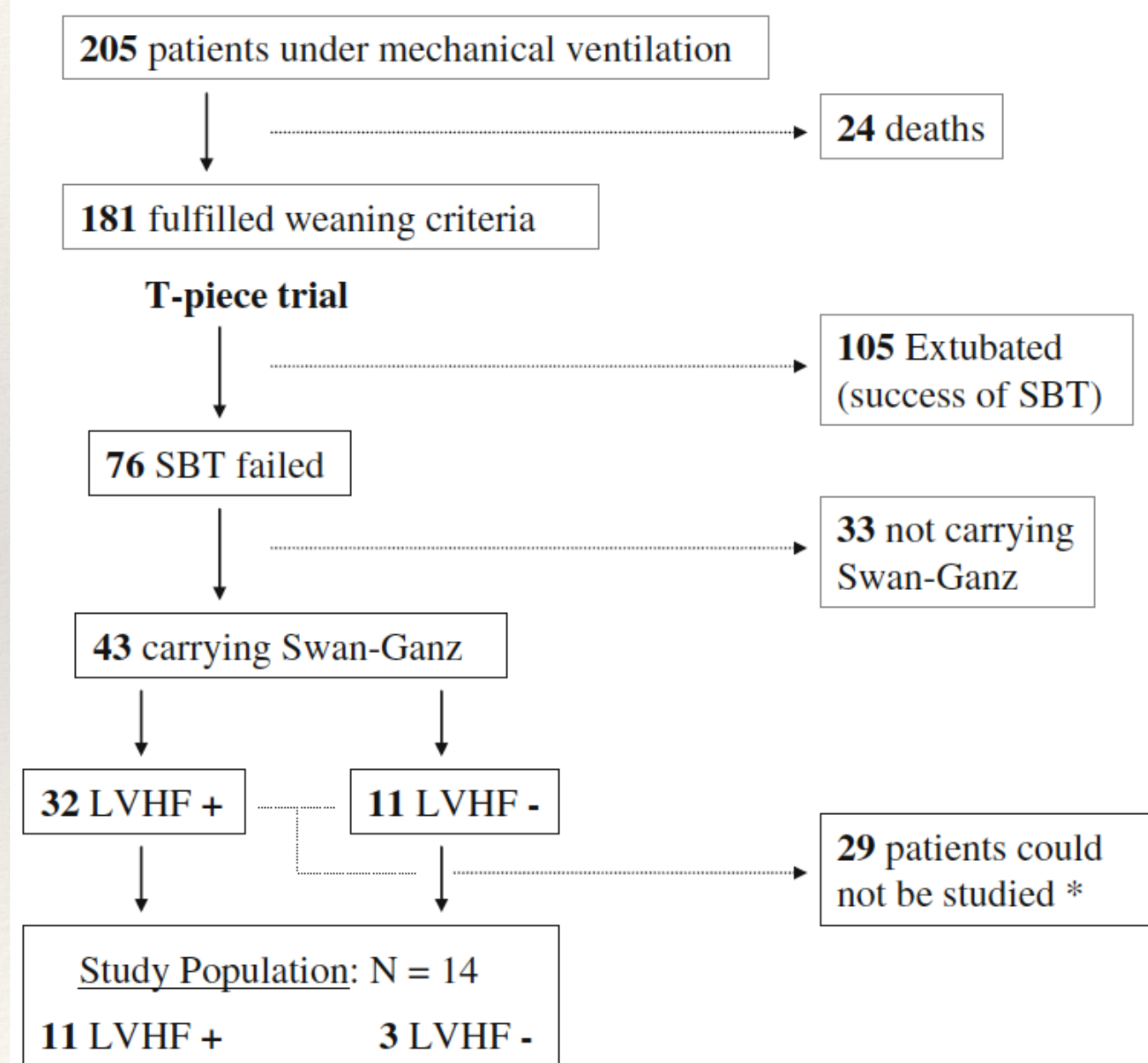


Table 3 Comparison of hemodynamic parameters during T-piece and pressure support trials

	ACV	PS-PEEP	PS-ZEEP	T-Piece
Heart rate (beats/min)	88 (80–98)	89 (81–100)	94 (87–103)	98 (88–106)*
Systolic blood pressure (mmHg)	116 (108–131)	124 (118–139)	138 (118–158)	158 (126–162)**
PAOP (mmHg)	15 (12–18)	17 (14–22)	20 (15–25)*	21 (18–24)*
Cardiac output (l/min)	7.1 (6.1–7.6)	7.2 (6.1–7.8)	7.2 (6.1–7.8)	6.9 (6.3–7.8)
SVO ₂ (%) ₂	69 (64–73)	69 (65–71)	69 (65–74)	69 (64–74)

Table 4 Individual patient tolerance to pressure support trials, cumulative fluid balance, and extubation outcome

Patients	Success PSV-PEEP, <i>n</i> (%)	Success PSV-ZEEP, <i>n</i> (%)	Fluid balance at study day (ml)	Fluid balance at extubation day (ml)	Delay between study and extubation (days)
1 ^a	No ^b	No ^b	−900	−5,440	3
2	No ^b	No ^b	−1,100	−16,800	12
3 ^a	Yes ^b	Yes ^b	50	−5,700	3
4	Yes	Yes	−800	−3,500	2
5	Yes	No ^b	−5,300	Not extubated	—
6	No ^b	No ^b	−970	−330	4
7	Yes	Yes ^b	−4,250	−4,260	1
8 ^a	Yes ^b	Yes ^b	−2,560	−3,620	1
9	Yes	Yes	−3,100	−3,380	1
10	Yes	Yes	−700	Not extubated	—
11	Yes	Yes	1,220	−4,690	1
12 ^a	Yes ^b	No ^b	4,200	−11,900	15
13	Yes ^b	No ^b	4,600	−12,560	3
14	Yes	Yes	−9,000	−11,140	13
Median (IQR)	11 (79%)	8 (57%)	−935 (−3,343 to 342)	−5,065 (−11,710 to −3,530)	3 (1–10)

Diagnostic de la dysfonction VG lors du sevrage

Diagnostic de la dysfonction VG lors du sevrage

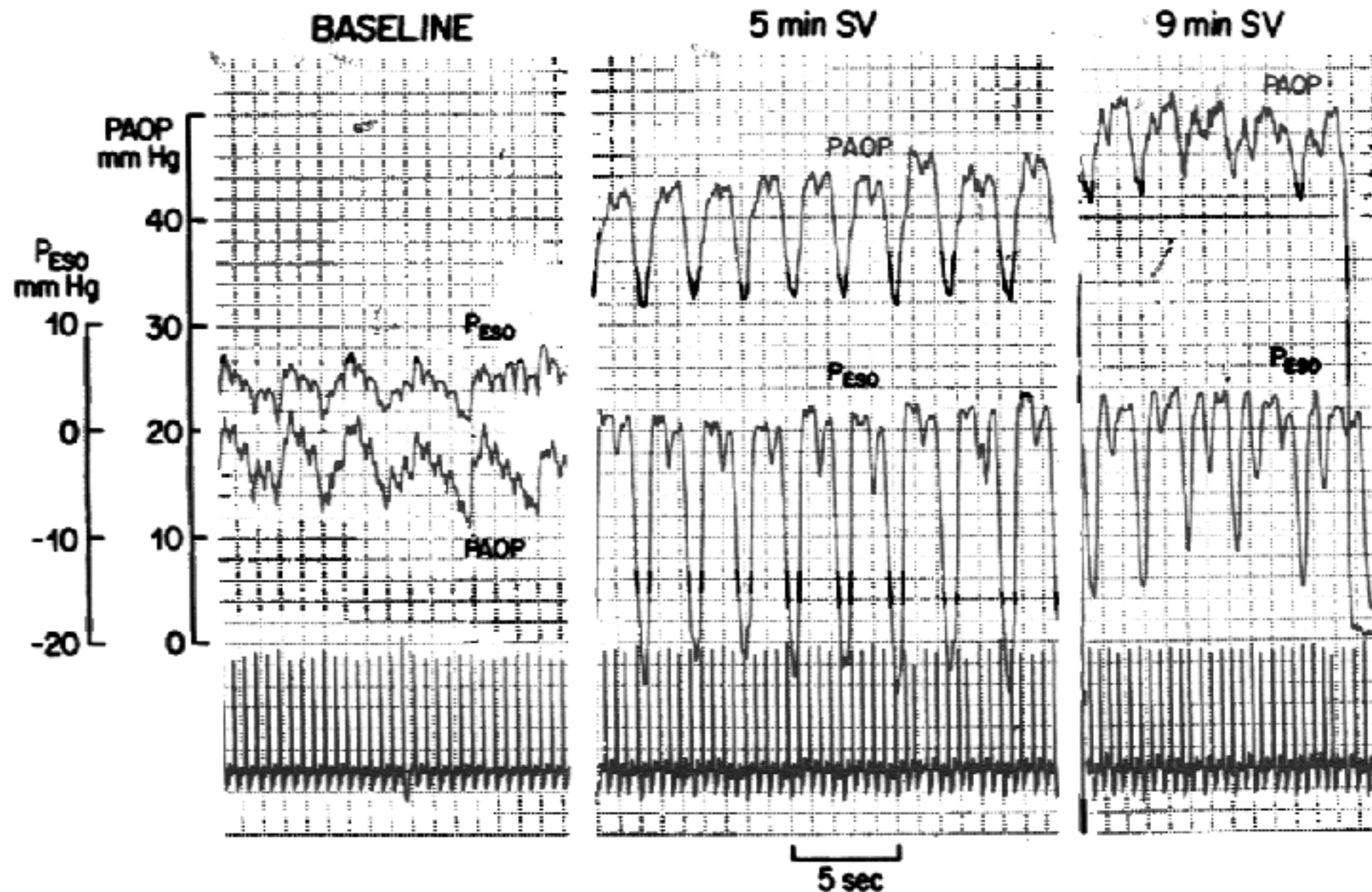
- ❖ **Swan Ganz (Gold standard)**
 - ❖ **Augmentation de la PAPO**
- ❖ Baisse de la SvO₂
- ❖ Variation de l'eau extra-vasculaire pulmonaire
- ❖ Moyens non ou moins invasifs
 - ❖ Clinique
 - ❖ Echographie doppler cardiaque
 - ❖ Lever de jambes passif
 - ❖ Biologie
 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ Hémococoncentration



Anesthesiology
69:171-179, 1988

Acute Left Ventricular Dysfunction during Unsuccessful Weaning from Mechanical Ventilation

Francois Lemaire, M.D.,* Jean-Louis Teboul, M.D.,† Luc Cinotti, M.D.,‡ Guillen Giotto, M.D.,§
Fekri Abrouk, M.D.,§ Gabriel Steg, M.D.,§ Isabelle Macquin-Mavier, M.D.,|| Warren M. Zapol, M.D.**

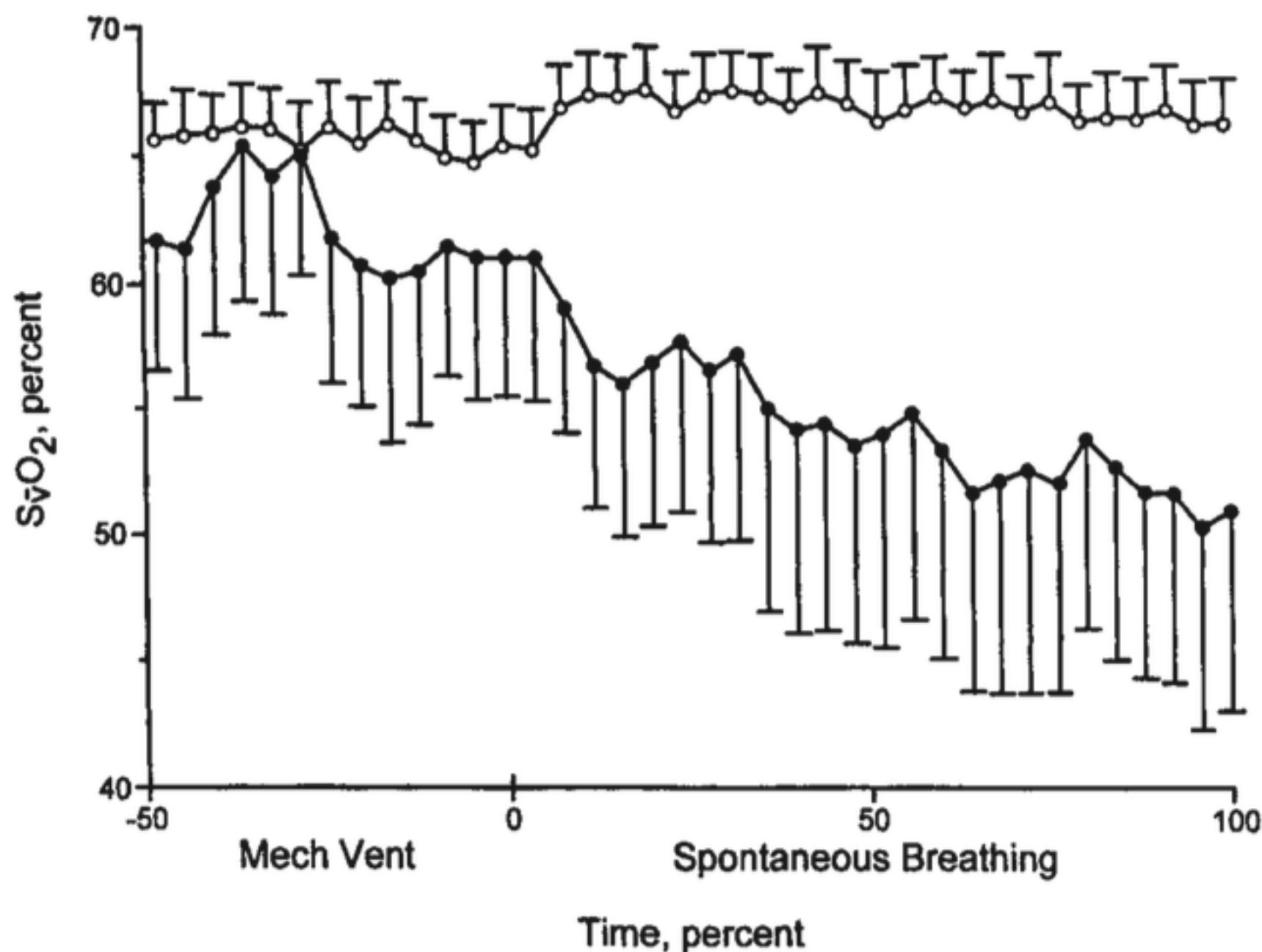


Diagnostic de la dysfonction VG lors du sevrage

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 - ❖ Biologie
 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ Hémococoncentration

Continuous Recordings of Mixed Venous Oxygen Saturation during Weaning from Mechanical Ventilation and the Ramifications Thereof

AMAL JUBRAN, MALI MATHRU, DAVID DRIES, and MARTIN J. TOBIN



CI, L/min/m²

P_{RA} , mm Hg

$\overline{P}_{pa}$, mm Hg

P_{pao} , mm Hg

$\overline{P}_a$, mm Hg

p Value[†]

0.33

0.05

0.04

0.82

0.05

0.64

0.005

0.50

0.0001

0.13

Diagnostic de la dysfonction VG lors du sevrage

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 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ Hémococoncentration

Extravascular Lung Water, B-Type Natriuretic Peptide, and Blood Volume Contraction Enable Diagnosis of Weaning-Induced Pulmonary Edema*

Martin Dres, MD^{1,2}; Jean-Louis Teboul, MD, PhD^{1,2}; Nadia Anguel, MD¹; Laurent Guerin, MD^{1,2}; Christian Richard, MD^{1,2}; Xavier Monnet, MD, PhD^{1,2}

Avant épreuve de sevrage

GDS

Paramètres ventilatoires

paramètres hémodynamique

Table 2. Ventilatory and hemodynamic parameters, and arterial and central venous blood gases data during MV and at 30th min of SBT

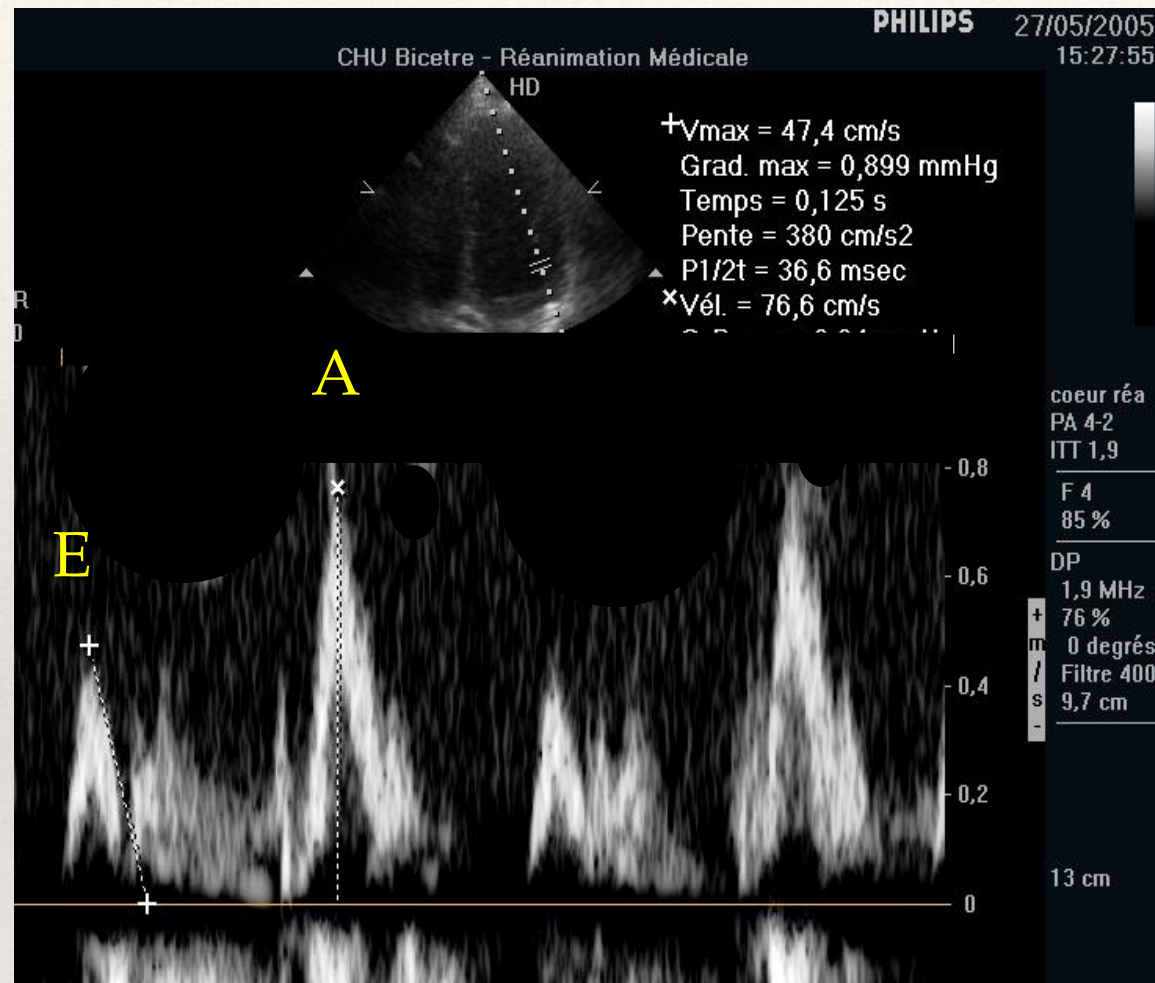
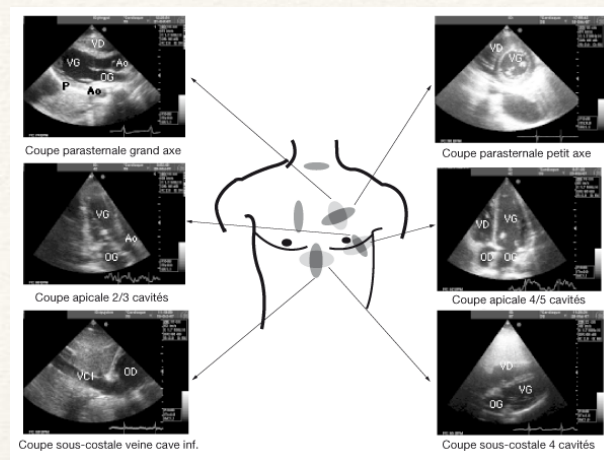
Variable	All Patients (n = 73)	Extubation Success (n = 42)	Extubation Failure (n = 31)	<i>p</i> ^a
During mechanical ventilation				
Blood gases				
pH	7.39 ± 0.9	7.38 ± 0.9	7.4 ± 0.8	.42
Paco ₂ , torr	35 ± 11	34 ± 9	37 ± 13	.22
PaO ₂ , torr	103 ± 35	103 ± 32	103 ± 39	.41
SaO ₂ , %	97 ± 2	97 ± 2	96 ± 3	.46
ScvO ₂ , %	69 ± 7	69 ± 7	68 ± 8	.36
O ₂ ER, %	28.8 ± 7	28.6 ± 7	29.3 ± 9	.1
Ventilatory parameters measured at 1 st min of SBT				
f/V _T , breath/min/L	73 ± 27	68 ± 21	78 ± 25	.45
RR, beat/min	28 ± 6	29 ± 5	26 ± 7	.17
MIP, cm H ₂ O	41 ± 13	42 ± 12	41 ± 15	.37
MEP, cm H ₂ O	30 ± 11	32 ± 10	27 ± 10	.05
CROP index	41 ± 35	47 ± 41	36 ± 29	.09
Hemodynamic parameters				
HR, beat/min	95 ± 18	93 ± 16	98 ± 21	.21
SAP, mm Hg	132 ± 21	131 ± 19	134 ± 23	.49
DAP, mm Hg	72 ± 14	72 ± 13	71 ± 16	.92
MAP, mm Hg	92 ± 14	91 ± 13	92 ± 15	.78

Diagnostic de la dysfonction VG lors du sevrage

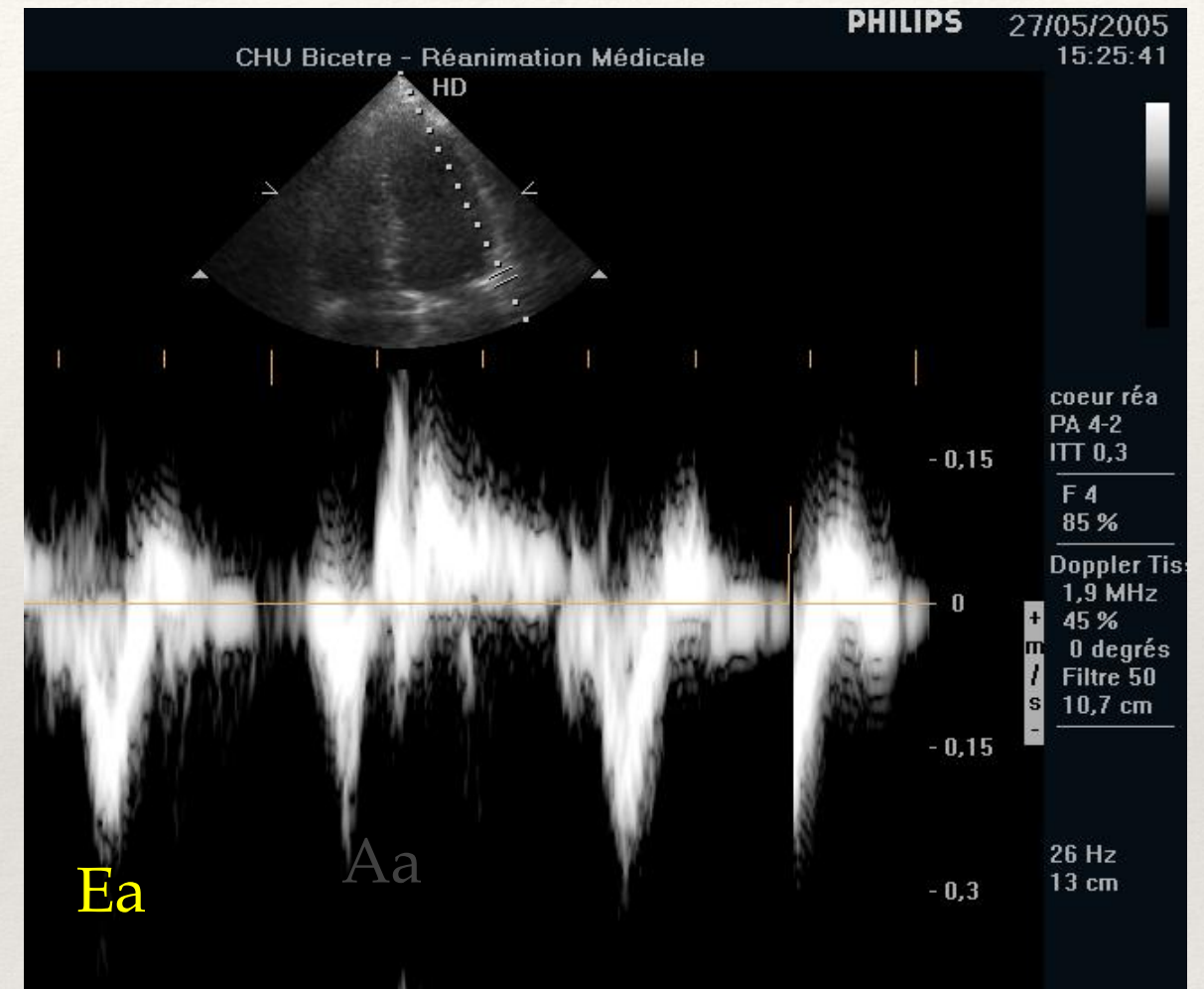
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 - ❖ Lever de jambes passif
 - ❖ Biologie
 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ Hémococoncentration

Echocardiographic diagnosis of pulmonary artery occlusion pressure elevation during weaning from mechanical ventilation*

Bouchra Lamia, MD, MPH, PhD; Julien Maizel, MD; Ana Ochagavia, MD; Denis Chemla, MD, PhD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD



Analyse du flux sanguin mitral
vitesse maximale de l'onde E
vitesse maximale de l'onde A
Rapport E/A



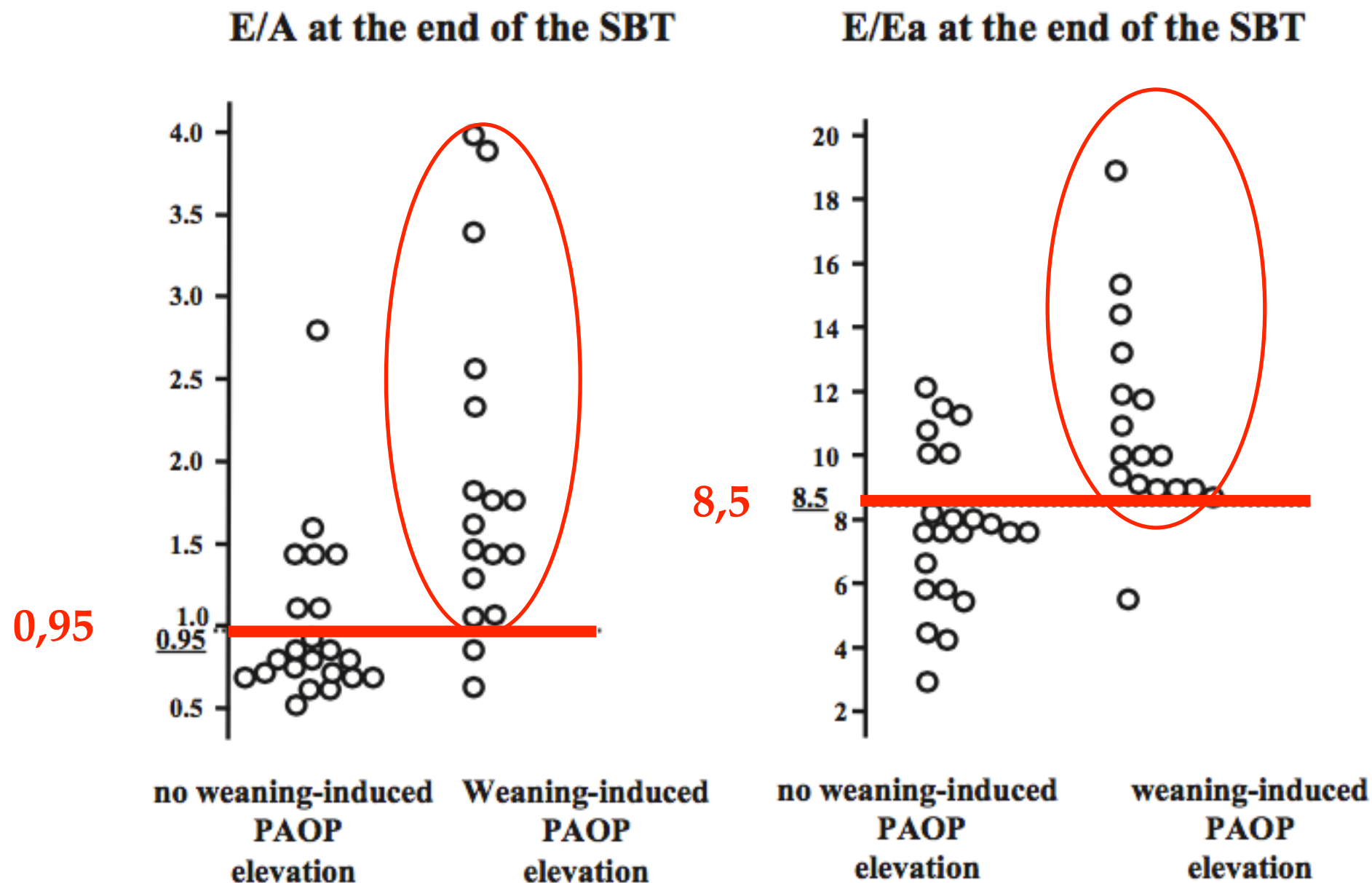
Doppler tissulaire de l'anneau mitral

E/A et E/Ea mesurés a la fin de l'épreuve de sevrage et PAPO > 18 ?

Echocardiographic diagnosis of pulmonary artery occlusion pressure elevation during weaning from mechanical ventilation*

Bouchra Lamia, MD, MPH, PhD; Julien Maizel, MD; Ana Ochagavia, MD; Denis Chemla, MD, PhD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

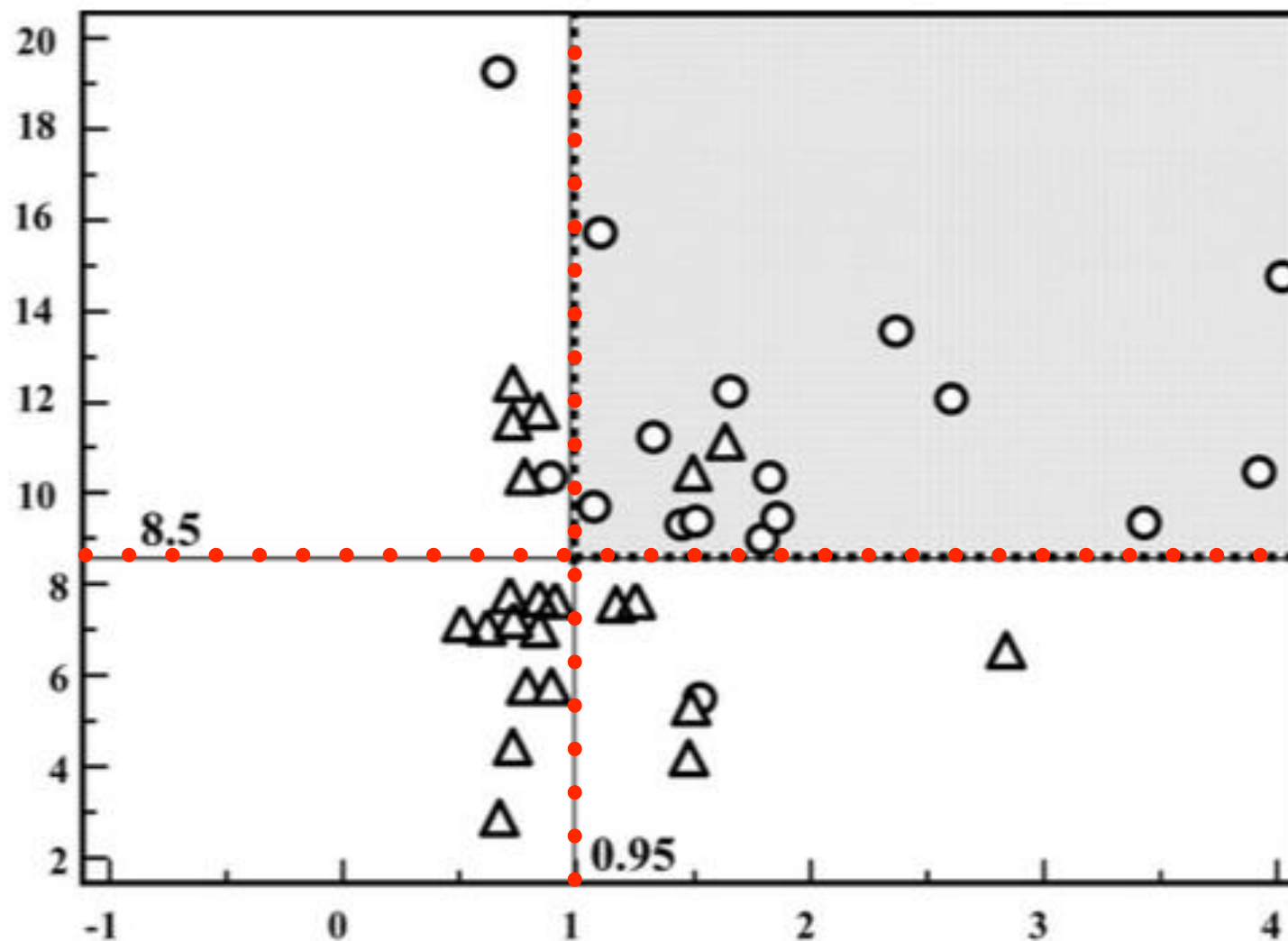
Crit Care Med 2009 Vol. 37, No. 5



ssb : 88% sp : 68%
VPN : 88% VPP: 68%

ssb: 94% sp: 73%
VPN: 94% et VPP: 73%

E/Ea at the end of the SBT



E/A at the end of the SBT

○ PAOP elevation

△ no PAOP elevation

Se = 82%
Sp = 91%
PPV = 88%
NPV = 87%

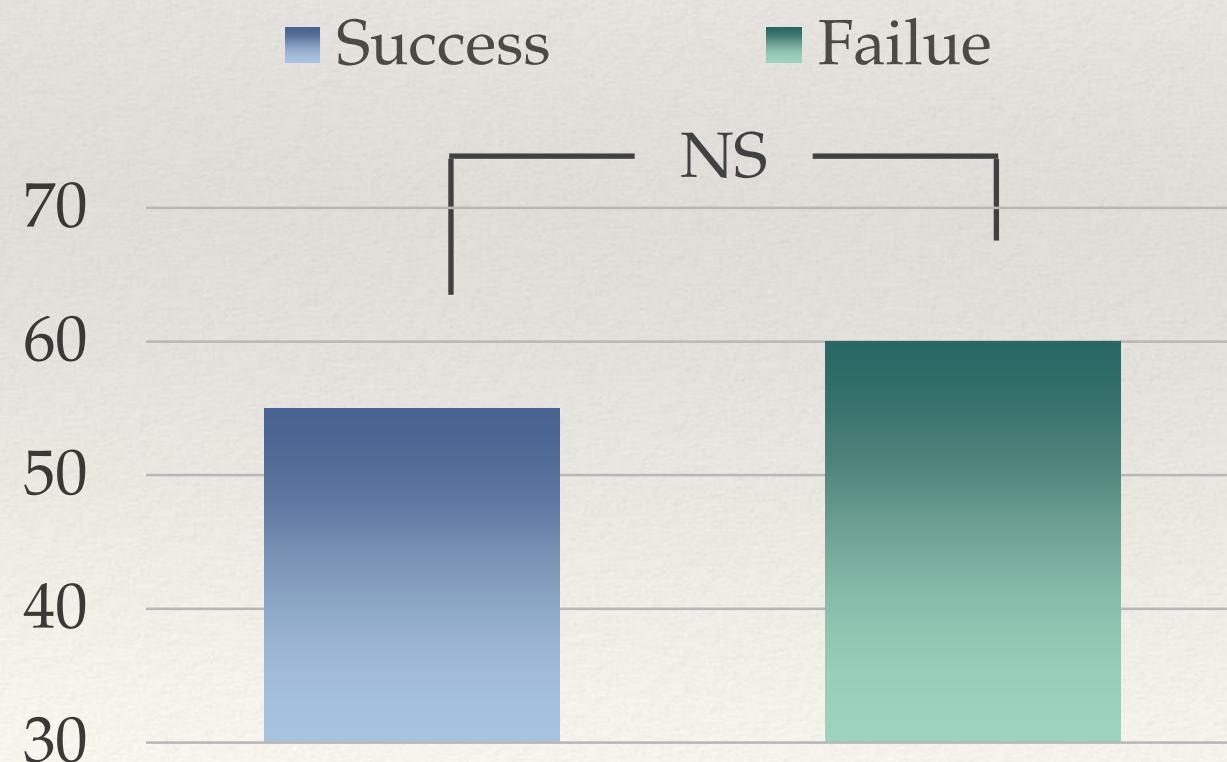
RESEARCH

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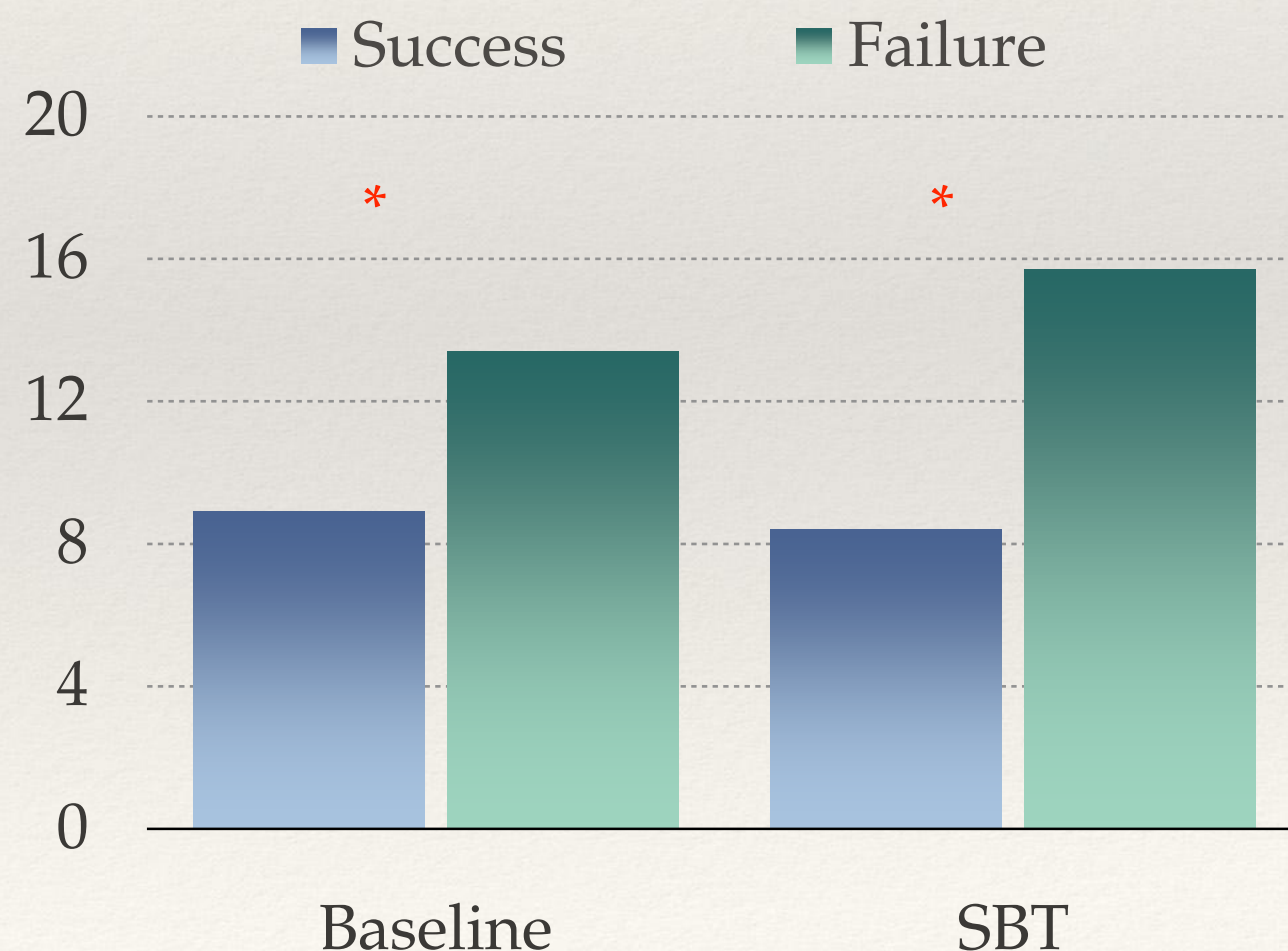
Transthoracic Echocardiography with Doppler Tissue Imaging predicts weaning failure from mechanical ventilation: evolution of the left ventricle relaxation rate during a spontaneous breathing trial is the key factor in weaning outcome

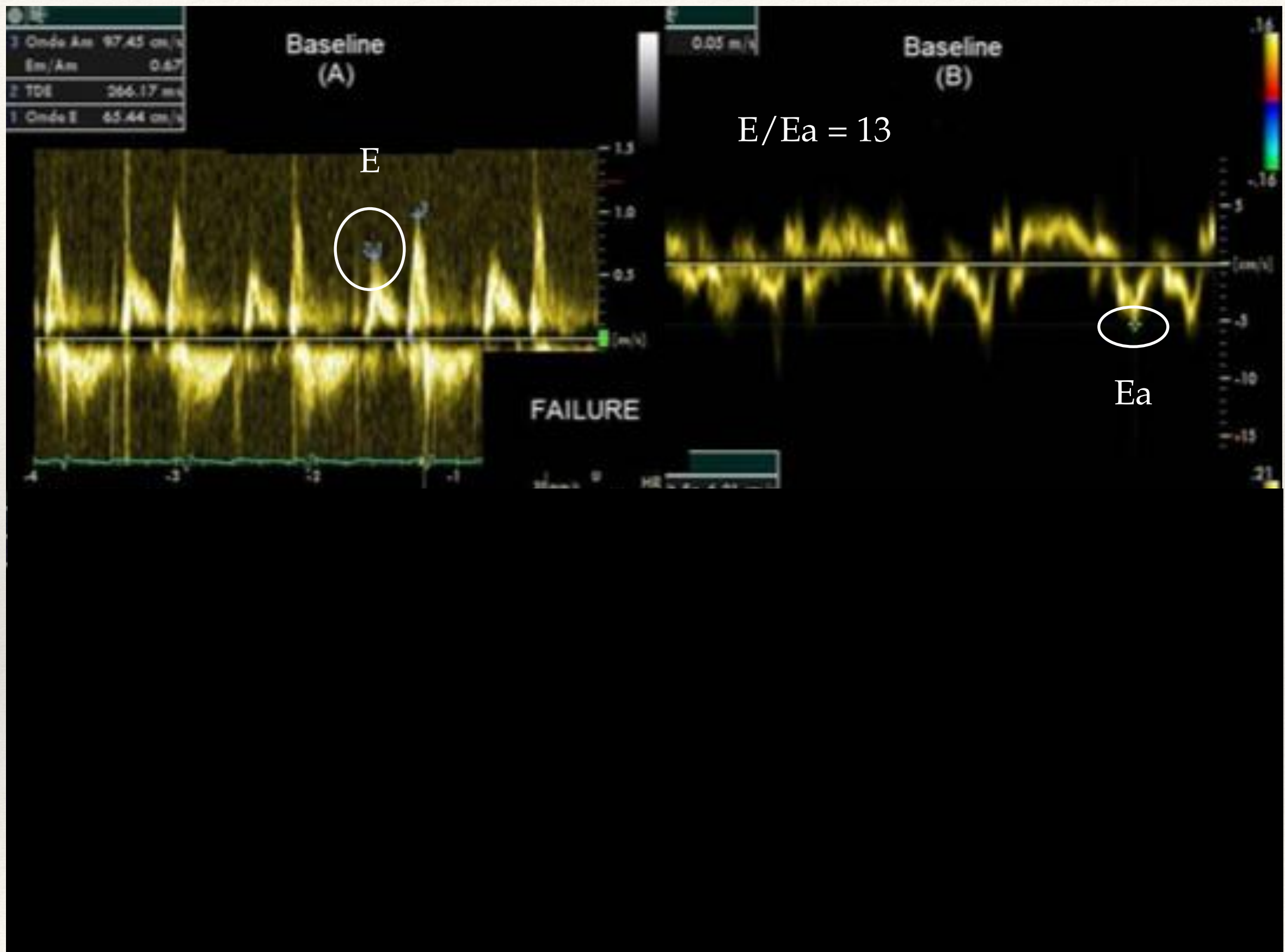
Sébastien Moschietto^{1*}, Denis Doyen², Ludovic Grech¹, Jean Dellamonica¹, Hervé Hyvernât¹ and Gilles Bernardin¹

FEVG



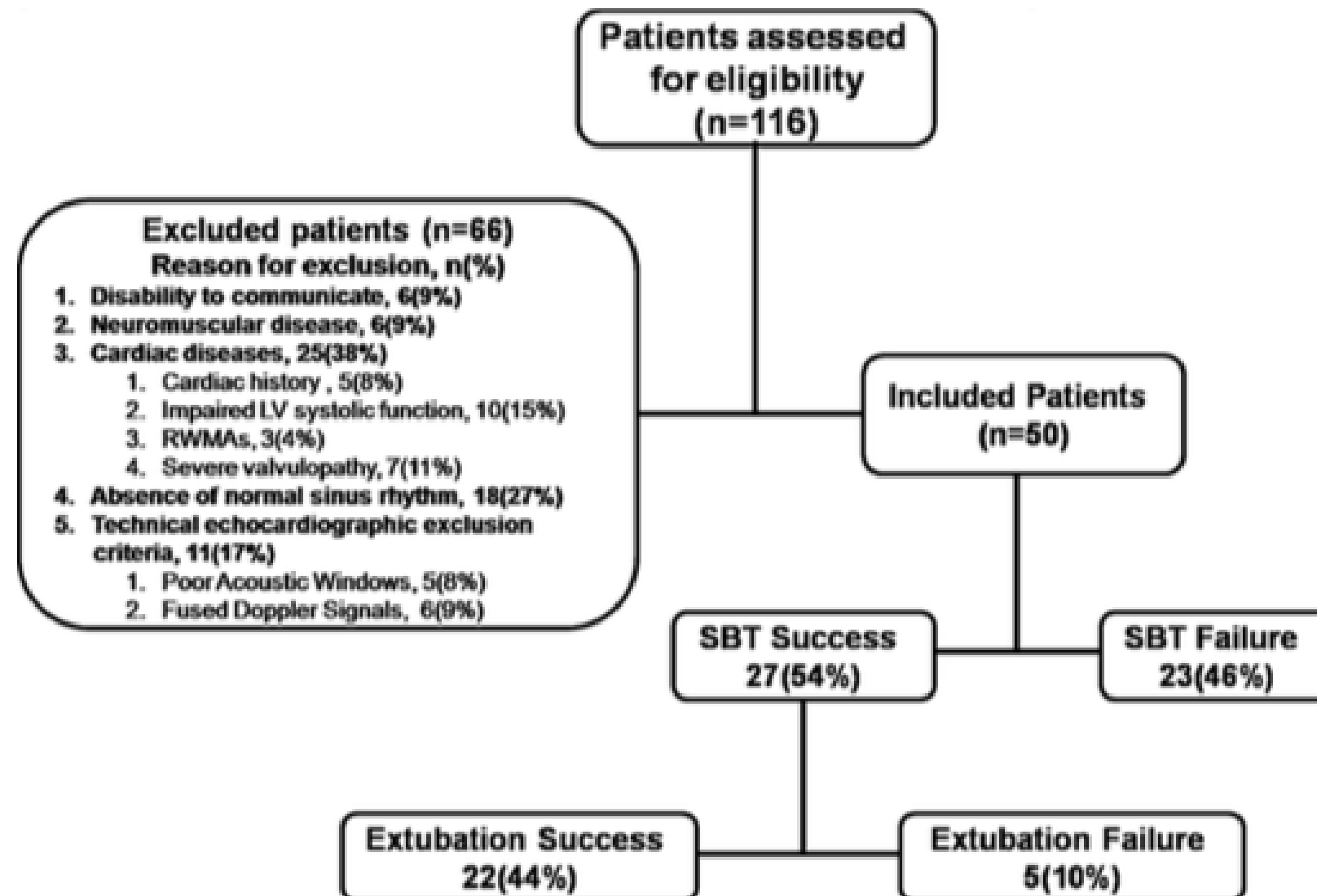
E/Ea





John Papanikolaou
Demosthenes Makris
Theodosios Saranteas
Dimitrios Karakitsos
Elias Zintzaras
Andreas Karabinis
Georgia Kostopanagiotou
Epaminondas Zakynthinos

New insights into weaning from mechanical ventilation: left ventricular diastolic dysfunction is a key player



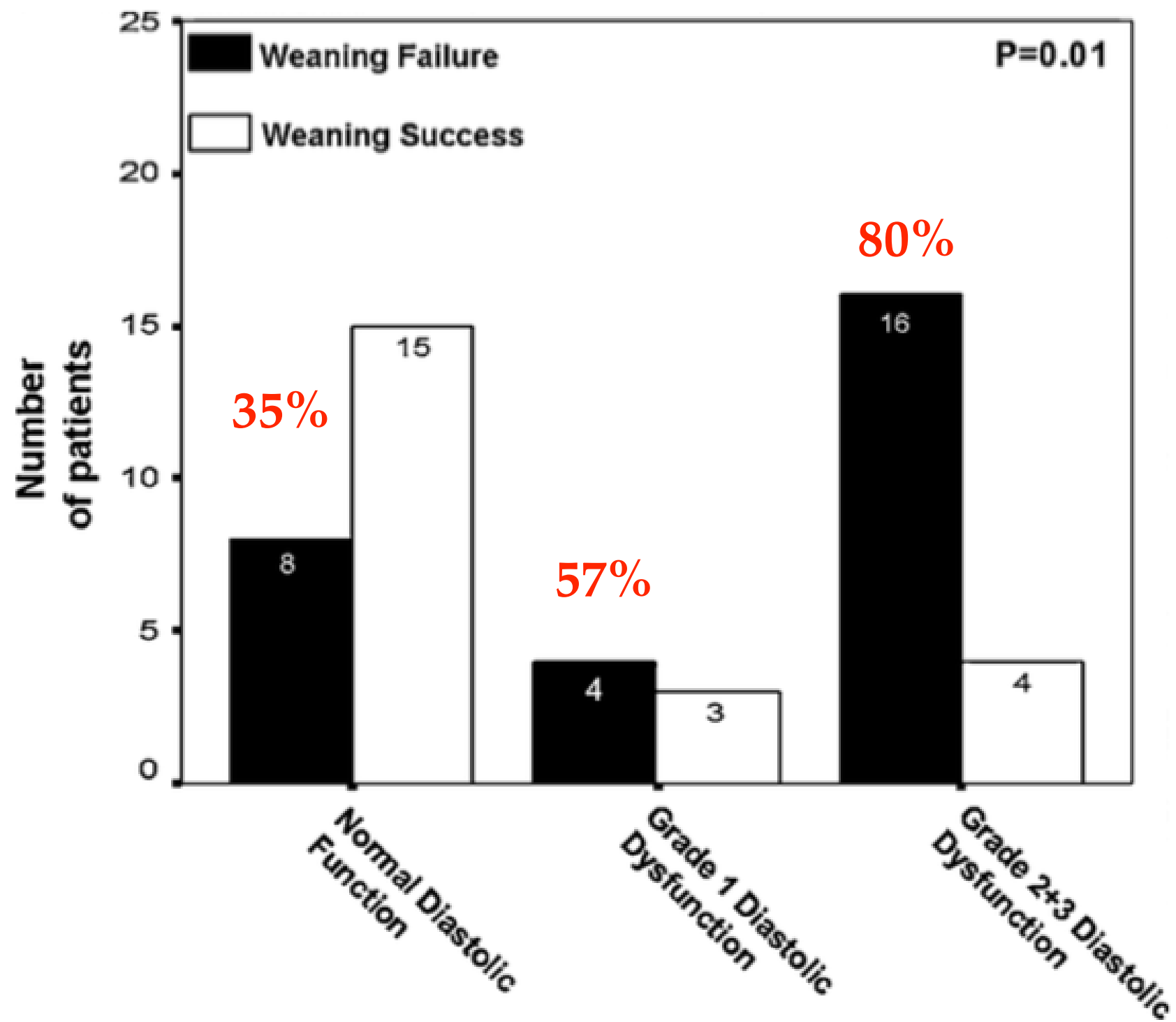


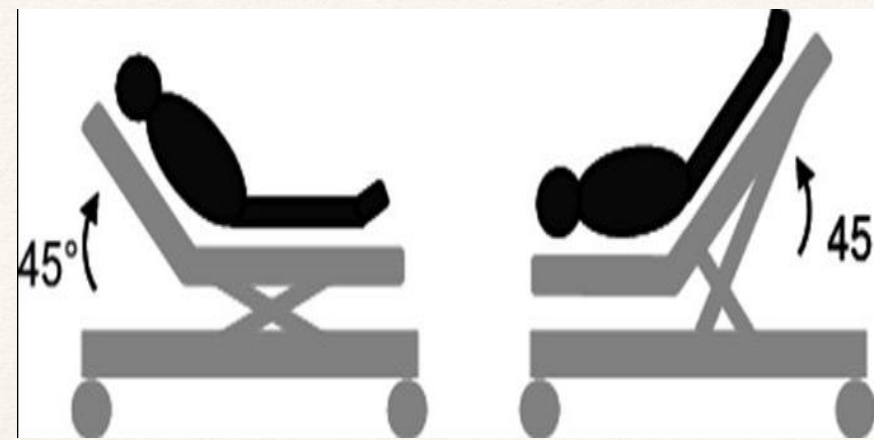
Table 1 Indices of cardiac function of potential utility for weaning from mechanical ventilatory support

	Value	Potential utility
Measurement before SBT		
LV ejection fraction	<40 %	Increased likelihood of failure of SBT
LV ejection fraction	Normal	Increased likelihood of success of SBT
Mitral diastolic inflow	If EF reduced: $E/A > 2$	Increased likelihood of failure of SBT
Mitral diastolic inflow	If EF normal: $E/e' > 12$	Increased likelihood of failure of SBT
CO before/after PSL	No increase in CO	Increased likelihood of failure of SBT
Measurement after SBT		
Mitral diastolic inflow	Increased E/A , E/e'	Identification of SBT-induced cardiogenic pulmonary oedema

A pulsed wave Doppler late mitral valve inflow velocity, CO cardiac output, E pulsed wave Doppler early mitral valve inflow velocity, e' mitral annular tissue Doppler velocity, EF ejection fraction, LV left ventricle, PLR passive leg raise, SBT spontaneous breathing trial

Diagnostic de la dysfonction VG lors du sevrage

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 - ❖ augmentation de la PAPO
- ❖ **Baisse de la SvO2**
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 - ❖ **Lever de jambes passif**
 - ❖ Biologie
 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ Hémococoncentration



Martin Dres
Jean-Louis Teboul
Nadia Anguel
Laurent Guerin
Christian Richard
Xavier Monnet

Passive leg raising performed before a spontaneous breathing trial predicts weaning-induced cardiac dysfunction

30 patients performing several SBTs

57 SBTs

11 successful SBTs

10 PLR+

1 PLR-

46 failed SBTs

15 failed SBTs without cardiac dysfunction

11 PLR+

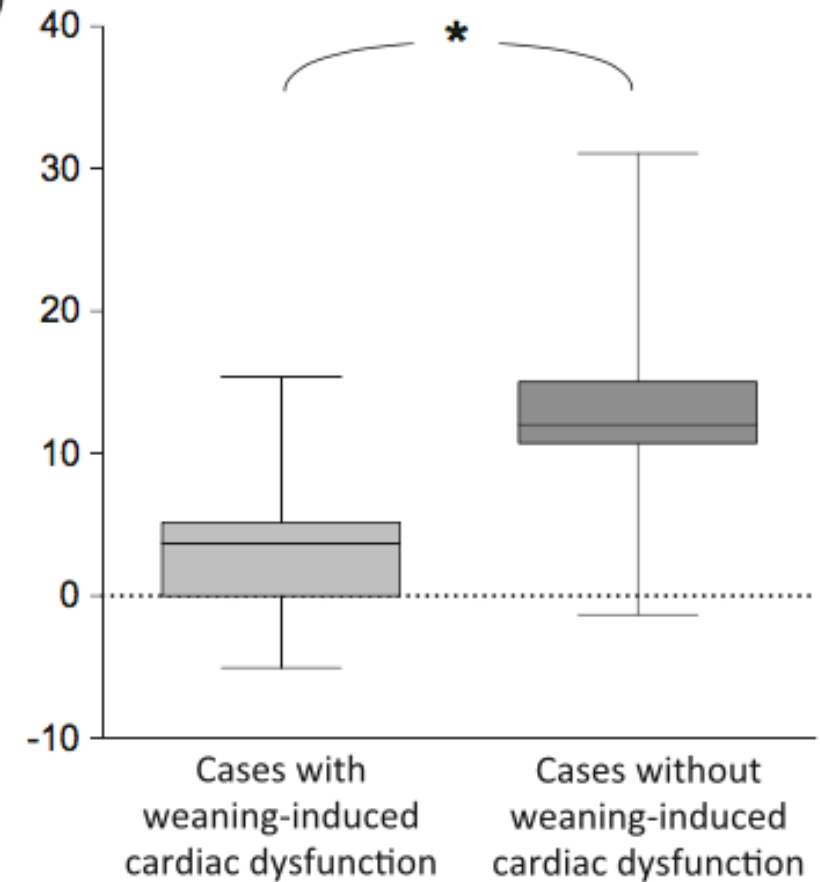
4 PLR-

31 failed SBTs with cardiac dysfunction

1 PLR+

30 PLR-

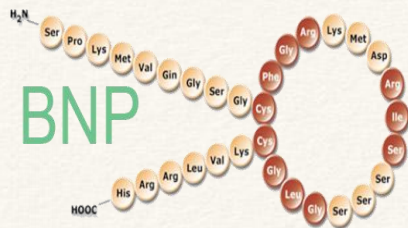
Change in cardiac index during PLR (%)



PLR - avant épreuve de sevrage prédit un échec de sevrage d'origine cardiaque avec une sensibilité 97% et spécificité de 81% et AUC : 0.88

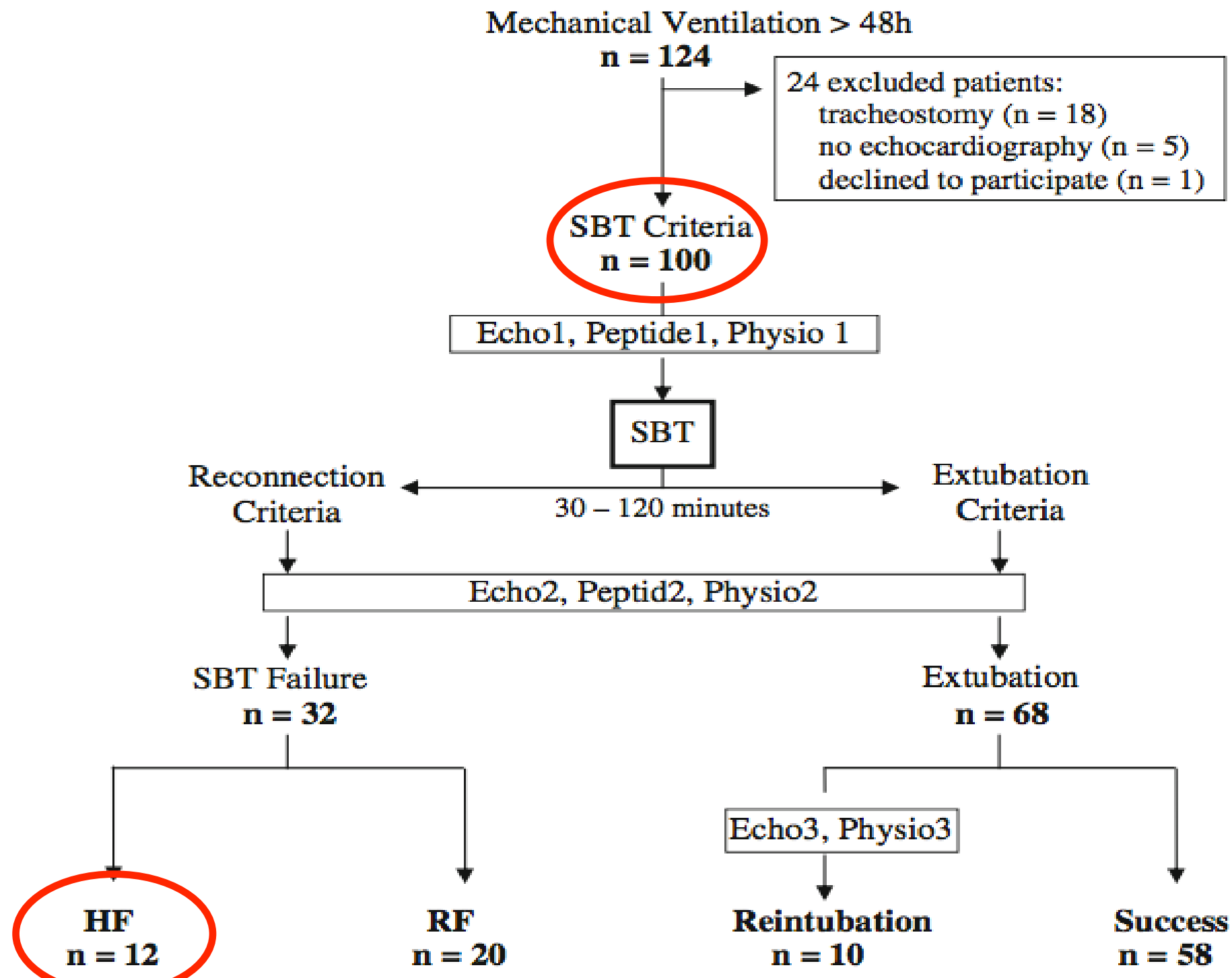
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 - ❖ **Biomarqueurs : B-type Natriuretic Peptides (BNP)**
 - ❖ Hémococoncentration

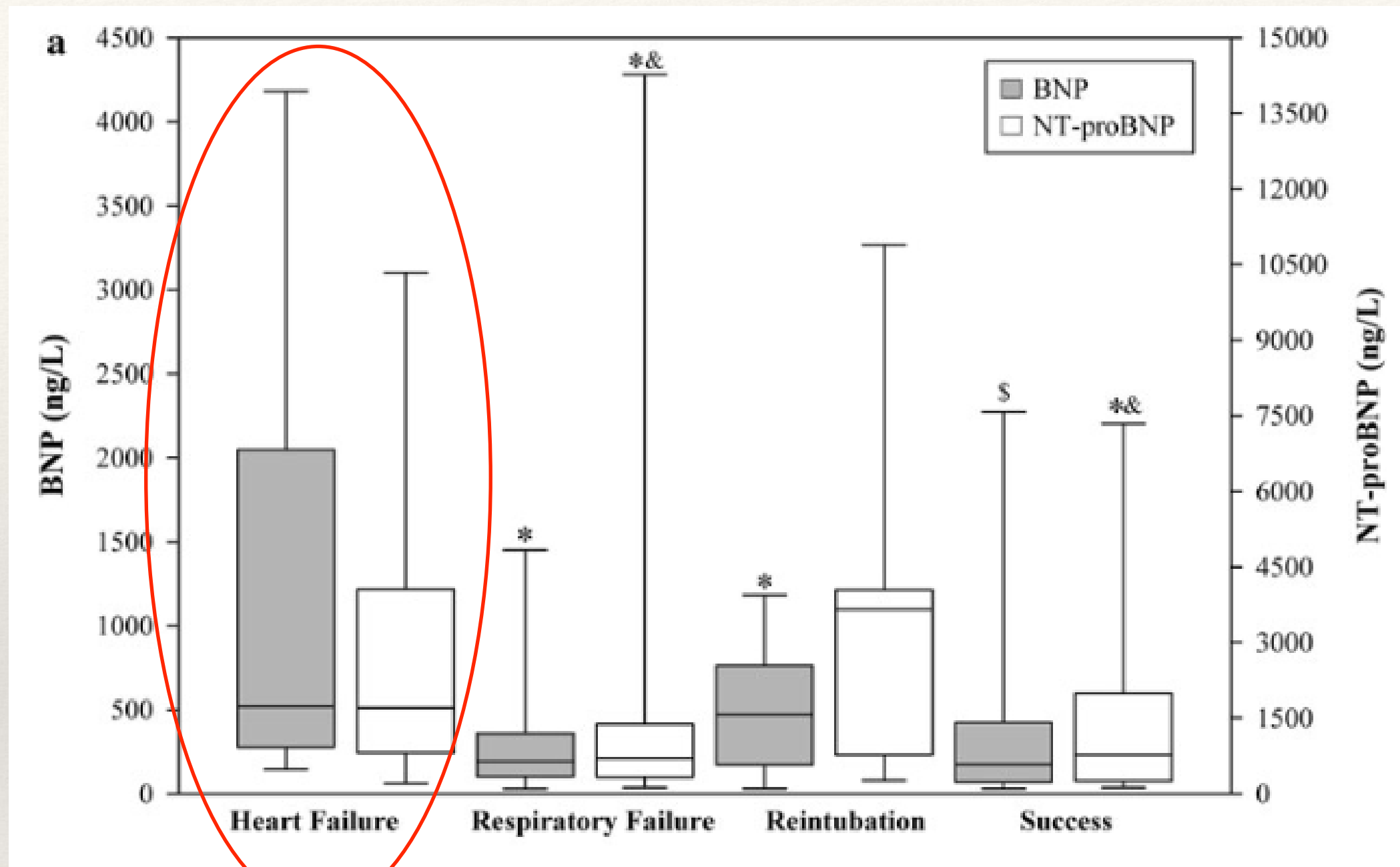


Lluís Zapata
Paula Vera
Antoni Roglan
Ignasi Gich
Jordi Ordóñez-Llanos
Antoni J. Betbesé

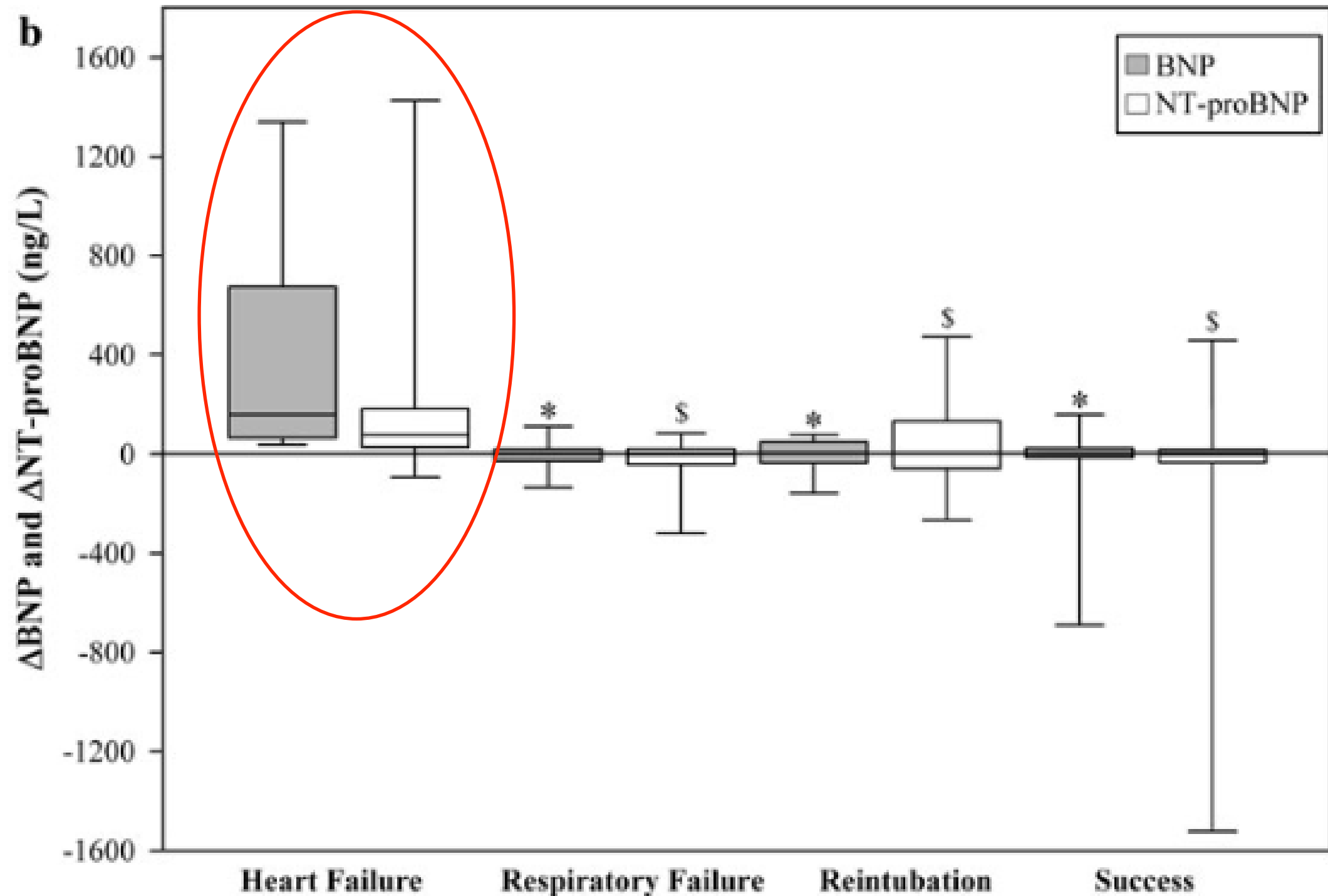
B-type natriuretic peptides for prediction and diagnosis of weaning failure from cardiac origin



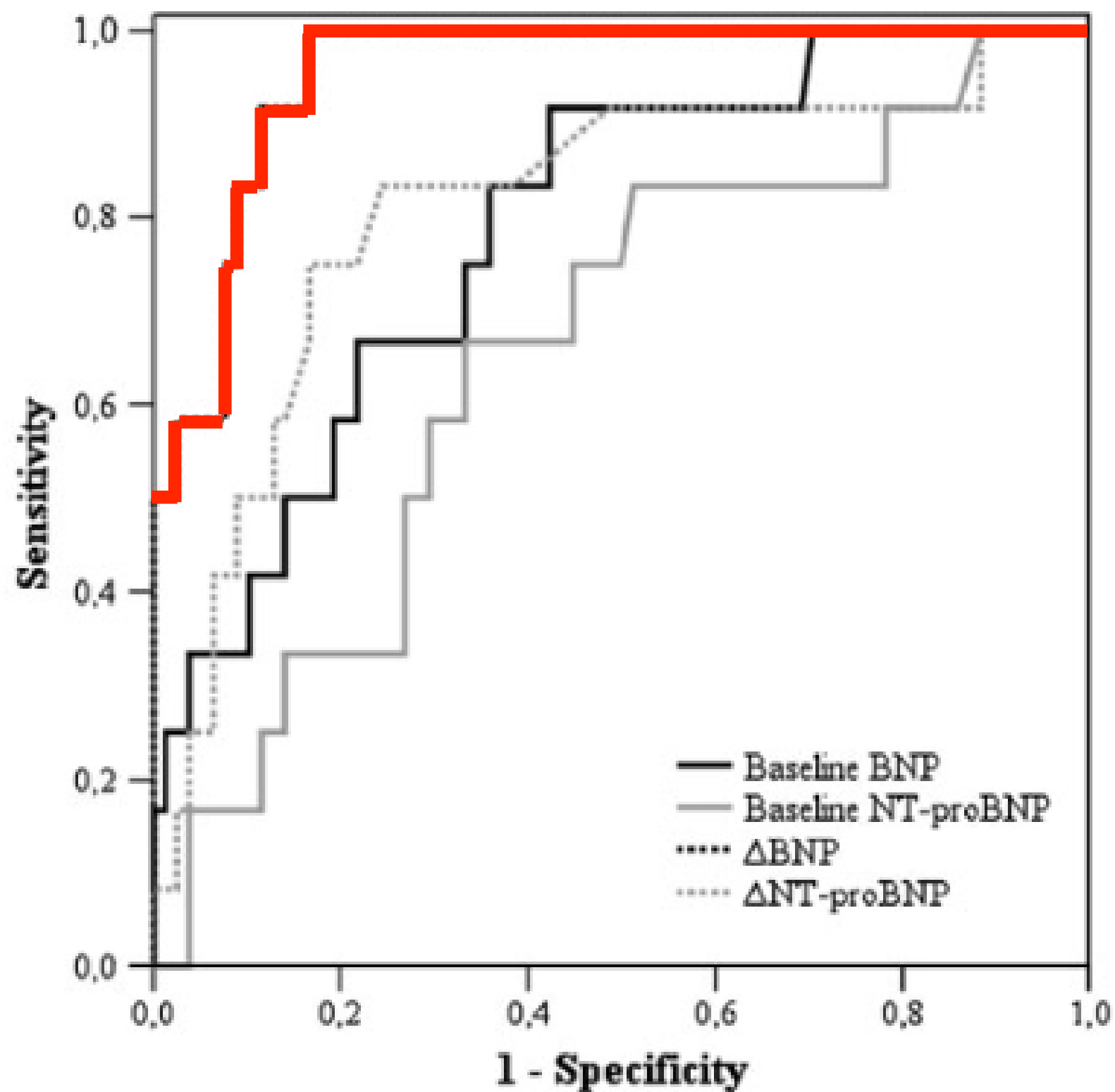
Before SBT



Seuil BNP : 263 ng/l Ssb: 83% Sp: 64% exactitude 68%
NT-proBNP: 1343 ng/l Ssb et Sp 67% exactitude 66%



Variation BNP de 48 ng/l Ssb: 91,7; Sp: 88.5%; exactitude 88.9%
 Variation NT-proBNP 21ng/l Ssb: 83. 3% sp: 75.6% et exactitude 83.3%

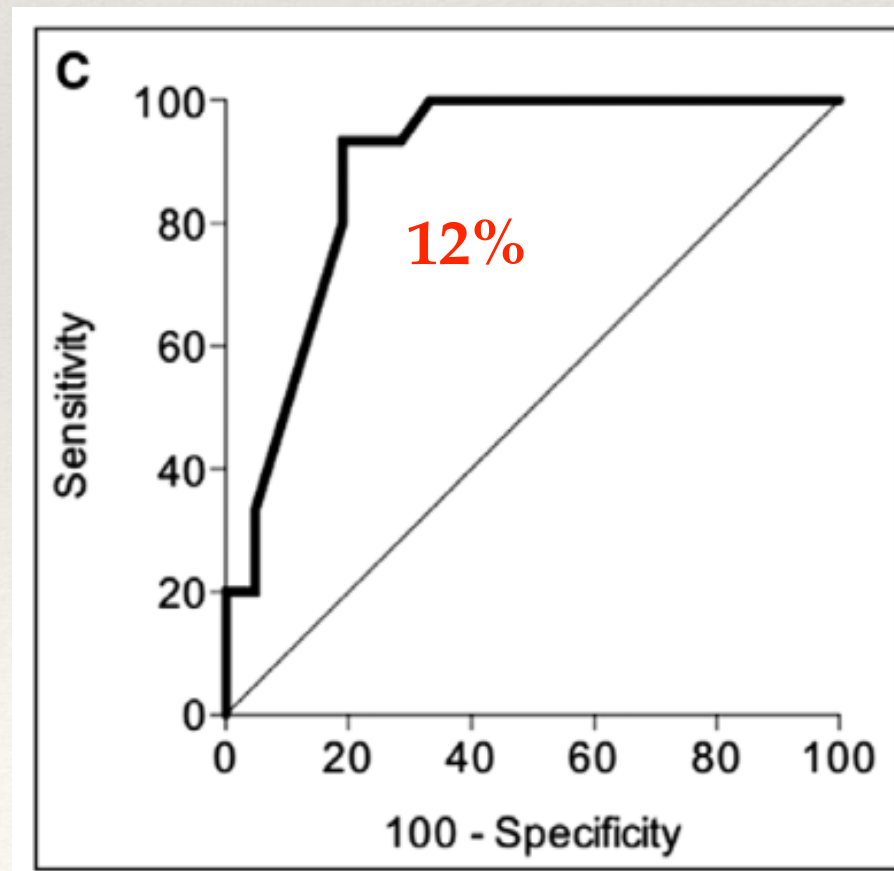


Test	AUC ROC	Standard Error	95 % CI	p
Baseline BNP	0.796	0.065	0.663-0.918	< 0.001
Baseline NT-proBNP	0.664	0.082	0.497-0.818	0.08
Δ BNP	0.954	0.022	0.911-0.977	< 0.001
Δ NT-proBNP	0.810	0.073	0.666-0.953	0.001

Extravascular Lung Water, B-Type Natriuretic Peptide, and Blood Volume Contraction Enable Diagnosis of Weaning-Induced Pulmonary Edema*

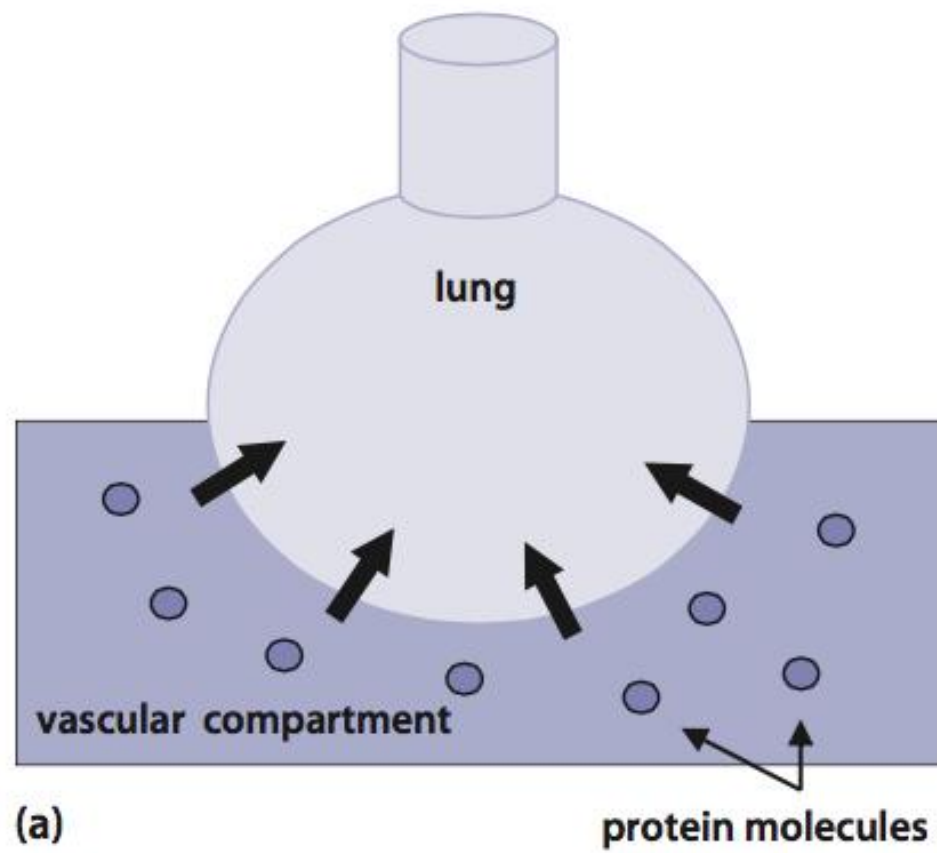
Martin Dres, MD^{1,2}; Jean-Louis Teboul, MD, PhD^{1,2}; Nadia Anguel, MD¹; Laurent Guerin, MD^{1,2}; Christian Richard, MD^{1,2}; Xavier Monnet, MD, PhD^{1,2}

	Threshold	Areas Under the Receiver Operating Characteristics Curve	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Youden Index	Positive Likelihood Ratio	Negative Likelihood Ratio
Variation of B-type natriuretic peptide	12%	0.76	0.76	0.78	0.83	0.82	0.54	3.45	0.31



Diagnostic de la dysfonction VG lors du sevrage

- ❖ **Swan Ganz (Gold standard)**
 - ❖ augmentation de la PAPO
- ❖ **Baisse de la SvO2**
- ❖ **Variation de l'eau extra-vasculaire pulmonaire**
- ❖ **Moyens non ou moins invasifs**
 - ❖ Clinique
 - ❖ Echographie doppler cardiaque
 - ❖ Lever de jambes passif
 - ❖ Biologie
 - ❖ Biomarqueurs : B-type Natriuretic Peptides (BNP)
 - ❖ **Hémoconcentration**

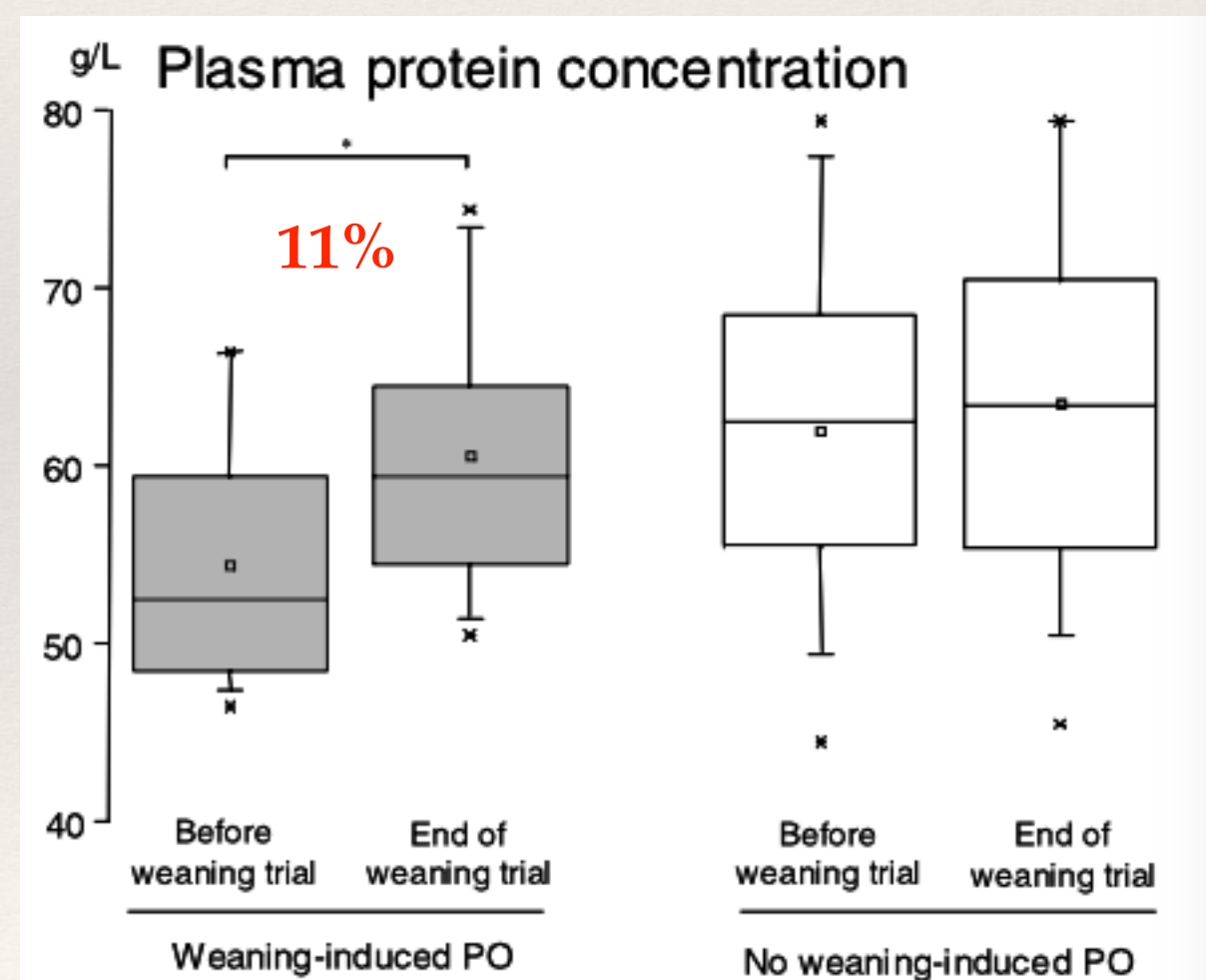
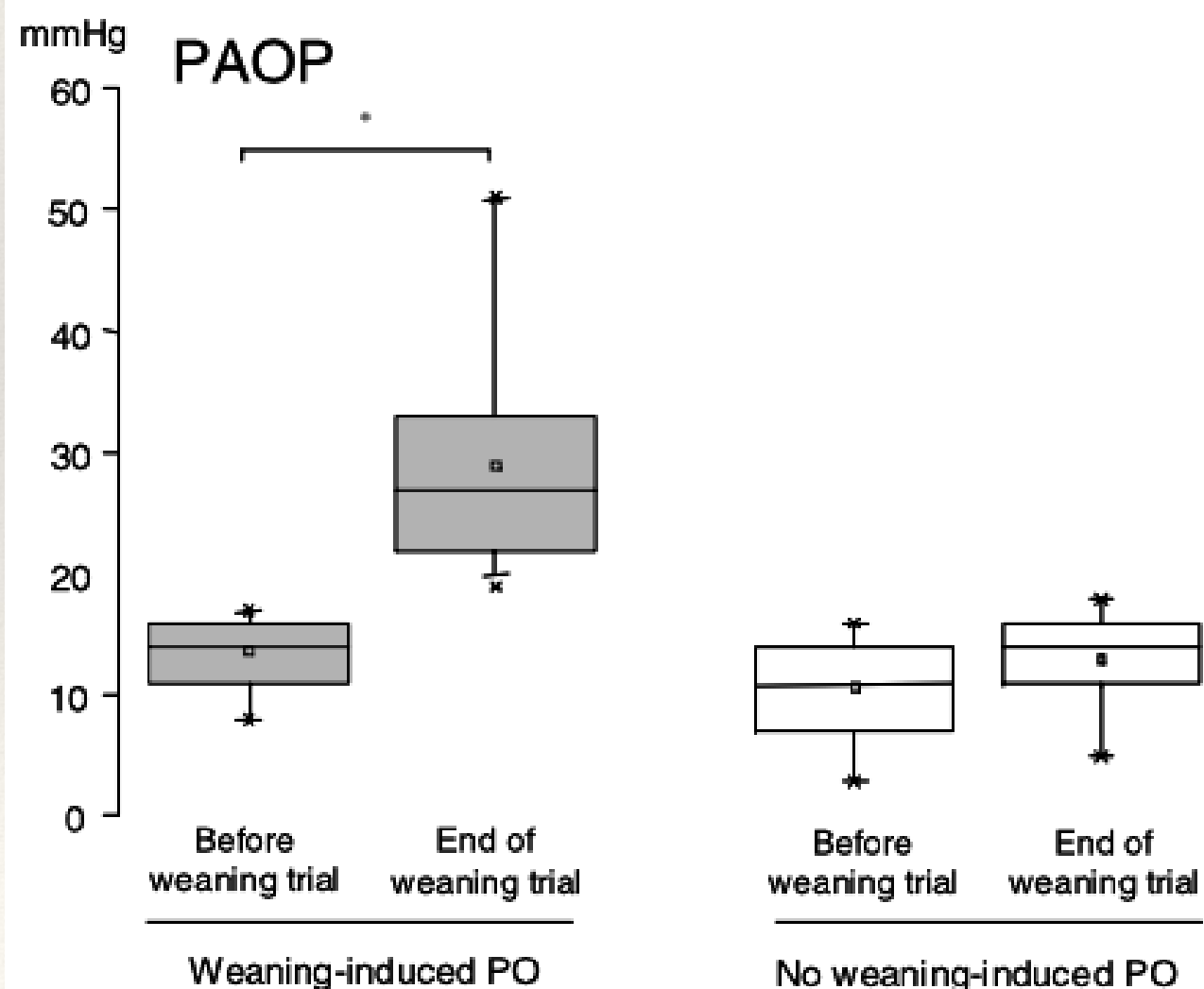


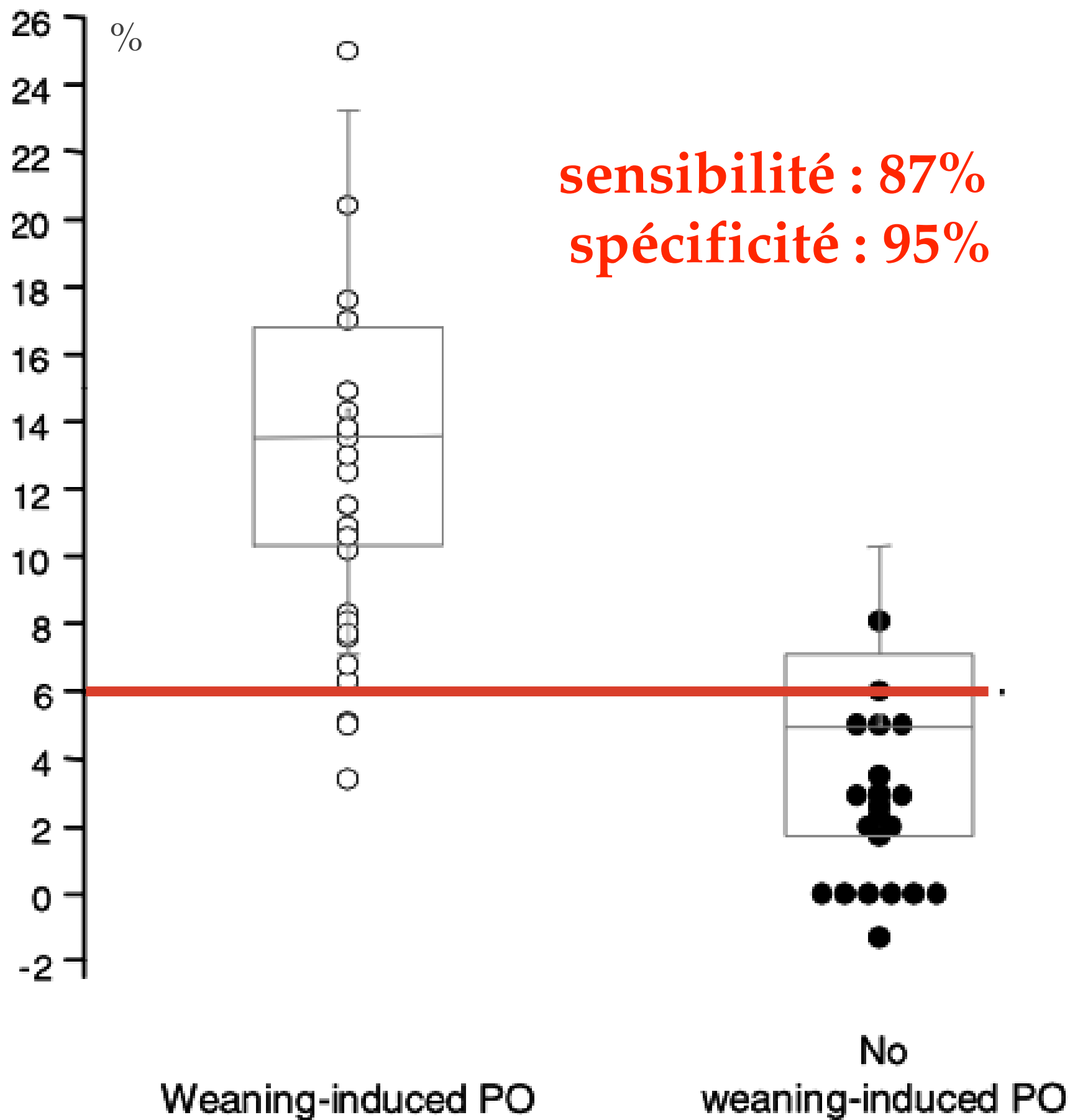
Hémoconcentration

Nadia Anguel
Xavier Monnet
David Osman
Vincent Castelain
Christian Richard
Jean-Louis Teboul

Increase in plasma protein concentration for diagnosing weaning-induced pulmonary oedema

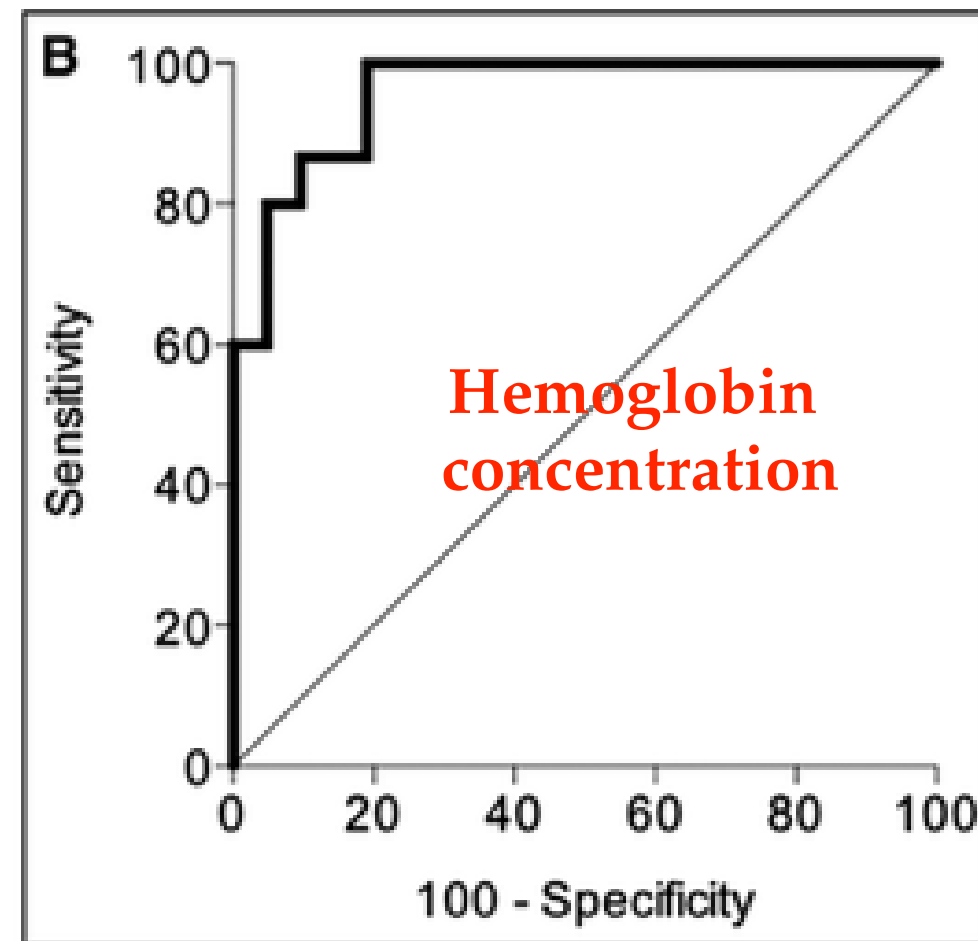
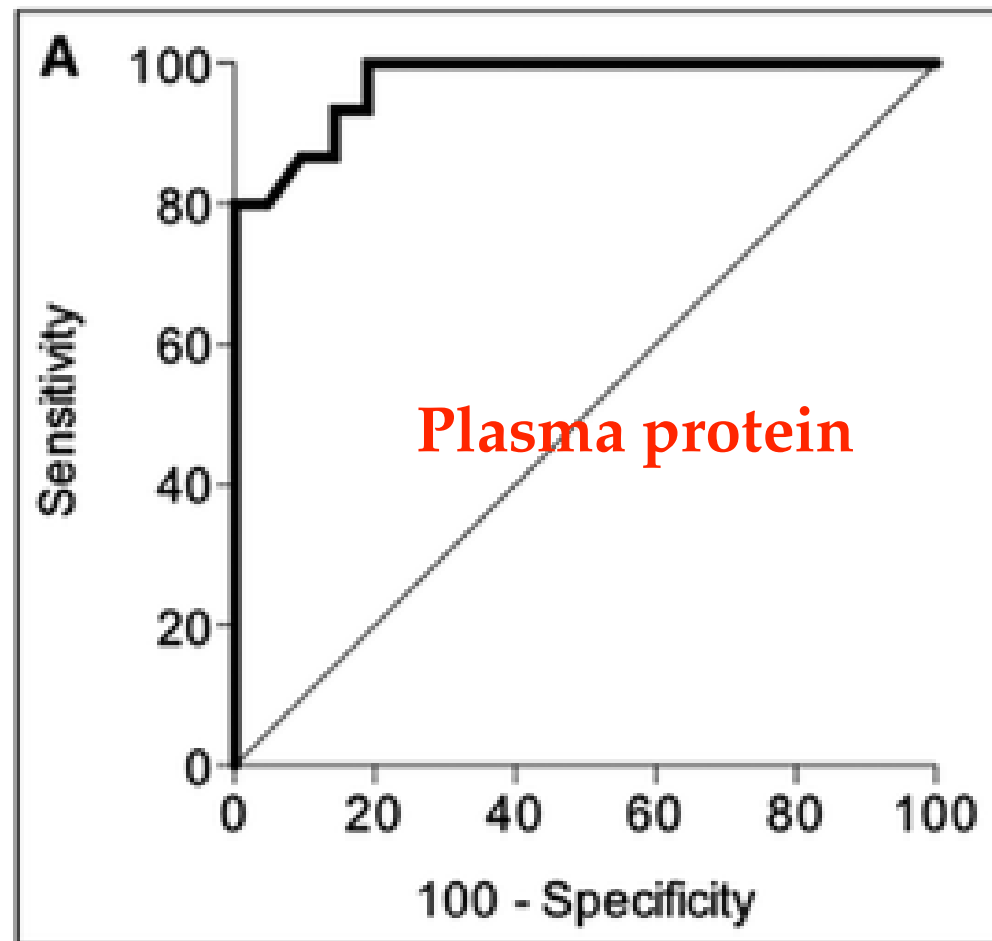
46 patients
24 OAP de sevrage





Extravascular Lung Water, B-Type Natriuretic Peptide, and Blood Volume Contraction Enable Diagnosis of Weaning-Induced Pulmonary Edema*

Martin Dres, MD^{1,2}; Jean-Louis Teboul, MD, PhD^{1,2}; Nadia Anguel, MD¹; Laurent Guerin, MD^{1,2}; Christian Richard, MD^{1,2}; Xavier Monnet, MD, PhD^{1,2}



	Threshold	Areas Under the Receiver Operating Characteristics Curve	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Youden Index	Positive Likelihood Ratio	Negative Likelihood Ratio
Variation of plasma protein concentration	5%	0.97	0.86	0.87	0.90	0.90	0.73	6.66	0.16
Variation of hemoglobin	5%	0.96	0.81	1.00	1.00	0.88	0.81	∞	0.19

Traitement

❖ Diurétiques

❖ Nitrates

❖ Levosimendan

❖ VNI

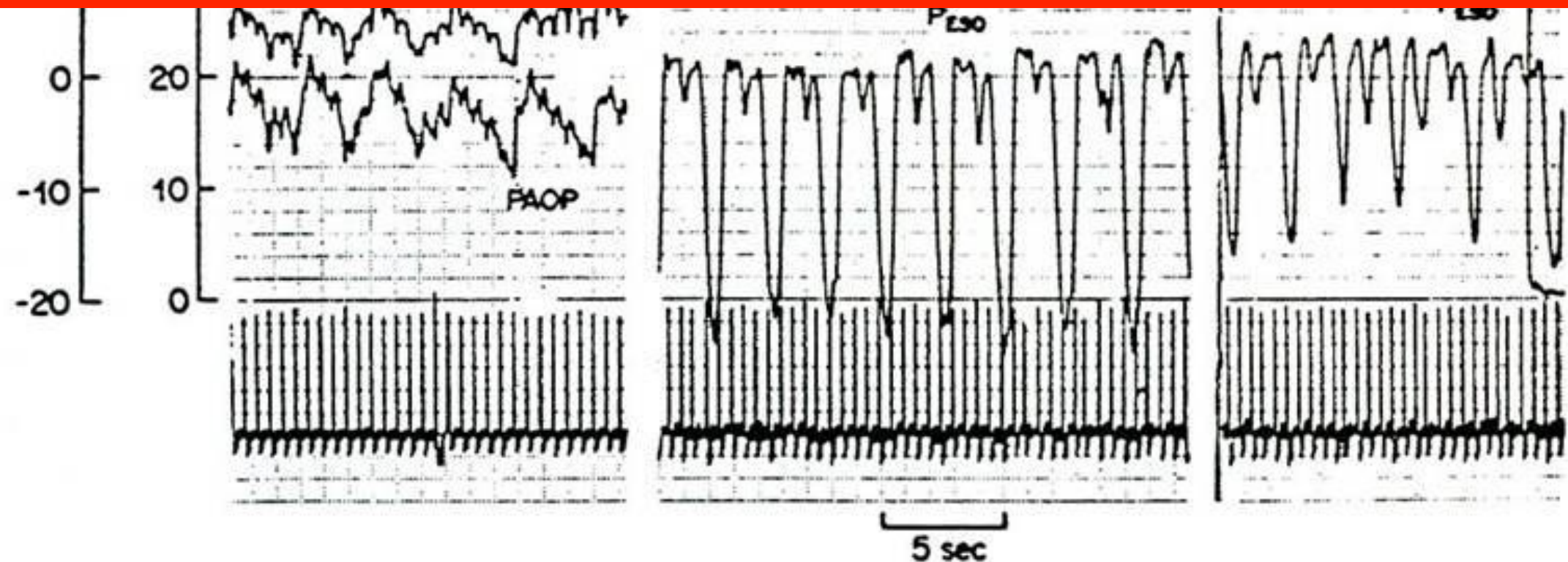
Diurétiques

- ❖ Pour diminuer la surcharge volémique
- ❖ Si VTDVG est augmenté une baisse même minime du volume s'accompagne d'une **baisse de la PTDVG**
- ❖ En cas de dilatation du VD les diurétiques diminuent la PTDVG en **réduisant l'interdépendance ventriculaire** par le biais d'une réduction du VTDVD

Acute Left Ventricular Dysfunction during Unsuccessful Weaning from Mechanical Ventilation

Francois Lemaire, M.D.,* Jean-Louis Teboul, M.D.,† Luc Cinotti, M.D.,‡ Guillen Giotto, M.D.,§

9/15 patients ont été traité avec furosemide avec succès du sevrage 1 semaine plus tard. La moyenne de perte de poids a été de 5 Kg.



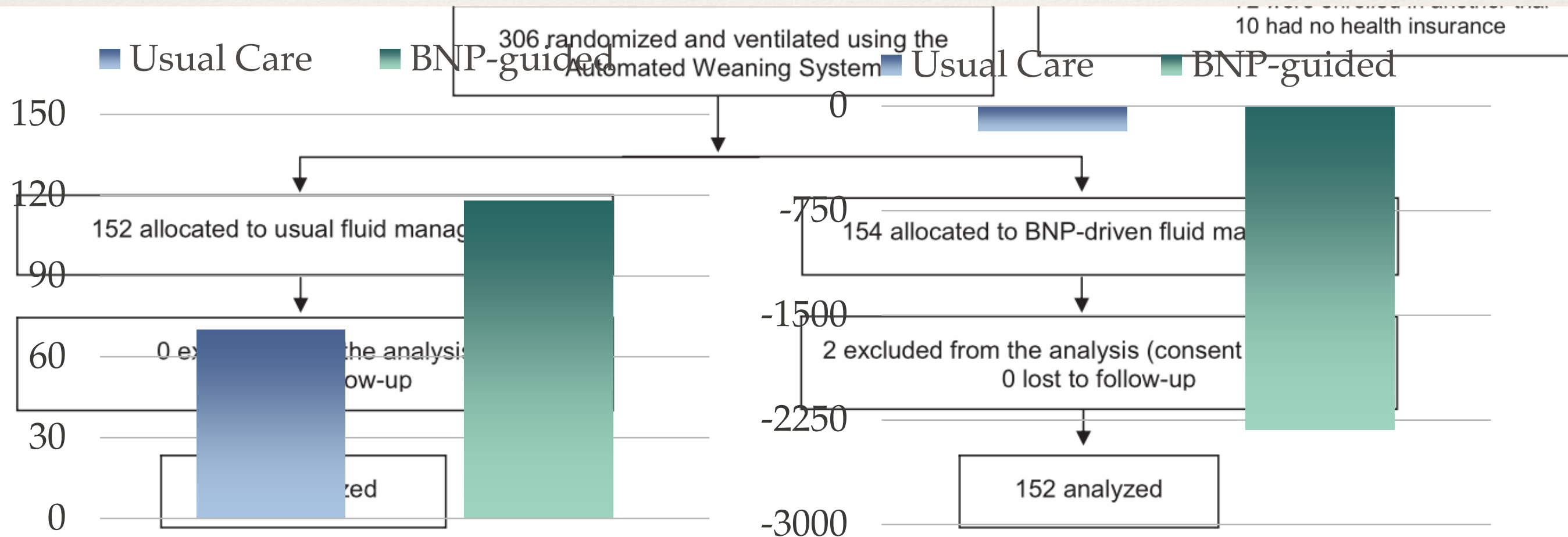
Natriuretic Peptide-driven Fluid Management during Ventilator Weaning

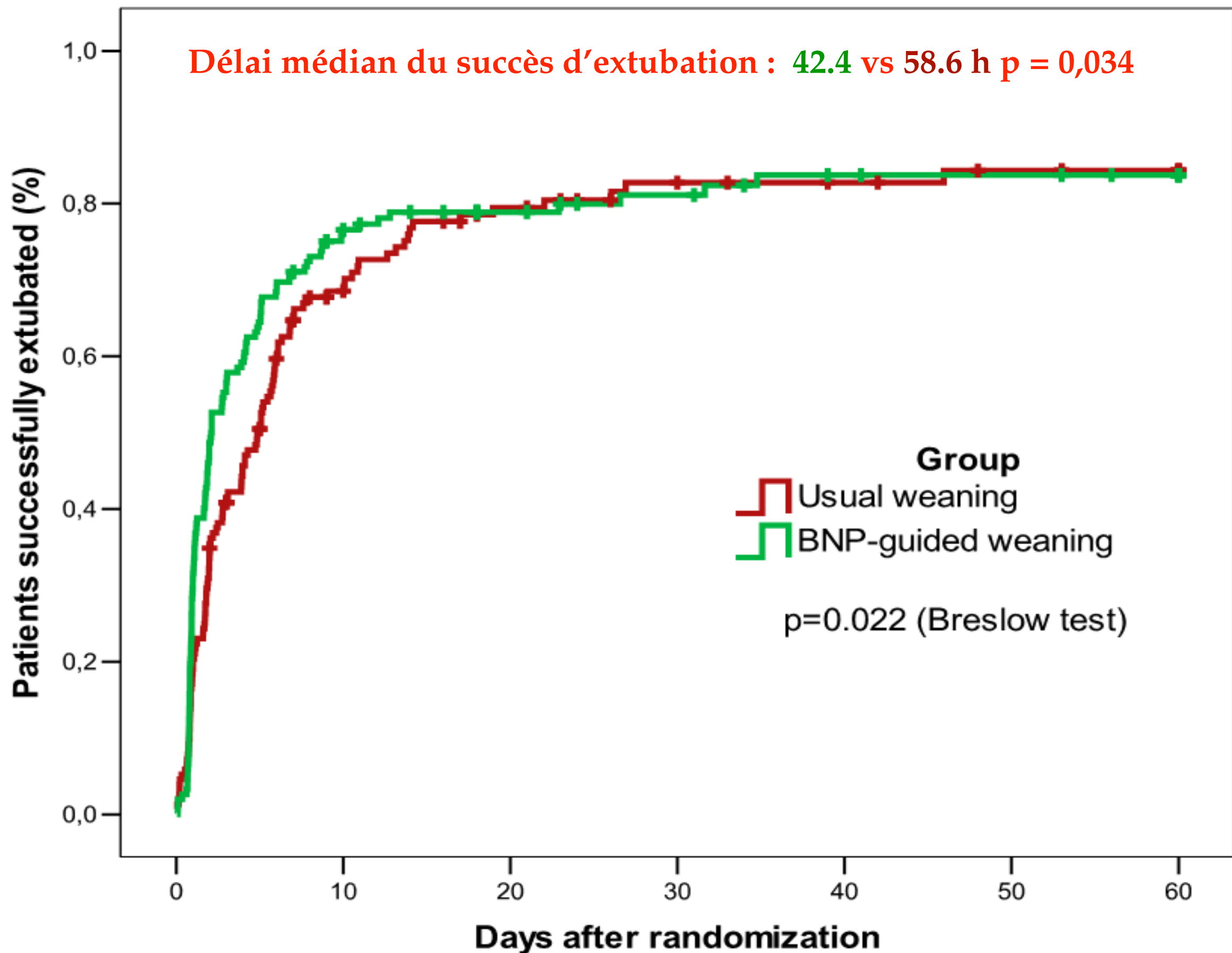
A Randomized Controlled Trial

Armand Mekontso Dessap^{1,2,3}, Ferran Roche-Campo^{1,4}, Achille Kouatchet⁵, Vinko Tomicic⁶, Gaetan Beduneau⁷, Romain Sonnevile⁸, Belen Cabello⁴, Samir Jaber⁹, Elie Azoulay¹⁰, Diego Castanares-Zapatero¹¹, Jerome Devaquet¹², François Lellouche¹³, Sandrine Katsahian¹⁴, and Laurent Brochard^{1,2,3,15}

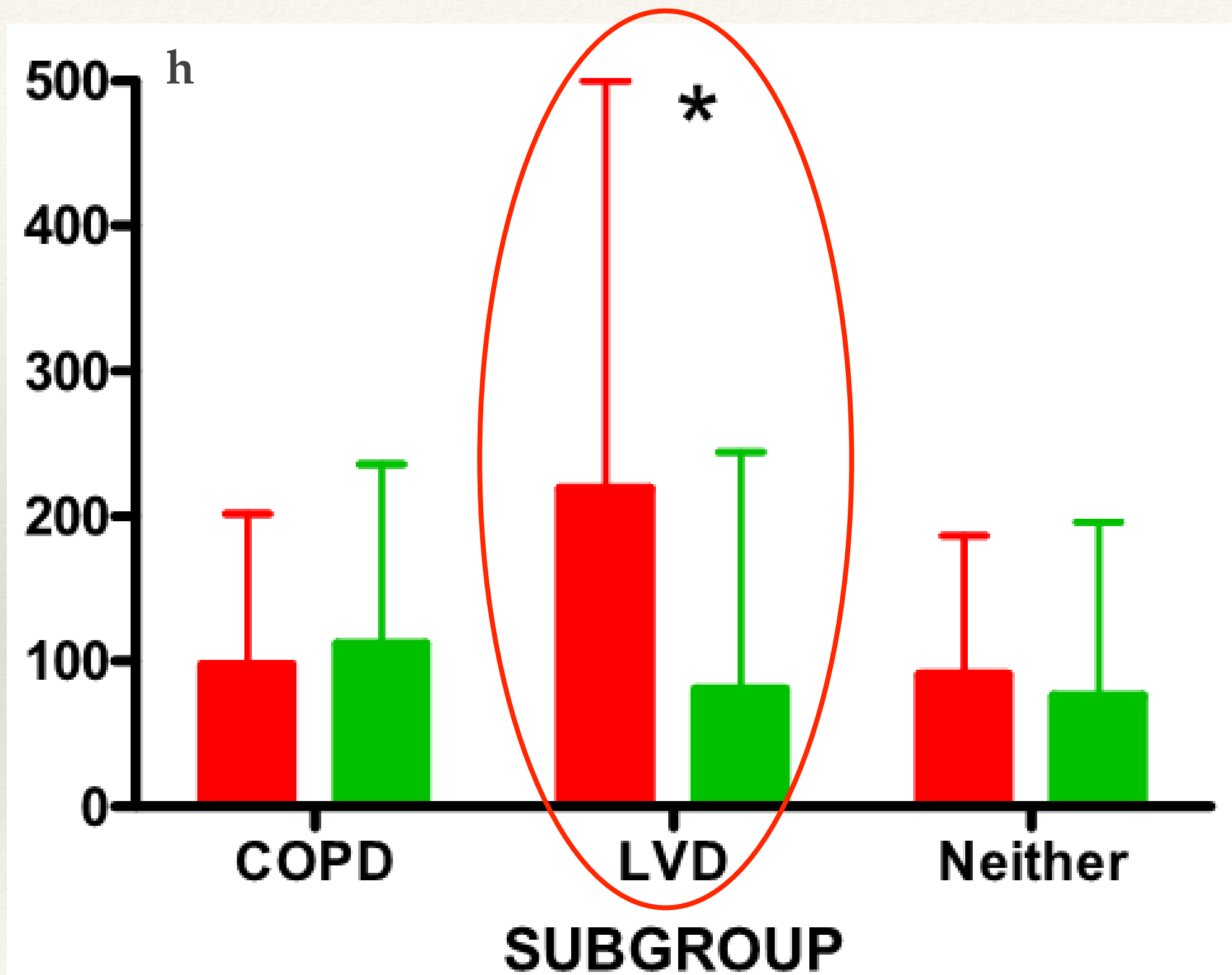
Cumulative furosemide dose during weaning (mg)

Cumulative fluid balance during weaning (ml)





Succès d'extubation



Traitement

- ❖ Diurétiques
- ❖ Nitrates
- ❖ Levosimendan
- ❖ VNI

Dérivé nitré

- ❖ Dilatation veineuse —> réduction du volume sanguin central
- ❖ Vasodilatation artérielle —> baisse de la post charge
- ❖ Vasodilatation coronaire —> améliore le transport d'oxygène au myocarde

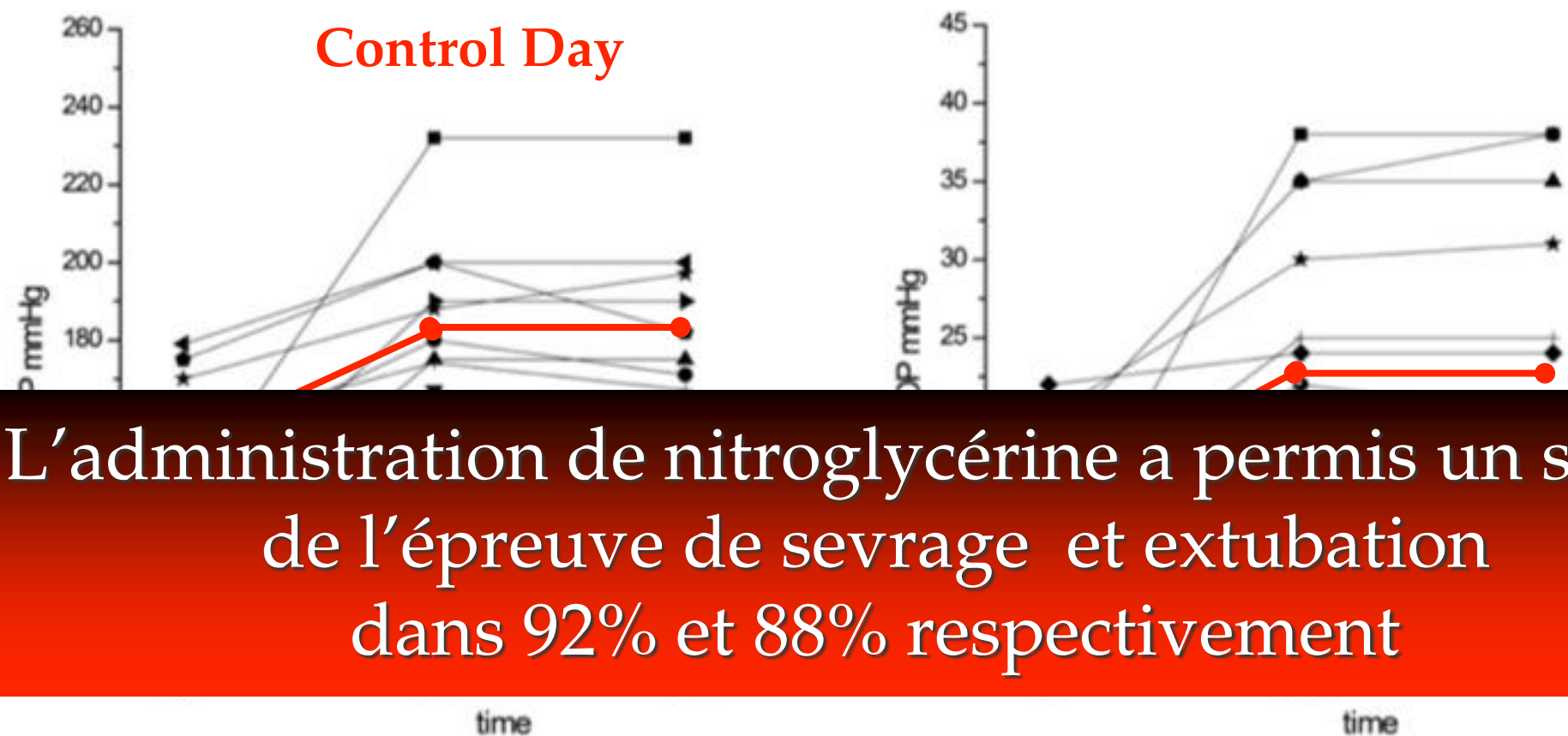
RESEARCH

Open Access

Nitroglycerin can facilitate weaning of difficult-to-wean chronic obstructive pulmonary disease patients: a prospective interventional non-randomized study

Christina Routsi^{1*}, Ioannis Stanopoulos², Epaminondas Zakynthinos¹, Panagiotis Politis¹, Vassilios Papas¹, Demetrios Zervakis¹, Spyros Zakynthinos¹

- ❖ 12 patients BPCO, Difficulté de sevrage, TAS > 140 mmHg
- ❖ 2 jours de suite
 - ❖ J1 **sans** Nitroglycérine.
 - ❖ J2 **avec** Nitroglycérine IV continue débuté au début de l'épreuve de ventilation spontanée



L'administration de nitroglycérine a permis un succès de l'épreuve de sevrage et extubation dans 92% et 88% respectivement

Traitement

- ❖ Diurétiques
- ❖ Nitrates
- ❖ Levosimendan
- ❖ VNI

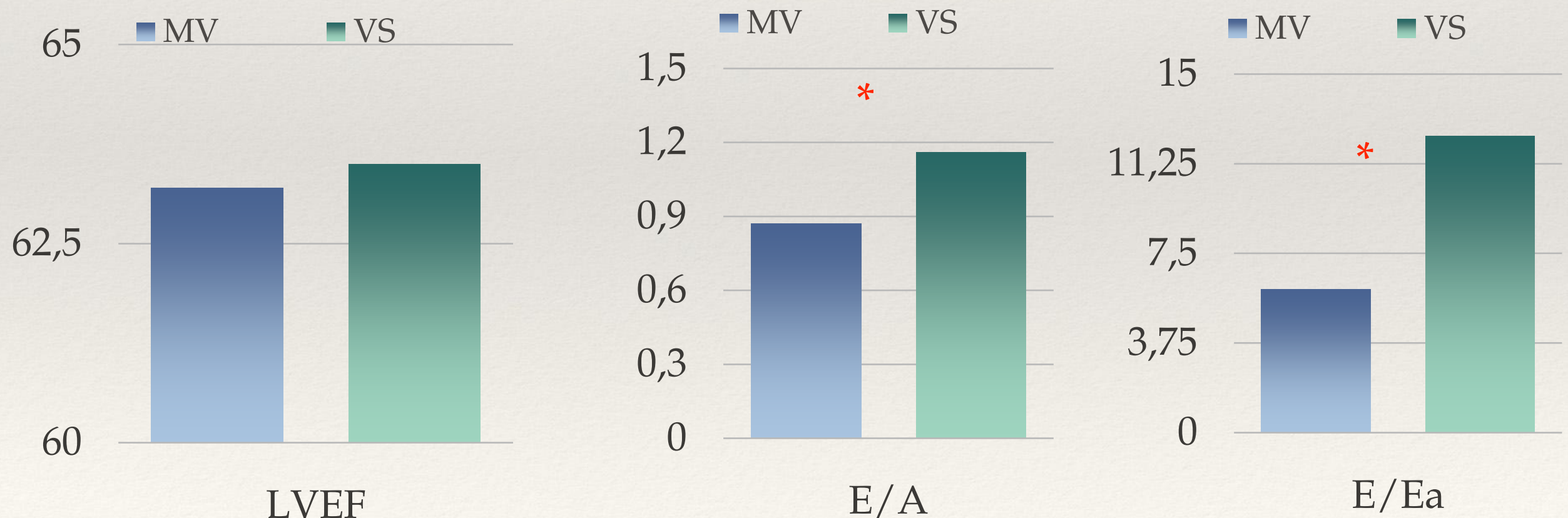
Weaning difficult-to-wean chronic obstructive pulmonary disease patients: A pilot study comparing initial hemodynamic effects of levosimendan and dobutamine

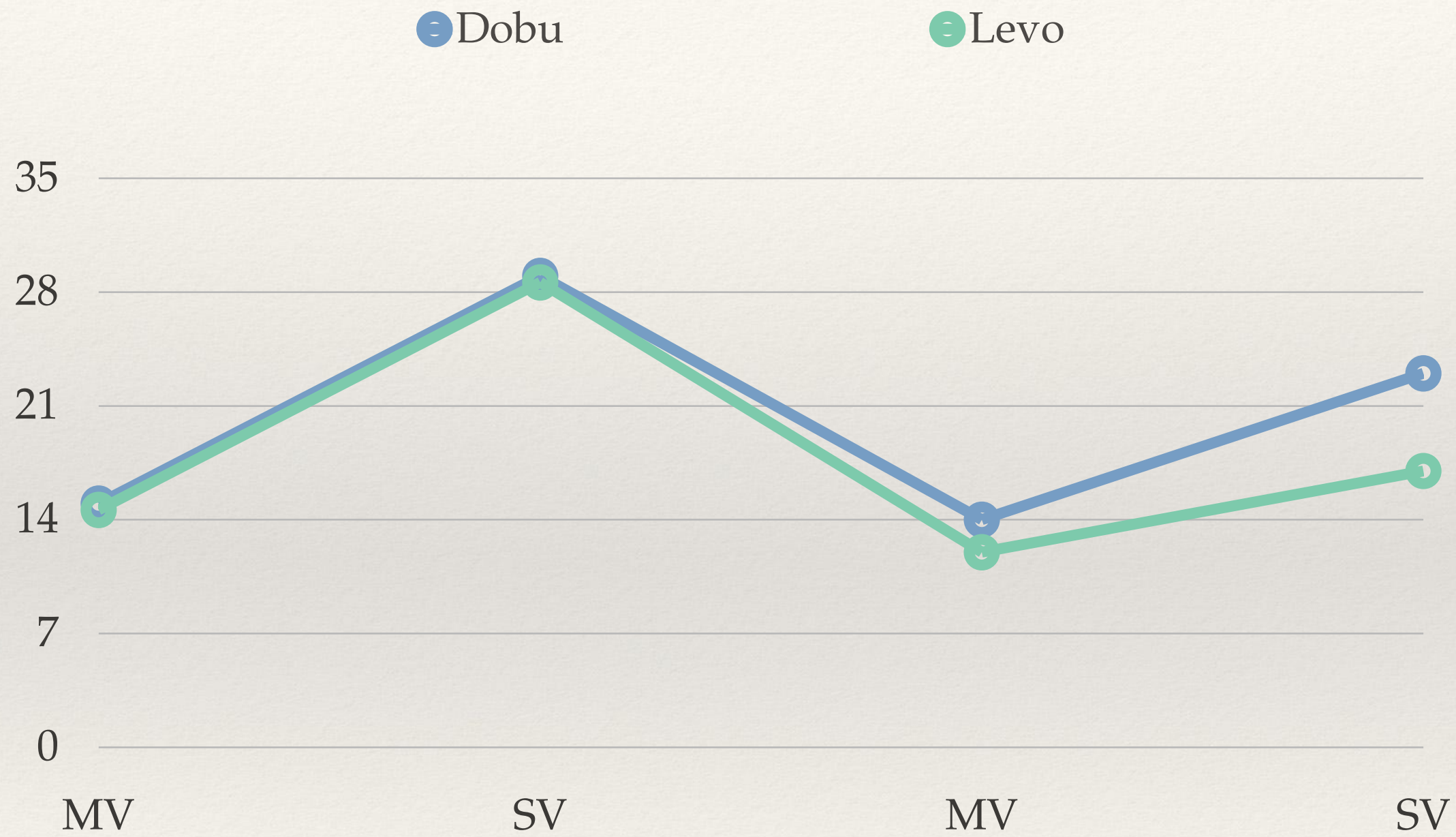
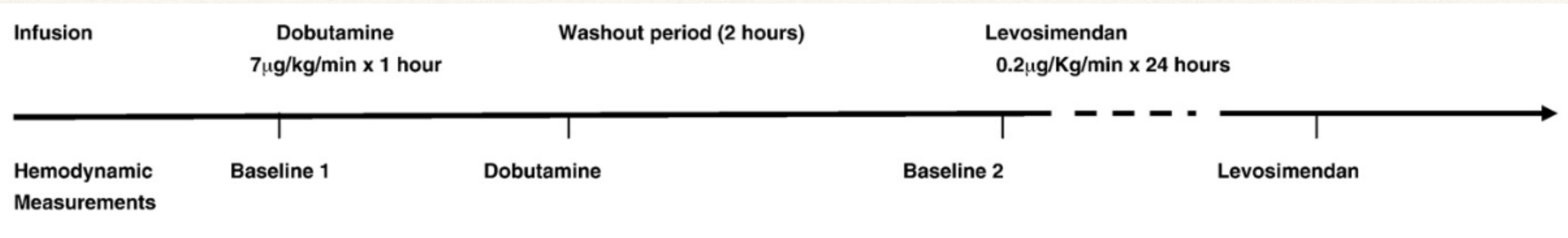
Lamia Ouanes-Besbes^a, Islem Ouanes^a, Fahmi Dachraoui^a, Saoussen Dimassi^a, Alexandre Mebazaa^b, Fekri Abroug MD^{a,*}

^aIntensive Care Unit, CHU Fatouma Bourguiba, 5000 Monastir, Tunisia

^bDepartment of Anesthesiology and Critical Care Medicine, Hopital Lariboisière, Paris, France

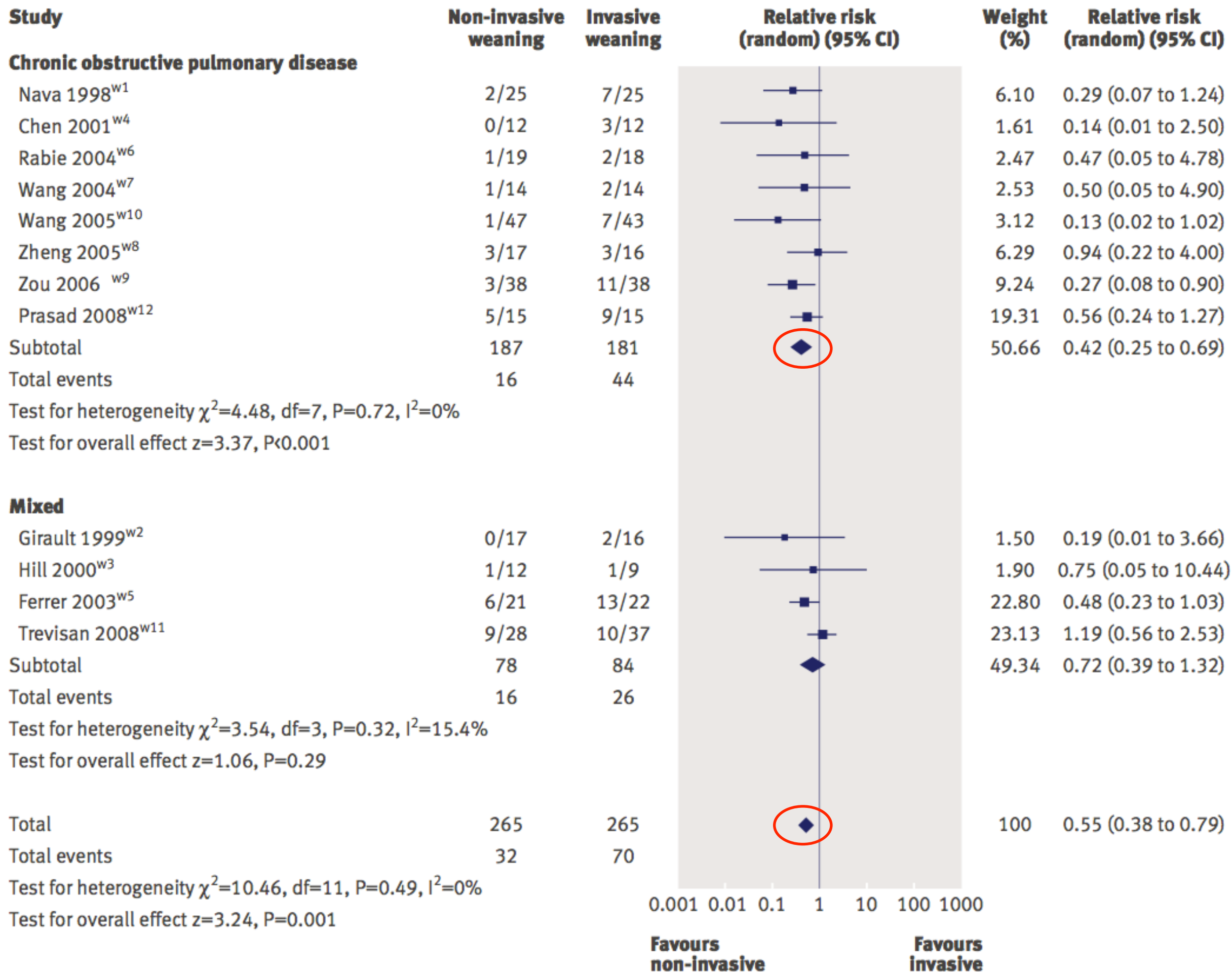
10 BPCO weaning difficulties ascribed to LV dysfunction



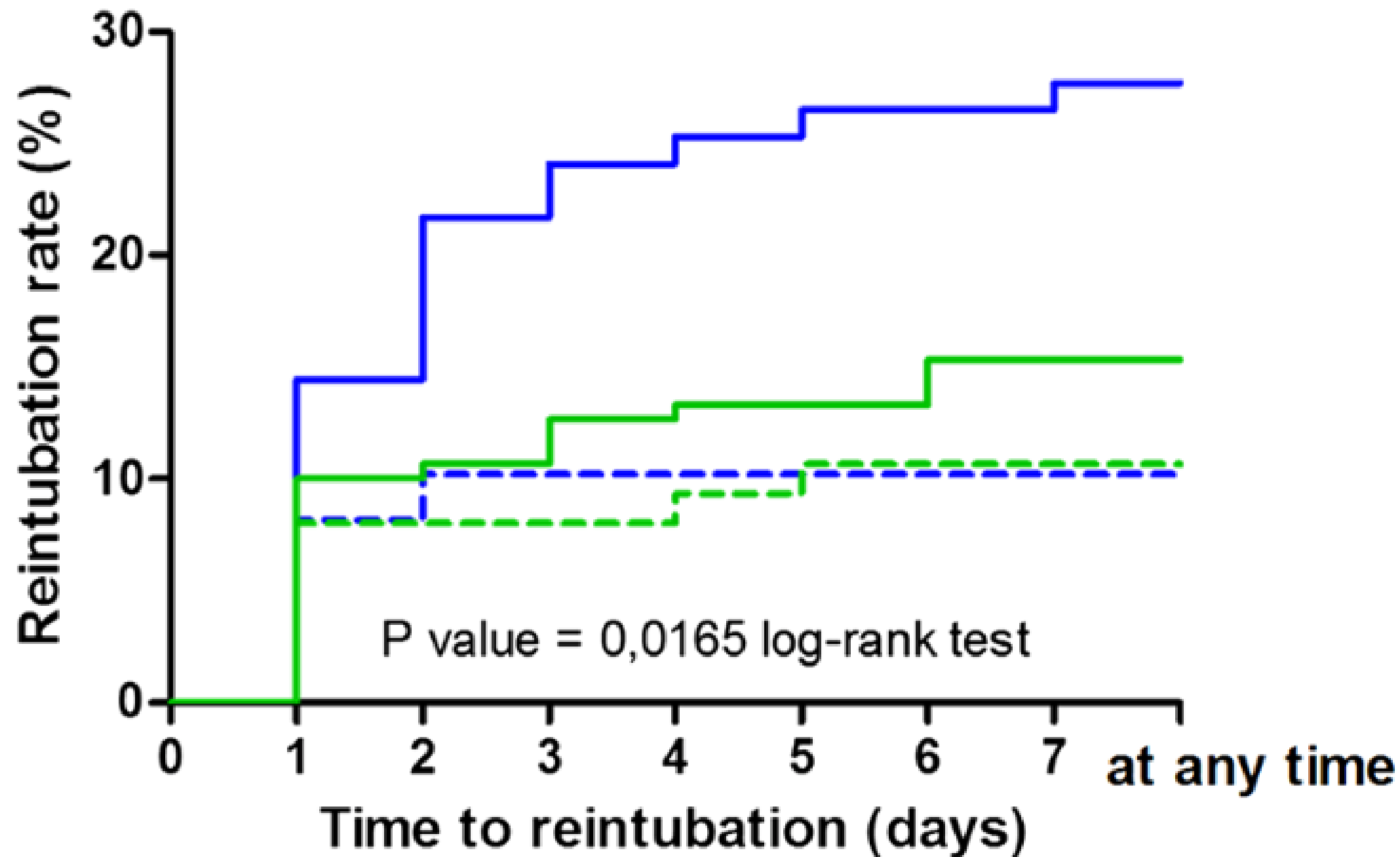


Traitement

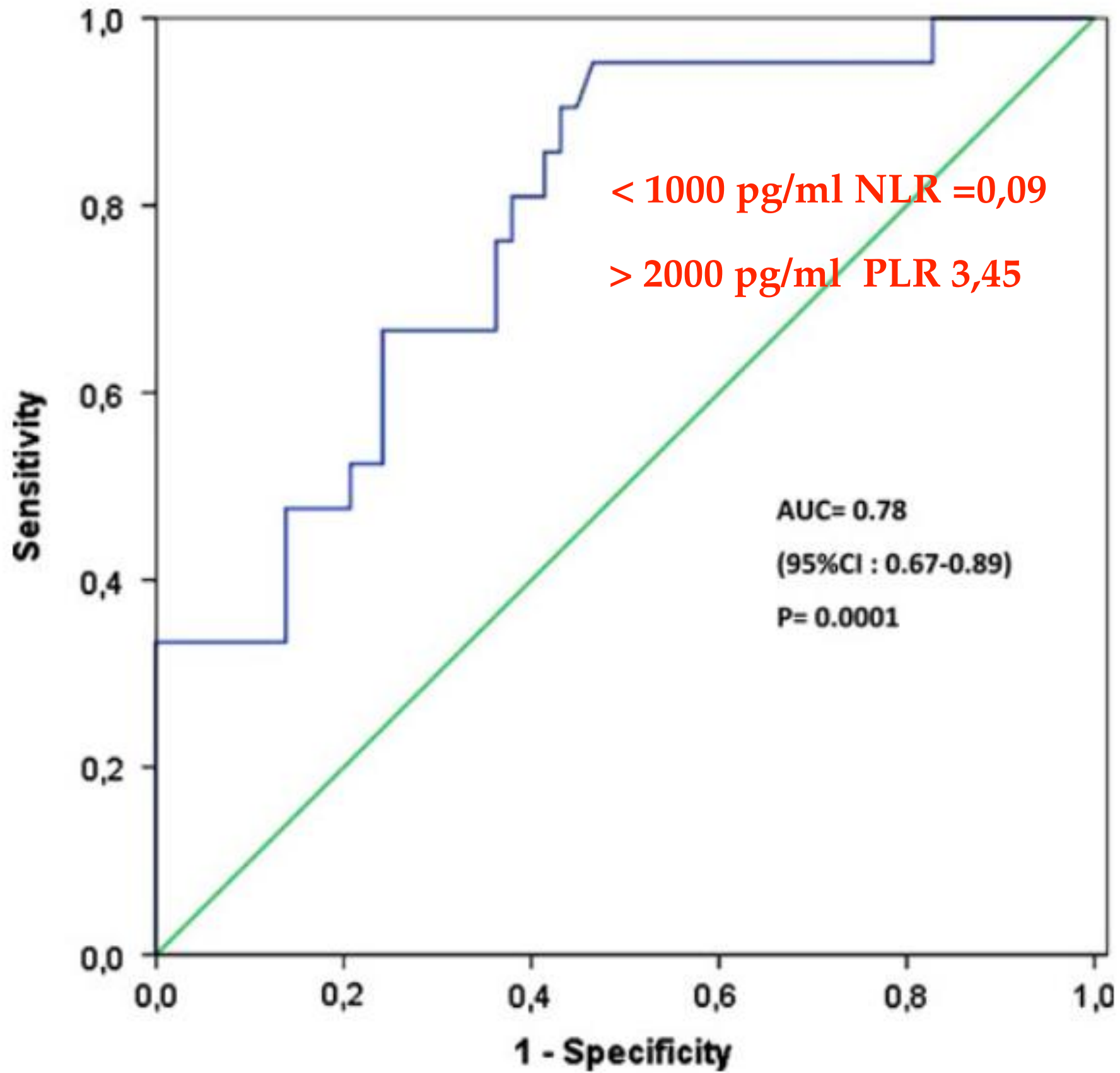
- ❖ Diurétiques
- ❖ Nitrates
- ❖ Levosimendan
- ❖ VNI



- High-risk control cohort
- - Low-risk control cohort
- High-risk second cohort (with NIV)
- - Low-risk second cohort



Lamia Ouanes
Fahmi Dachra
Islem Ouanes
Rania Bouneb
Faten Jalloul
Mohamed Dja
Mohamed Fac
Fekri Abroug



**breathing
extubation**



AMERICAN THORACIC SOCIETY DOCUMENTS

Official Executive Summary of an American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically Ill Adults

- ♦For patients at **high risk for extubation failure** who have been receiving mechanical ventilation for more than 24 hours, and who have passed a spontaneous breathing trial, we recommend **extubation to preventative NIV** (Strong recommendation, moderate certainty in the evidence).

Conclusions

- ❖ Cause fréquente et bien établie d'échec de sevrage
- ❖ Mécanisme variable d'un patient à un autre
- ❖ Progrès important pour son diagnostic en faveur des moyens non invasifs.
- ❖ Le traitement permet souvent le succès du sevrage