Le remplissage vasculaire chez l'adulte aux soins intensifs

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I. Introduction

- Thérapie ancienne (Lewins-Latta, 1832)
- Le remplissage vasculaire est l'une des thérapies le plus couramment utilisé chez les patients gravement malades
- Pierre angulaire de la gestion hémodynamique des patients (Myburgh et al. NEJM, 2013)
- Thérapie est également présente aux urgences, au quartier opératoire, chez les grands brûlés et les enfants ➔ Focus aux soins intensifs dans cet exposé

I. Introduction

Précoce vs tardif ?

651 pts en choc septique ou sepsis sévère

TABLE 4] Multivariate Regression

Variable	OR (95% CI)	*P* Value
Proportion of fluid in first 3 h	0.34 (0.15-0.75)	.0076
Total fluid in 6 h	1.00 (1.00-1.00)	.0138
Age	1.02 (1.01-1.04)	.0050
Weight	1.00 (0.99-1.01)	.7008
Admission APACHE III score	1.00 (0.98-1.01)	.4670
SOFA score on day 1	1.20 (1.14-1.27)	<.0001[a]

See Table 1 and 2 legends for expansion of abbreviations.
[a] $P < .05$.

[CHEST OCTOBER 2 0 1 4]

I. Introduction

14,115 patients

Quality Improvement Initiative for Severe Sepsis and Septic Shock Reduces 90-Day Mortality: A 7.5-Year Observational Study

Christian S. Scheer, MD[1]; Christian Fuchs, MD[1]; Sven-Olaf Kuhn, MD[1]; Marcus Vollmer, MSM[2]; Sebastian Rehberg, MD, PhD[1]; Sigrun Friesecke, MD[3]; Peter Abel, MD[3]; Veronika Balau, MD[4]; Christoph Bandt, PhD[2]; Konrad Meissner, MD, PhD[1]; Klaus Hahnenkamp, MD, PhD[1]; Matthias Gründling, MD[1]

TABLE 3. (*Continued*). Cox Proportional Hazards Regression Analysis of Patient Characteristics and Bundle Elements

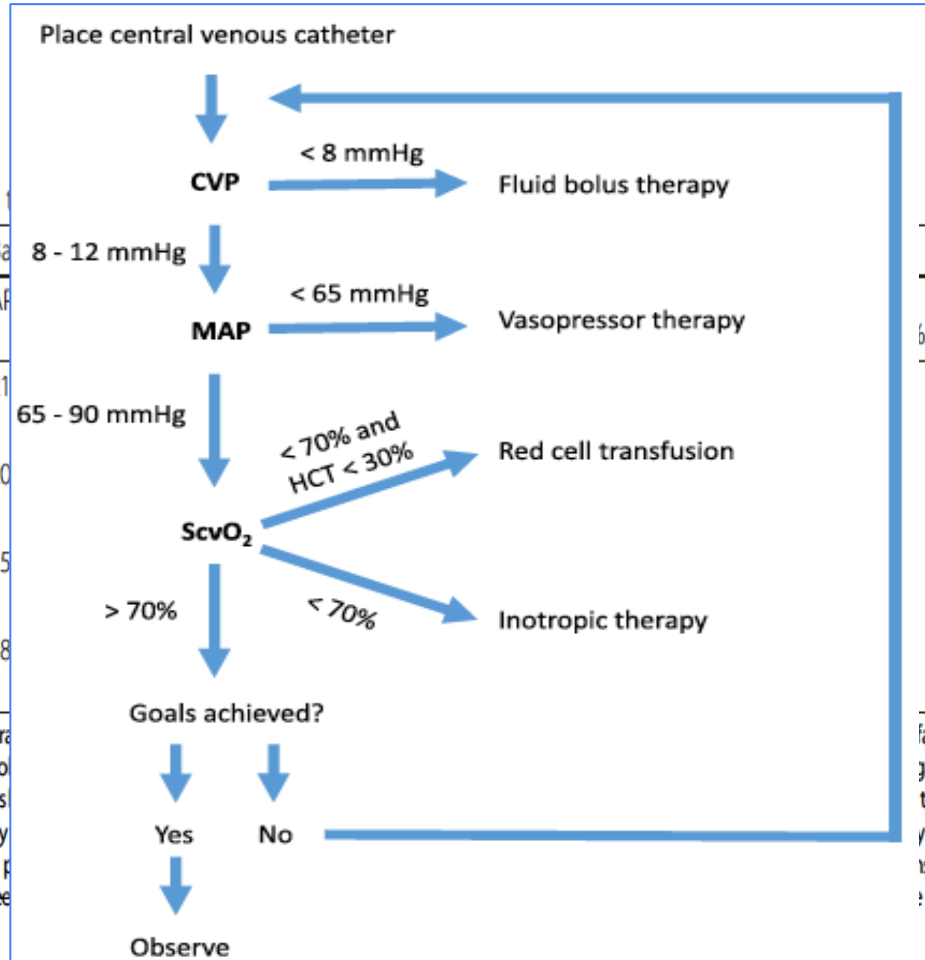
	Full Model		Final Model through Backward Elimination	
	Hazard Ratio (95% CI)	*p*	Hazard Ratio (95% CI)	*p*
$Scvo_2$ within 6 hr				
No	Reference			
Yes	0.975 (0.82–1.16)	0.780		
Calculated antibiotic therapy				
Not adequate	Reference			
Adequate	0.646 (0.52–0.80)	< 0.001	0.631 (0.53–0.75)	< 0.001
Preemptive adequate	1.129 (0.86–1.48)	0.380		
Preemptive not adequate	0.915 (0.68–1.23)	0.554		
Crystalloids first 6 hr, L				
< 1	Reference			
1–2	0.843 (0.67–1.07)	0.153	0.81 (0.67–0.97)	0.025
> 2	1.046 (0.80–1.37)	0.743		
Crystalloids first 24 hr, L				
< 2	Reference			
2–6	0.893 (0.69–1.15)	0.380		
≥ 6	0.709 (0.51–0.99)	0.042	0.78 (0.64–0.95)	0.012

I. Introduction

Table 2 Randomized trials of early goal-directed t

Trial	Study setting	Sample size	Ba... AP...	Inotropic therapy, %	Mortality EGDT vs. usual care, %
Rivers et al. [7]	Single center in USA	263	21	13.7	44.3 vs. 56.9[a] ($P = 0.03$)
ProCESS [49]	31 centers in USA	1,341	20	8.0	21.0 vs. 18.9[a] ($P = 0.83$)
ARISE [50]	51 centers in Australia and New Zealand	1,591	15	15.4	18.6 vs. 18.8[b] ($P = 0.90$)
ProMISe [52]	56 centers in England	1,251	18	18.1	29.5 vs. 29.2[b] ($P = 0.90$)

The Protocolized Care for Early Septic Shock (*ProCESS*), Austr ... failed to replicate positive findings of the original
trial by Rivers and colleagues [7]. The study by Rivers and co ... gan. It had a high control group mortality rate,
which likely reflects health problems unique to an impoveris ... that early goal-directed therapy (*EGDT*) did not
improve mortality in patients with increased disease severity ... y rates were markedly lower in the ProCESS, ARISE,
and ProMISe trials, which may reflect broad shifts in clinical p ... nservative thresholds for blood transfusion. Indeed,
the ARISE trial reported a median time of 70 minutes betwee ...
[a]Mortality at 60 days
[b]Mortality at 90 days



Gupta et al. Critical Care (2015) 19:286

I. Introduction

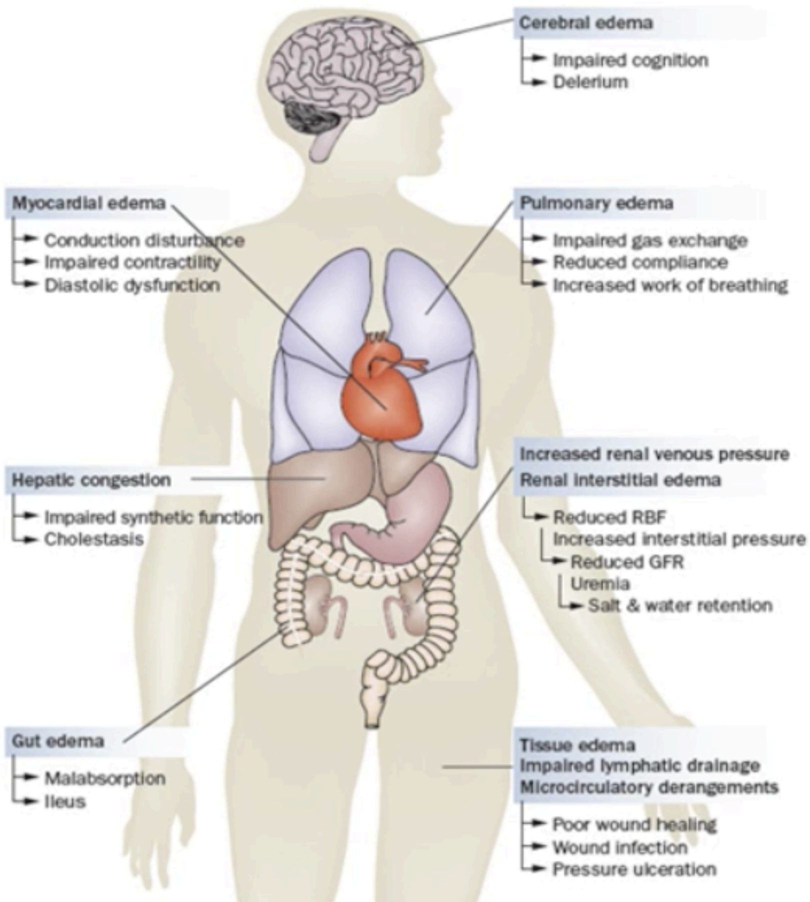
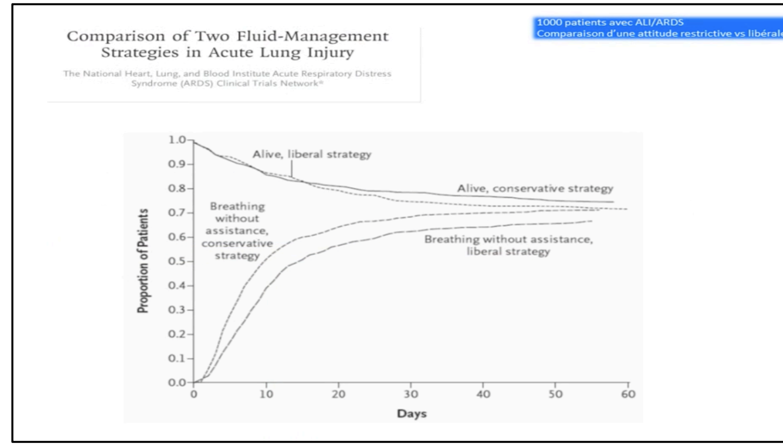
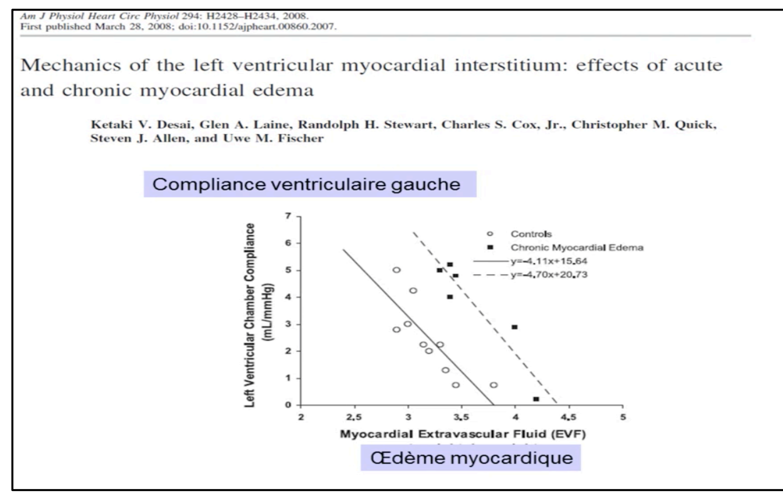


Figure 2 | Pathological sequelae of fluid overload in organ systems. Abbreviations: GFR, glomerular filtration rate; RBF, renal blood flow.





Prowle JR et al. Nat Rev Nephrol 2010

I. Introduction

Sepsis in European intensive care units: Results of the SOAP study*

3,147 pts, choc septique

Jean-Louis Vincent, MD, PhD, FCCM; Yasser Sakr, MB, BCh, MSc; Charles L. Sprung, MD; V. Marco Ranieri, MD; Konrad Reinhart, MD, PhD; Herwig Gerlach, MD, PhD; Rui Moreno, MD, PhD; Jean Carlet, MD, PhD; Jean-Roger Le Gall, MD; Didier Payen, MD; on behalf of the Sepsis Occurrence in Acutely Ill Patients Investigators

Table 7. Multivariate, forward stepwise logistic regression analysis in sepsis patients (n = 1177), with intensive care unit mortality as the dependent factor

	OR (95% CI)	*p* Value
SAPS II score[a] (per point increase)	1.0 (1.0–1.1)	<.001
Cumulative fluid balance[b] (per liter increase)	1.1 (1.0–1.1)	.001
Age (per year increase)	1.0 (1.0–1.0)	.001
Initial SOFA score (per point increase)	1.1 (1.0–1.1)	.002
Blood stream infection	1.7 (1.2–2.4)	.004
Cirrhosis	2.4 (1.3–4.5)	.008
Pseudomonas infection	1.6 (1.1–2.4)	.017
Medical admission	1.4 (1.0–1.8)	.049
Female gender	1.4 (1.0–1.8)	.044

I. Introduction

778 pts en choc septique

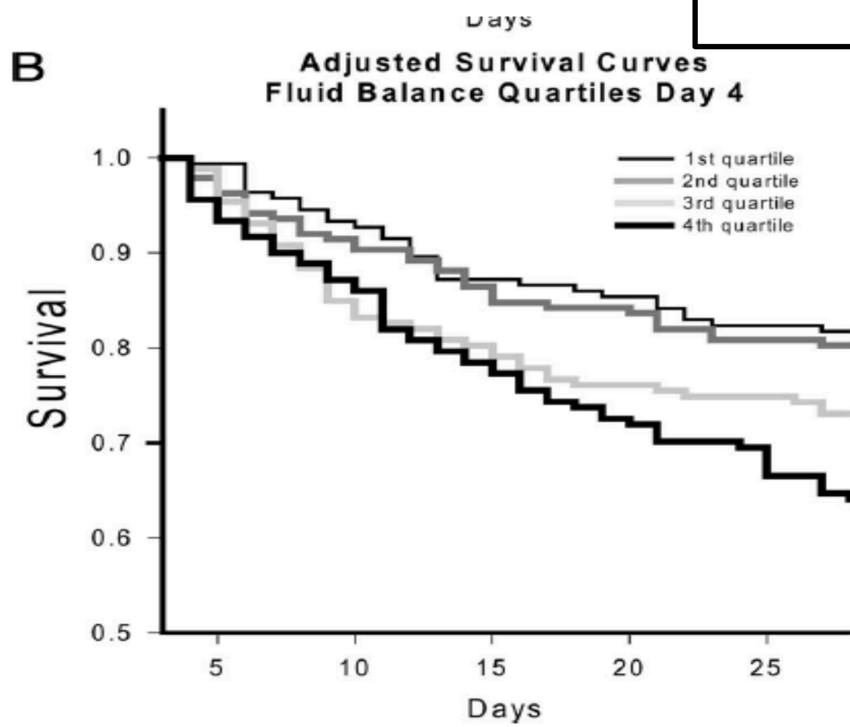


Figure 2. *A*, Cox survival curves, adjusted for age, Acute Physiology and Chronic Health Evaluation (APACHE) II score, and severity of shock (dose of norepinephrine), are shown for fluid balance quartiles at 12 hrs. Quartiles 3 and 4 have significant increases in mortality compared with both quartiles 1 and 2. *B*, Cox survival curves, adjusted for age, APACHE II score, and dose of norepinephrine, are shown for cumulative fluid balance quartiles at day 4. Quartiles 3 and 4 have significant increases in mortality compared with both quartiles 1 and 2.

Crit Care Med 2011 Vol. 39, No. 2

I. Introduction

2051 pts, ARDS. Adults and children

Study or Subgroup	Conservative fluid Mean [Days]	Conservative fluid SD [Days]	Conservative fluid Total	Liberal fluid Mean [Days]	Liberal fluid SD [Days]	Liberal fluid Total	Weight
Chen and Kollef. 2015	5.5	9.4	41	7.4	12.9	41	6.5%
Zhang et al. 2015	9	17.9	168	10.3	18.7	182	10.3%
Hjortrup et al. 2016	21.4	9.7	75	19.8	11.1	76	13.3%
Martin et al. 2005	10.3	8	20	8	8	20	6.4%
Wiedemann et al. 2006	14.6	11.2	503	12.1	11.1	497	51.6%
Richard et al. 2015	12.7	18.7	30	9.7	16.3	30	2.1%
Benakatti et al. 2014	15.8	10.8	54	12.1	9.4	47	9.8%
Total (95% CI)			**891**			**893**	**100.0%**

Heterogeneity: $Tau^2 = 0.33$; $Chi^2 = 6.63$, df = 6 (P = 0.36); $I^2 = 9\%$
Test for overall effect: Z = 2.78 (P = 0.005)

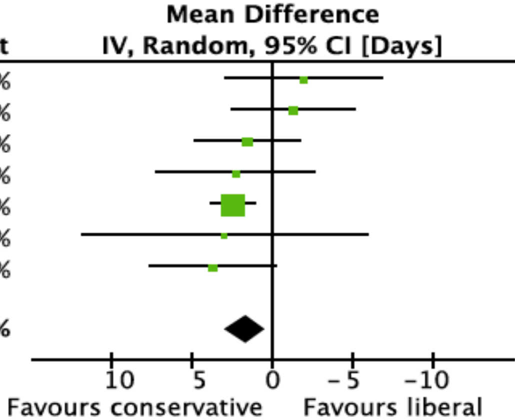


Fig. 4 Forest plot for outcome of ventilator-free days

Study or Subgroup	Conservative fluid Mean [Days]	Conservative fluid SD [Days]	Conservative fluid Total	Liberal fluid Mean [Days]	Liberal fluid SD [Days]	Liberal fluid Total	Weight	Mean Difference IV, Random, 95% CI [Days]
Benakatti et al. 2014	7.1	5.5	54	10.3	6.5	47	15.5%	−3.20 [−5.57, −0.83]
Hjortrup et al. 2016	6.7	6.1	75	6	5.3	76	17.5%	0.70 [−1.12, 2.52]
Hu et al. 2014	12.5	3.5	15	15.5	2.5	14	16.1%	−3.00 [−5.20, −0.80]
Mitchell et al. 1992	13.5	10.7	52	18	10.7	49	9.8%	−4.50 [−8.68, −0.32]
Richard et al. 2015	18.7	17.1	30	17	14.8	30	3.9%	1.70 [−6.39, 9.79]
Wang et al. 2014	12.1	3.2	50	15.8	4.6	50	18.5%	−3.70 [−5.25, −2.15]
Zhang et al. 2015	9	6	168	8.8	8.2	182	18.7%	0.20 [−1.30, 1.70]
Total (95% CI)			**444**			**448**	**100.0%**	**−1.88 [−3.64, −0.12]**

Heterogeneity: $Tau^2 = 3.74$; $Chi^2 = 24.47$, df = 6 (P = 0.0004); $I^2 = 75\%$
Test for overall effect: Z = 2.09 (P = 0.04)

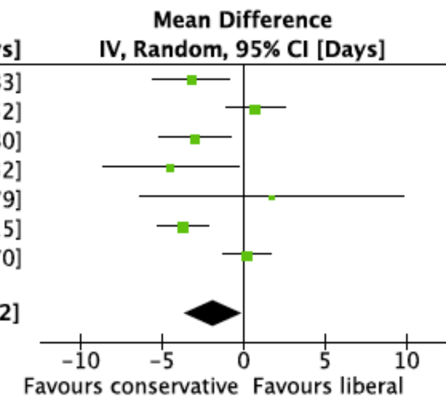


Fig. 5 Forest plot for ICU length of stay, conservative or deresuscitative fluid strategy versus standard care or liberal fluid strategy

Silversides et al. ICM, 2016

I. Introduction

9,190 pts en sepsis , Cohorte retrospective

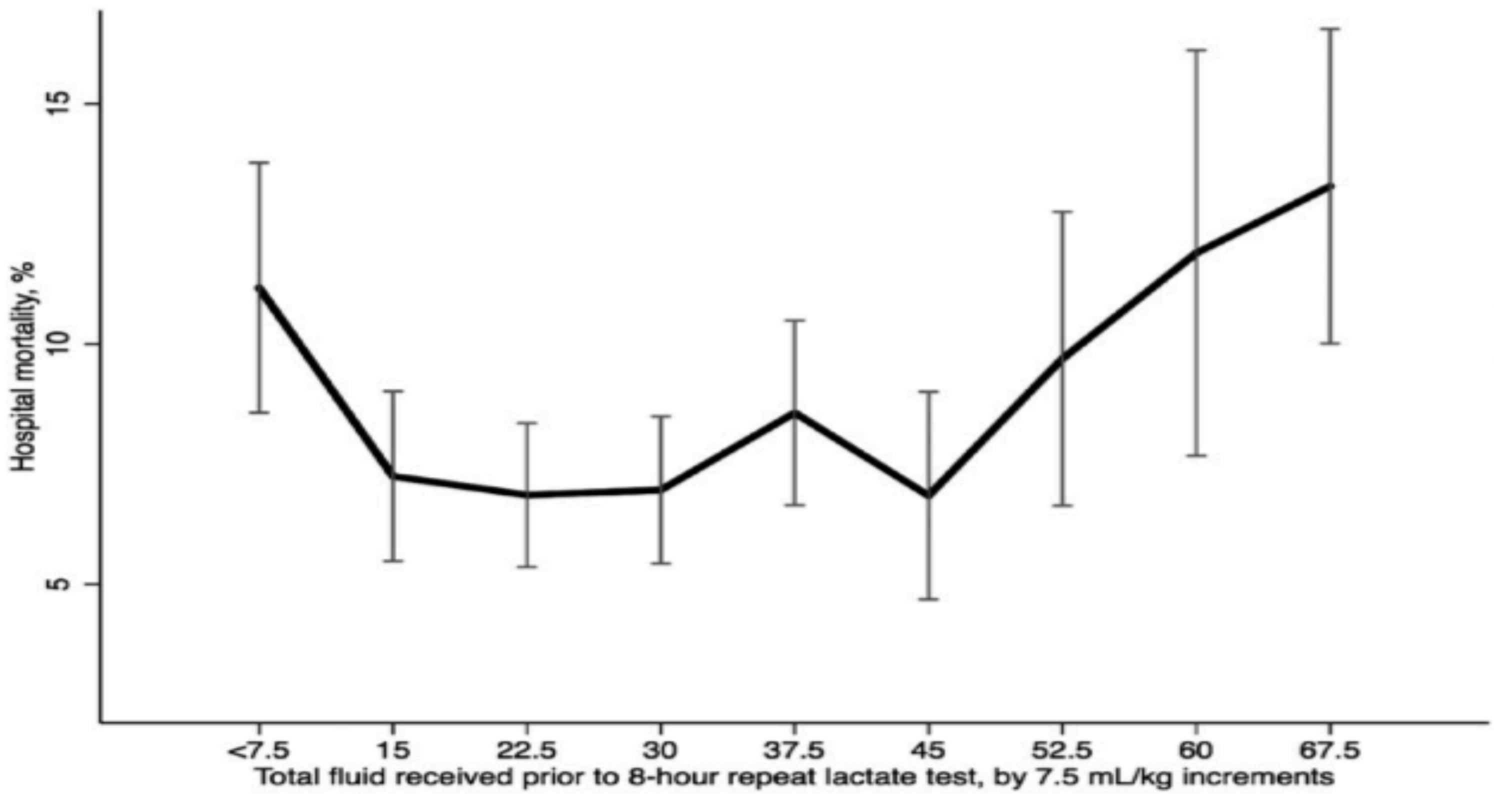
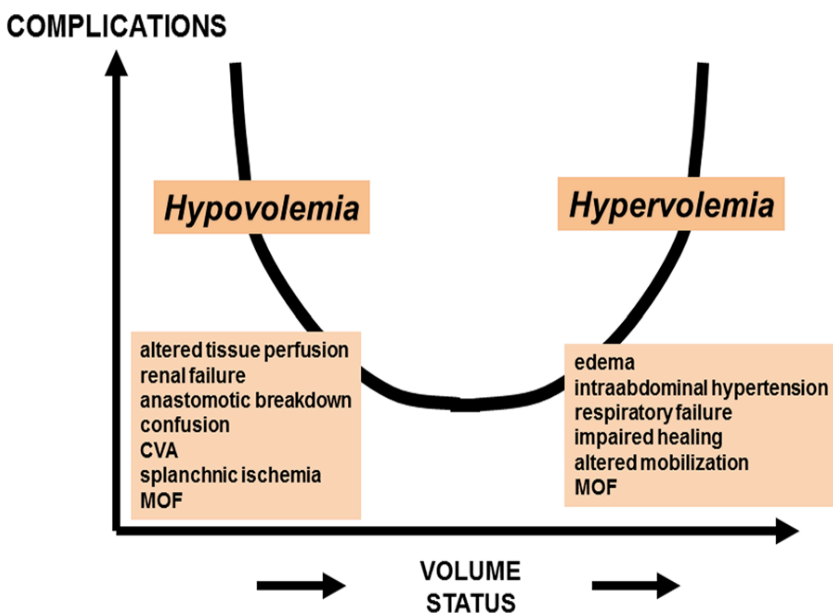


Figure 3. Mean hospital mortality among patients with decreased lactate within 8 hours of index test, stratified by total fluid received in increments of 7.5 ml/kg based on medication administration record.

Annals ATS October 2013

Keys messages (1)

- Remplissage vasculaire très fréquent à l'USI
- Cette thérapie de manière précoce peut améliorer la mortalité dans le sepsis
- Attention au remplissage excessif !!!



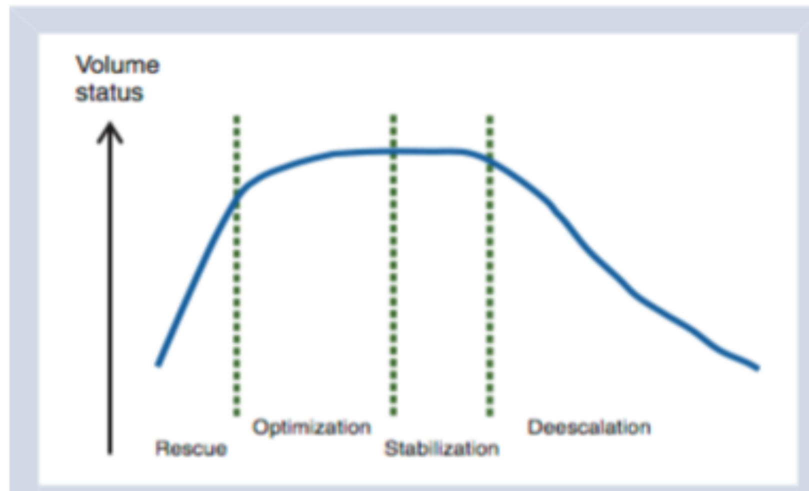


Fig 2 Patients' volume status at different stages of resuscitation. Reproduced with permission from ADQI (www.ADQI.org).

Vincent et al. Critical Care (2015)

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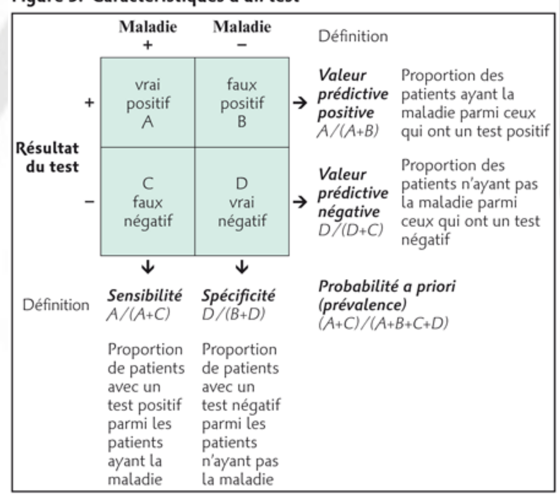
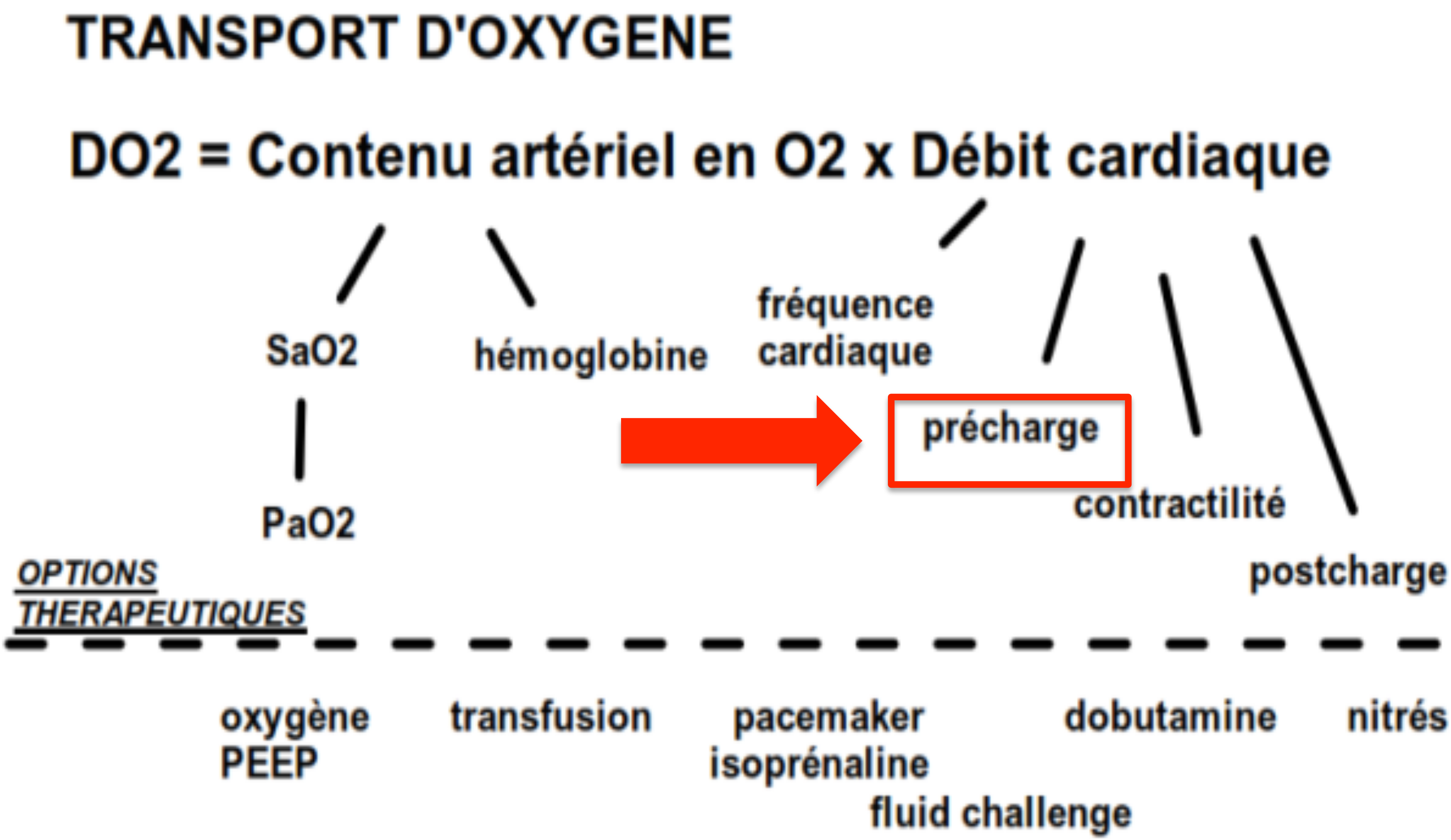
Figure 3. Caractéristiques d'un test

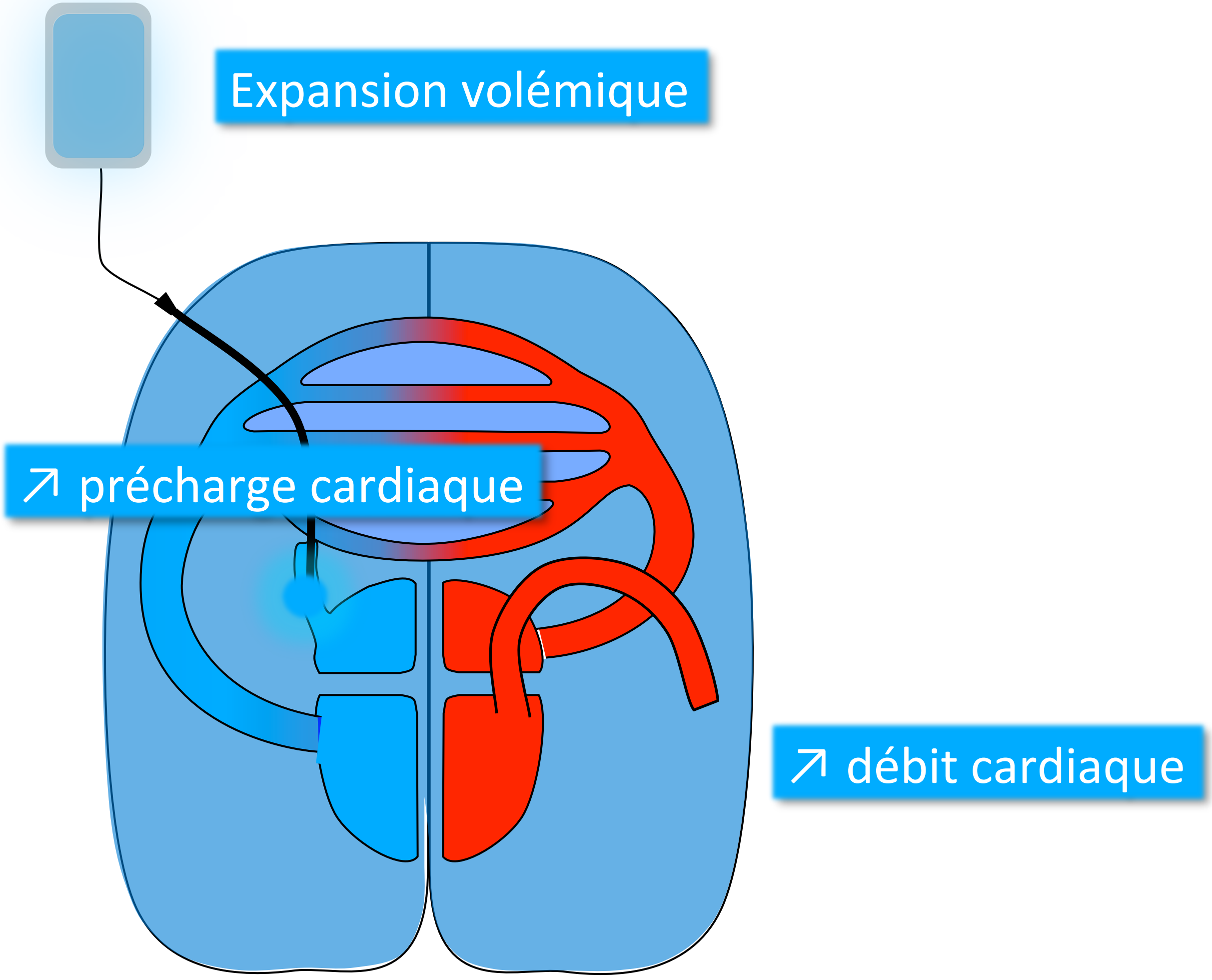


II. Indicateurs prédictifs de remplissage



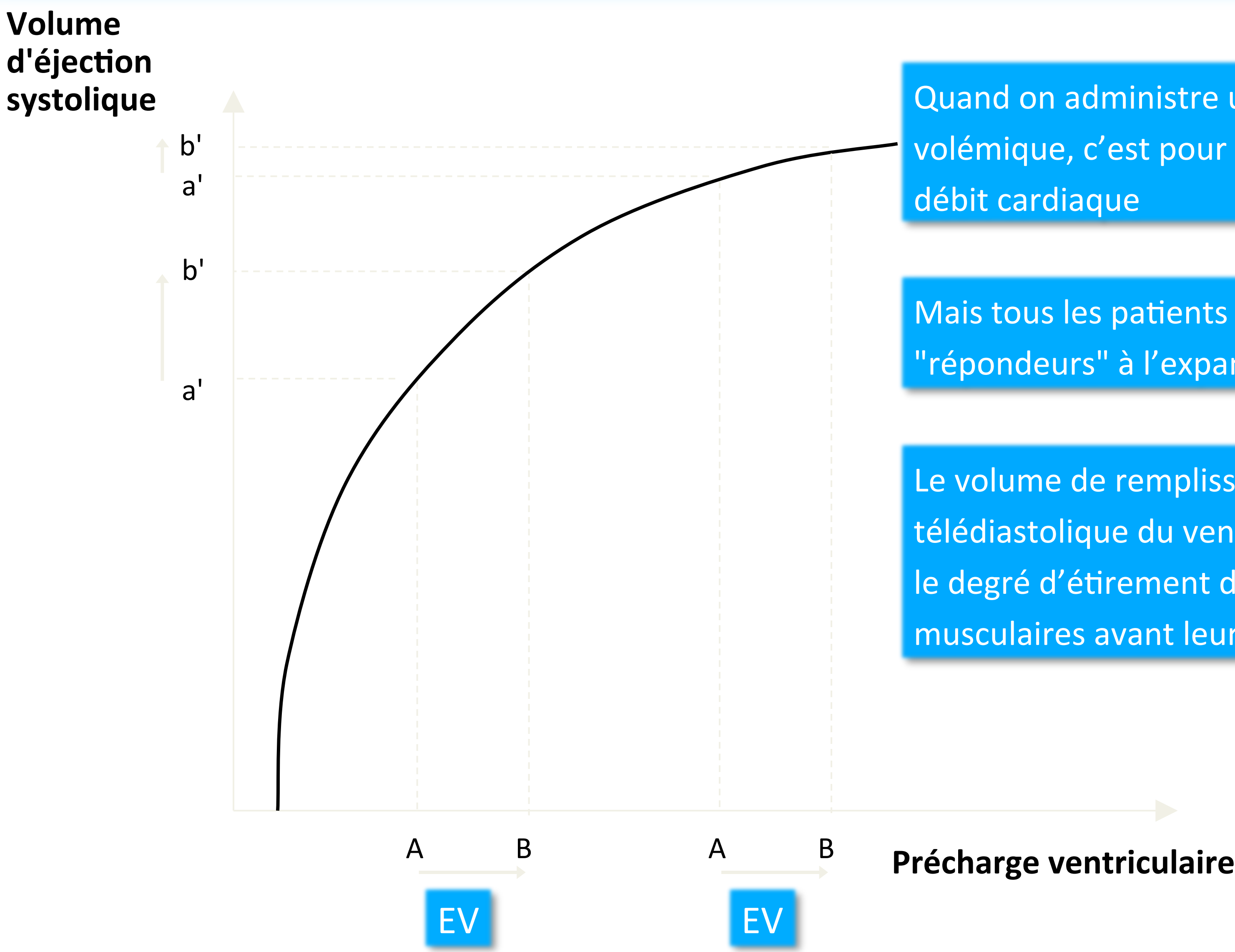
http://nsm05.casimages.com/img/2012/04/21//1204210954161467609746045.png

II. Indicateurs prédictifs de remplissage



X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage



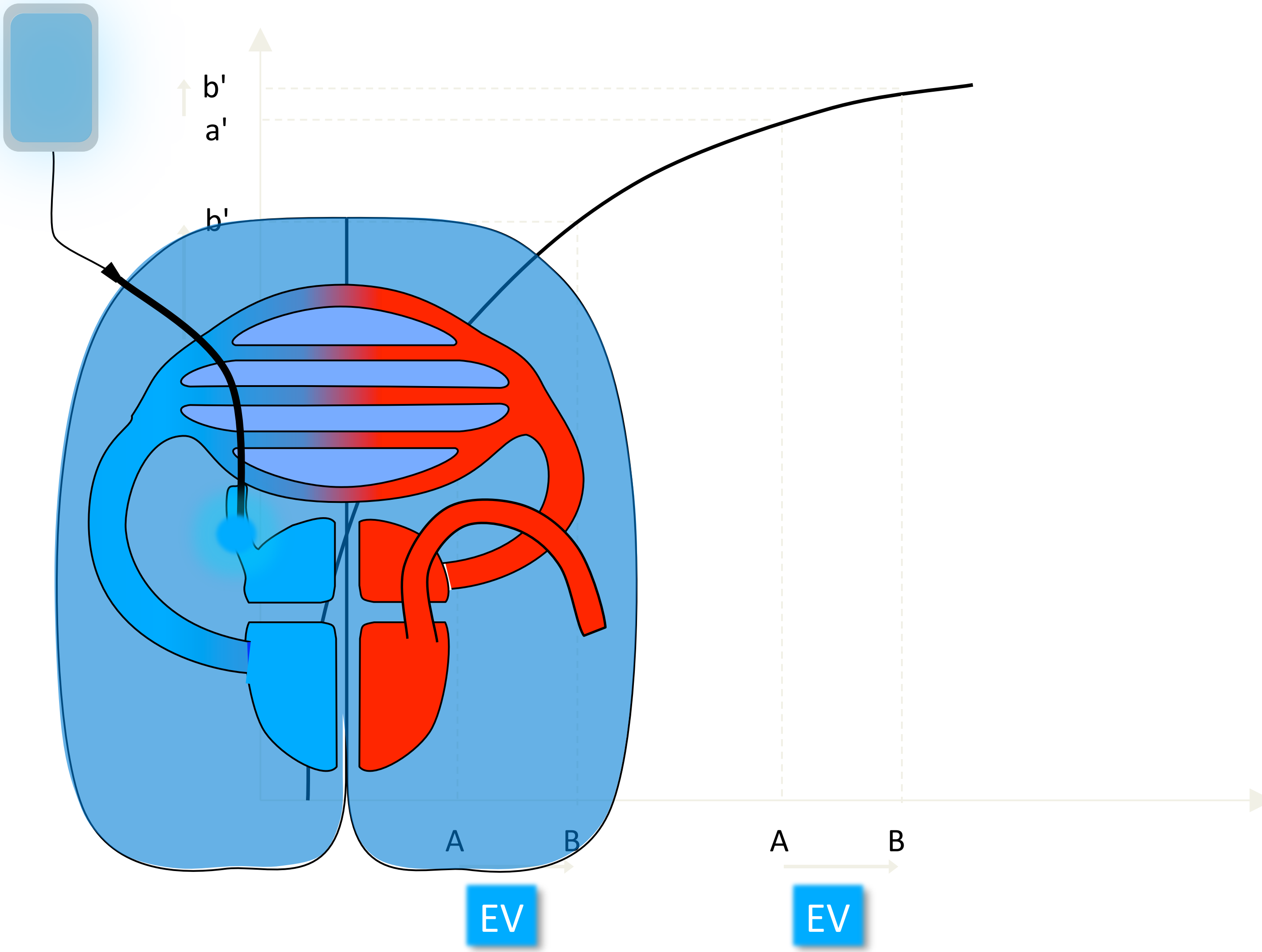
Quand on administre une expansion volémique, c'est pour augmenter le débit cardiaque

Mais tous les patients ne sont pas "répondeurs" à l'expansion volémique

Le volume de remplissage télédiastolique du ventricule détermine le degré d'étirement des fibres musculaires avant leur contraction

X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage



X. Monnet, SRLF 2015

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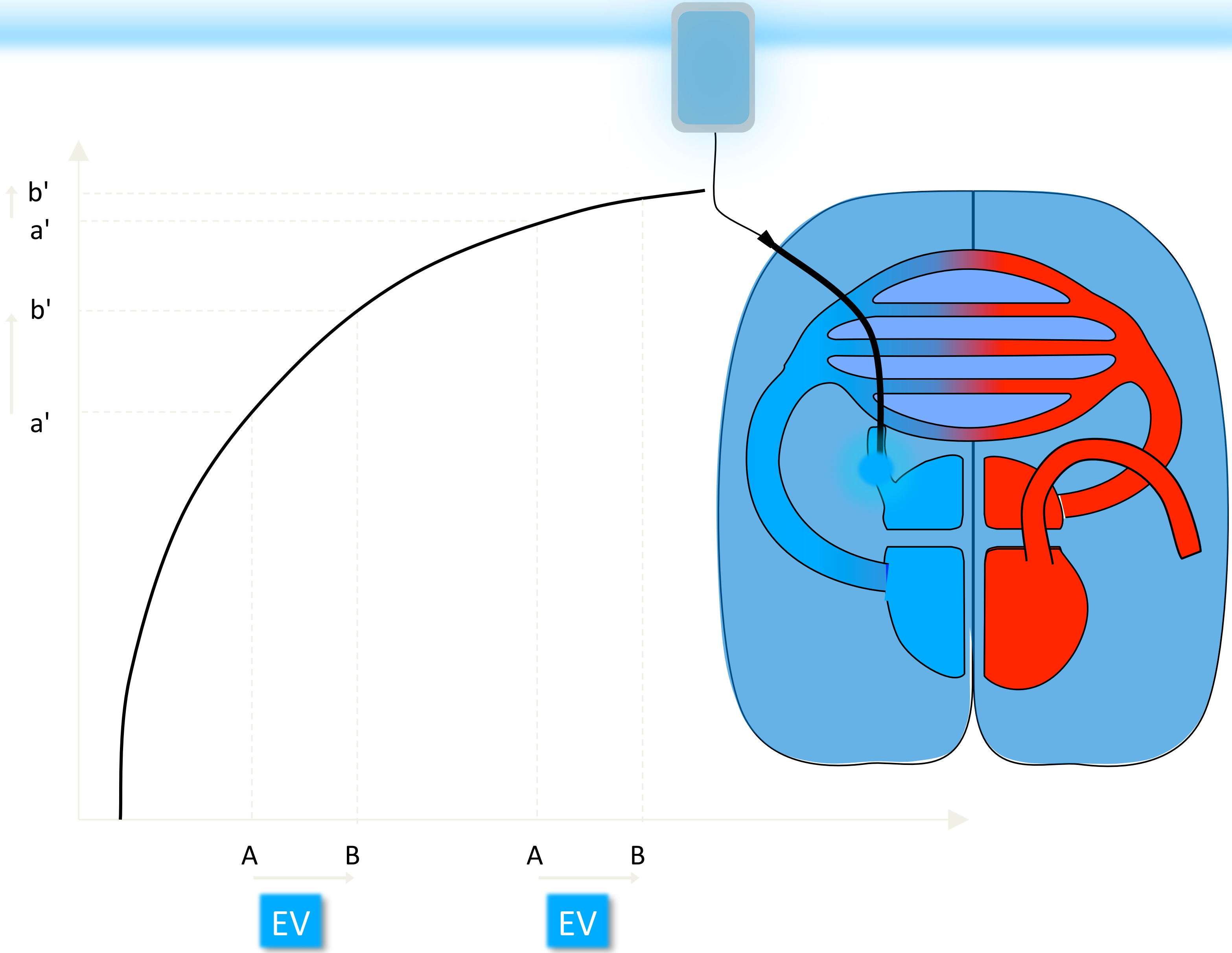
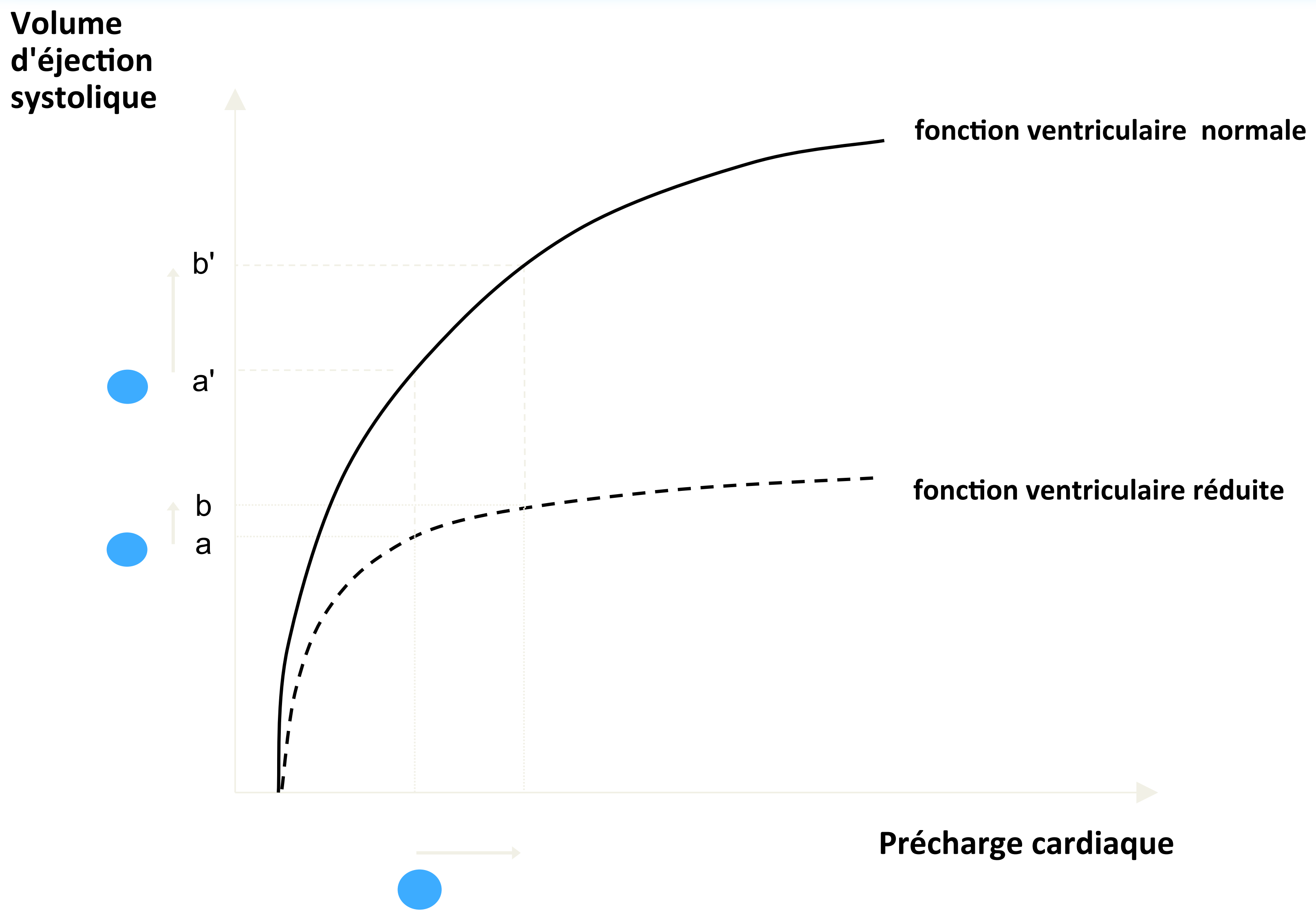


X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage



X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage

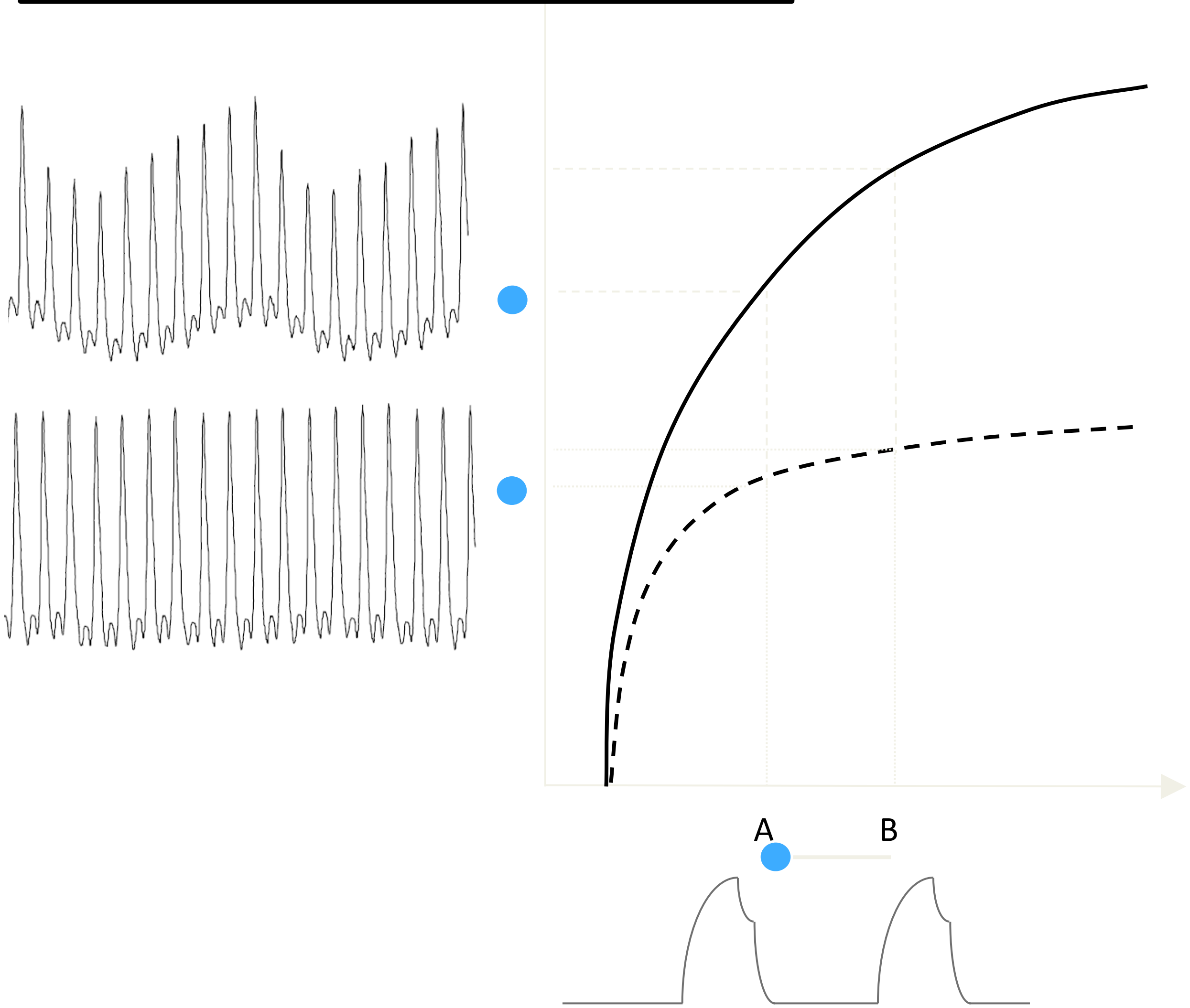
- La démarche commence par signal d'alarme :

➔ Chute du DC, hTA, tachycardie, clinique, oligurie, hyperlactatémie, …

- Ce n'est pas les indicateurs de remplissage qui nous mènent à se demander si le patient est hypovolémique
- Les indicateurs doivent-être pris dans le contexte hémodynamique global du patient

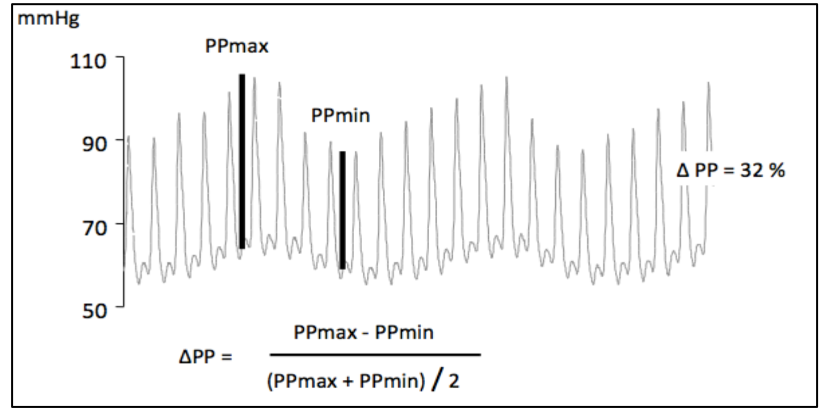
II. Indicateurs prédictifs de remplissage

Le delta PP (pression pulsée)



X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage



Volume responsiveness
Xavier Monnet and Jean-Louis Teboul

Current Opinion in Critical Care 2007, 13:549–553

Table 1 Studies that have investigated the arterial pulse pressure variation (PPV) for predicting volume responsiveness and the respective threshold value for diagnosis

Seuil ≥ 14%

Reference	Year of publication	Clinical setting	PPV threshold value (%)
Michard *et al.* [22]	2000	Medical ICU patients	13
Vieillard-Baron *et al.* [20]	2004	Medical ICU patients	12
Kramer *et al.* [23]	2004	Coronary artery bypass grafting	11
Preisman *et al.* [19]	2005	Coronary artery bypass grafting	9
Hofer *et al.* [21]	2005	Coronary artery bypass grafting	13
Feissel *et al.* [24]	2005	Mix of surgical and medical ICU patients	17
De Backer *et al.* [25]	2005	Mix of surgical and medical ICU patients	12
Cannesson *et al.* [9]	2006	Coronary artery bypass grafting	12
Solus-Biguenet *et al.* [10•]	2006	Hepatic resection	14
Lafanèchère *et al.* [17•]	2006	Medical ICU patients	12
Monnet *et al.* [18••]	2006	Medical ICU patients	12
Charron *et al.* [26]	2006	Surgical ICU patients	10
Natalini *et al.* [27•]	2006	Mix of surgical and medical ICU patients	15
Feissel *et al.* [30•]	2007	Medical ICU patients	12
Cannesson *et al.* [31•]	2007	Coronary artery bypass grafting	11

II. Indicateurs prédictifs de remplissage

Yang and Du *Critical Care* 2014, 18:650
http://ccforum.com/content/18/6/650

Sensitivity 88%, Specificity 89%

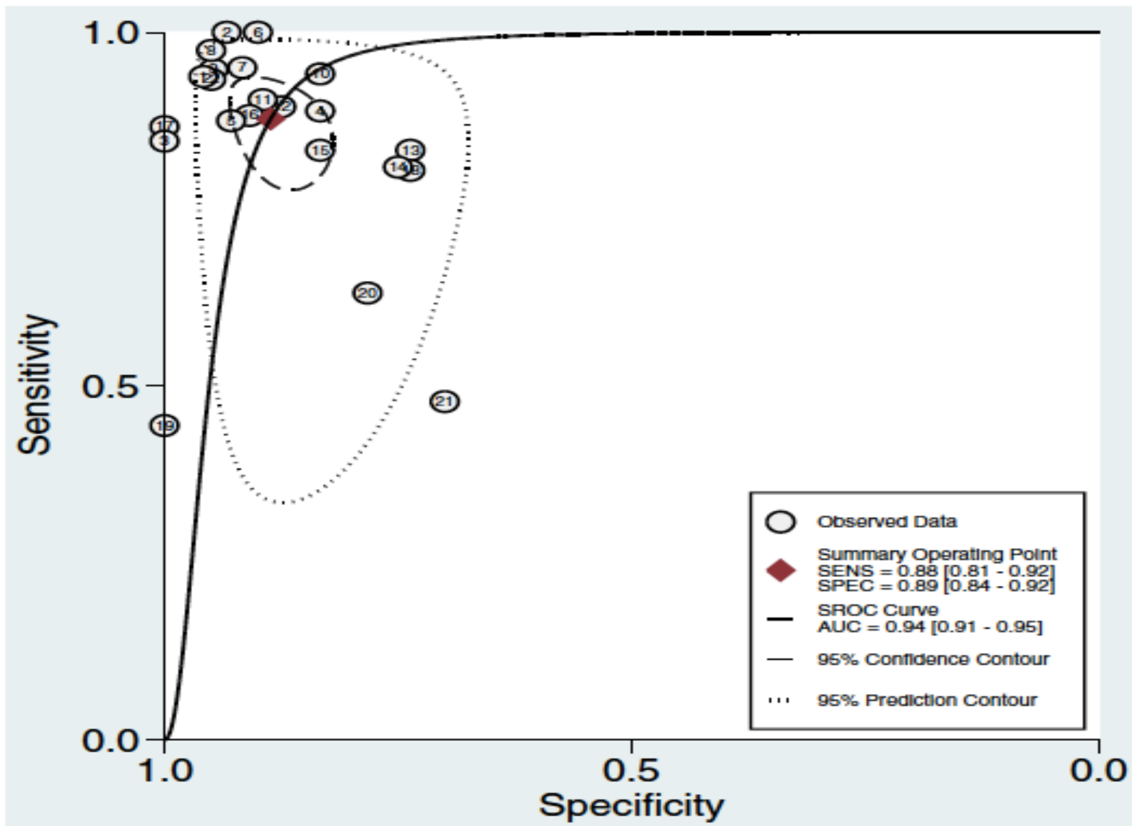


Figure 3 Summary receiver operating characteristic curve. AUC, area under the curve; SENS, sensitivity; SPEC, specificity; SROC, summary receiver operating characteristic.

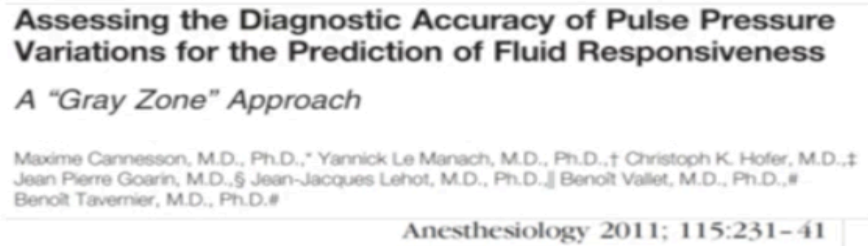
II. Indicateurs prédictifs de remplissage

Applicabilité : +/- 17%

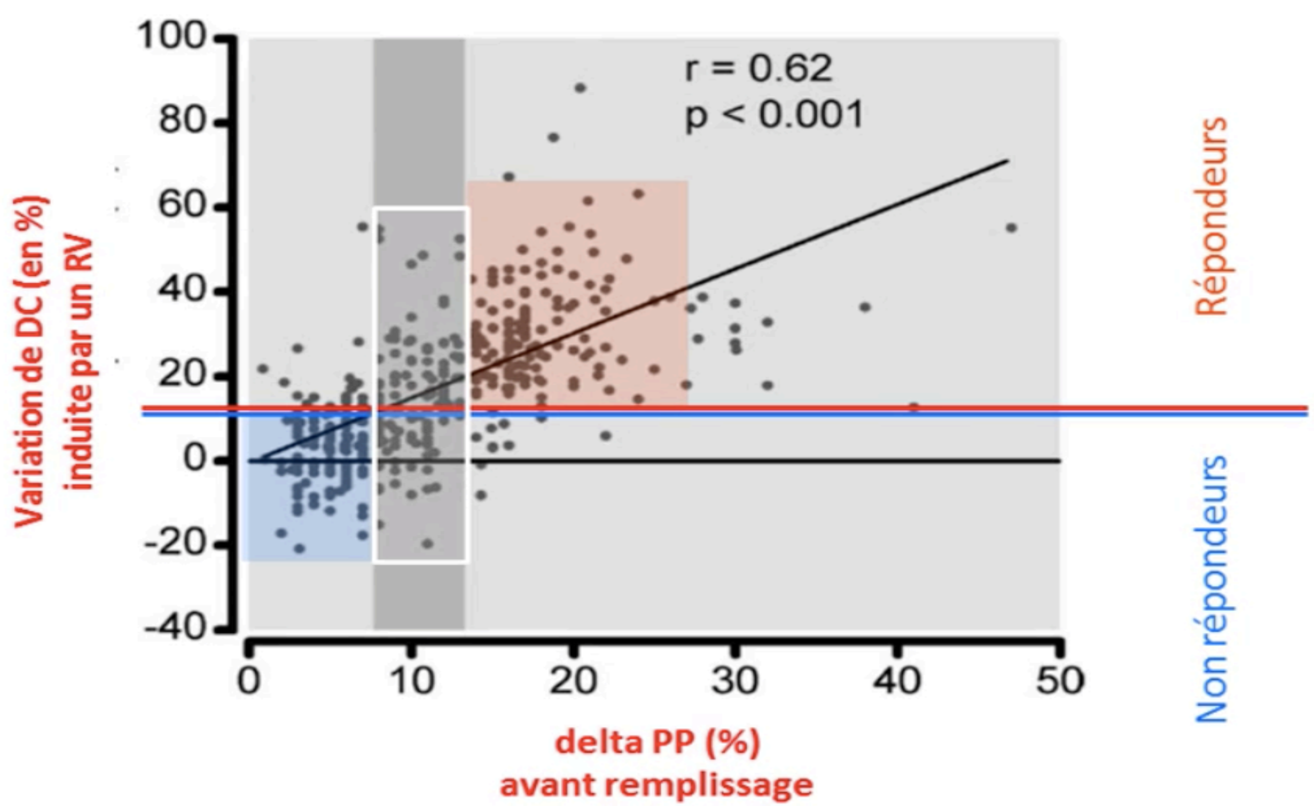
		False positive	False negative
L	**Low** HR/RR ratio (Extreme bradycardia or high frequency ventilation)		✓
I	**Irregular** heart beats	✓	
M	**Mechanical** ventilation with low tidal volume		✓
I	**Increased** abdominal Pressure (Pneumoperitoneum)	✓	
T	**Thorax** open		✓
S	**Spontaneous** breathing	✓	✓

Figure 1 Most common physiological limitations to the use of pulse pressure variation can be summarized as 'LIMITS'. HR/RR, heart rate/respiratory rate.

II. Indicateurs prédictifs de remplissage

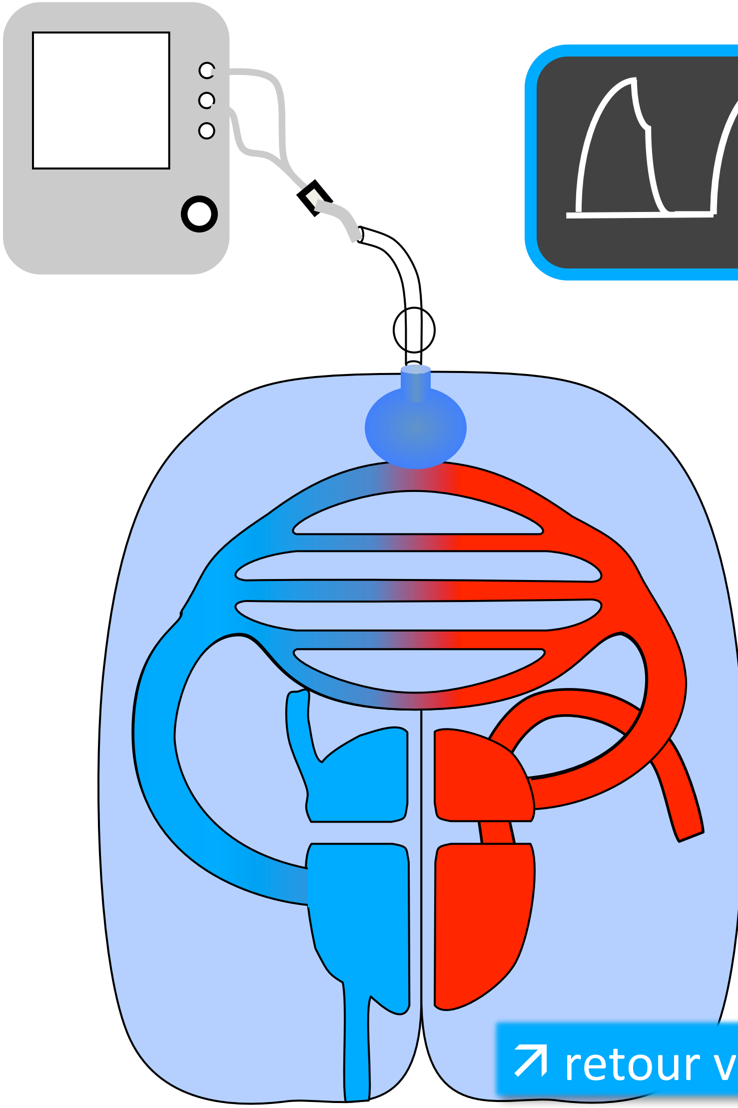


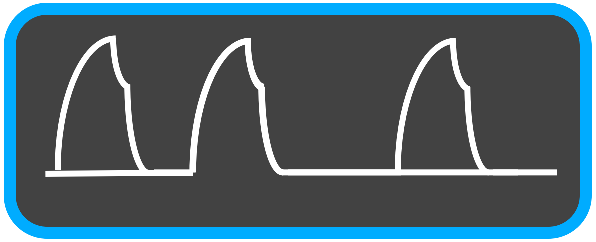
Zone grise : 9 – 13%



II. Indicateurs prédictifs de remplissage

test d'occlusion télé-expiratoire





Pas d'effort inspiratoire pendant la manœuvre !!

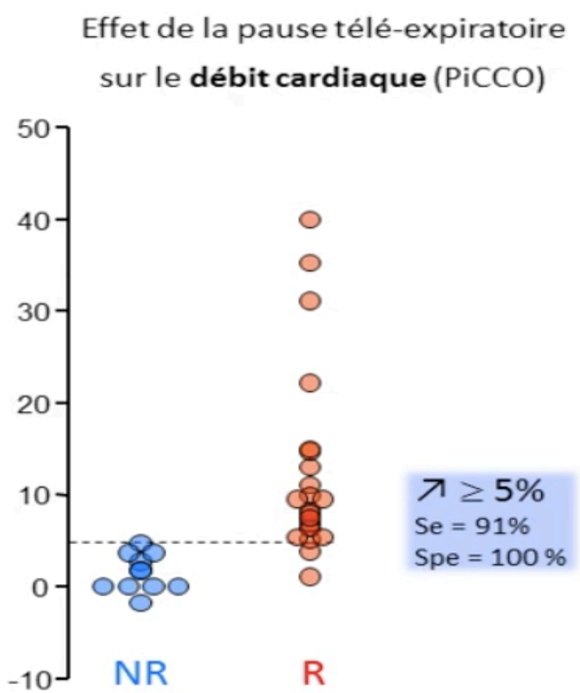
↗ retour veineux systémique

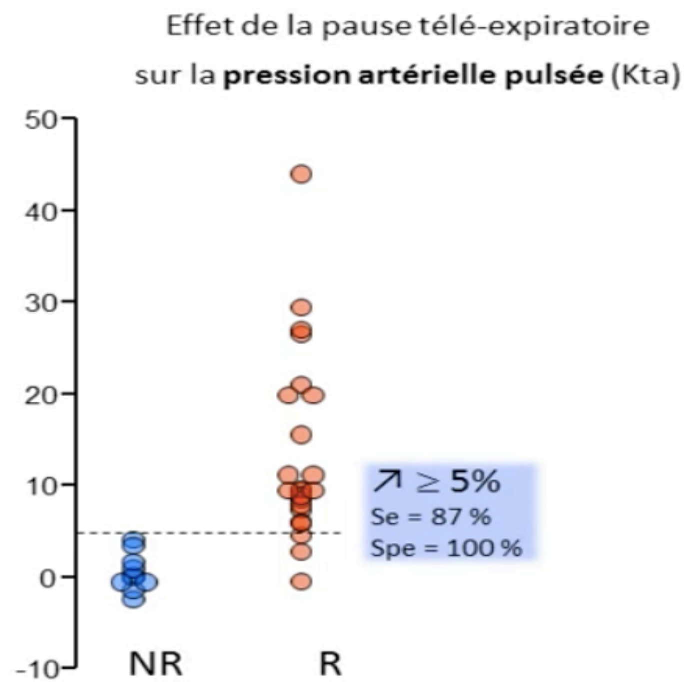
II. Indicateurs prédictifs de remplissage

Predicting volume responsiveness by using the end-expiratory occlusion in mechanically ventilated intensive care unit patients

Xavier Monnet, MD, PhD; David Osman, MD; Christophe Ridel, MD; Bouchra Lamia, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

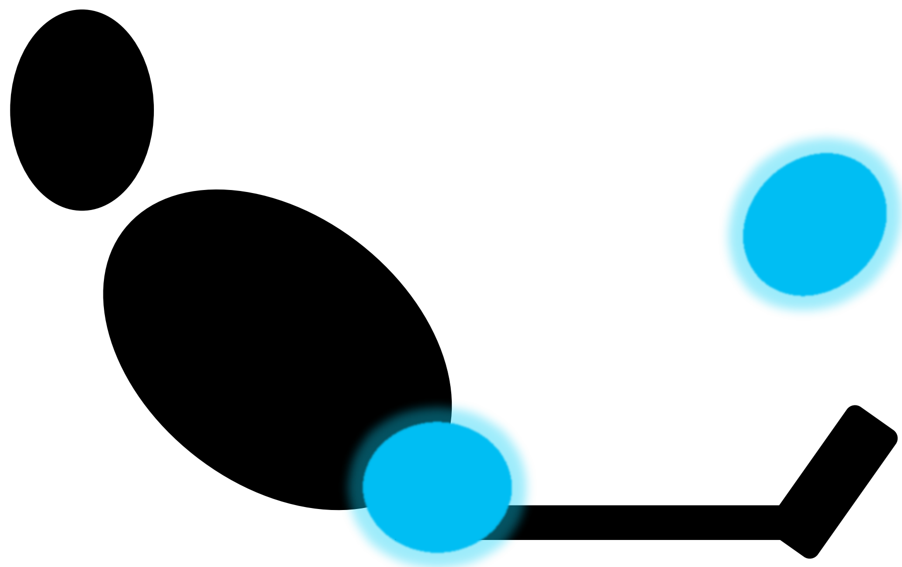
Crit Care Med 2009; 37:000–000





II. Indicateurs prédictifs de remplissage

- Lever jambe passif (LJP) → Auto remplissage vasculaire (250-300mL)
- Bascule des jambes à 45°



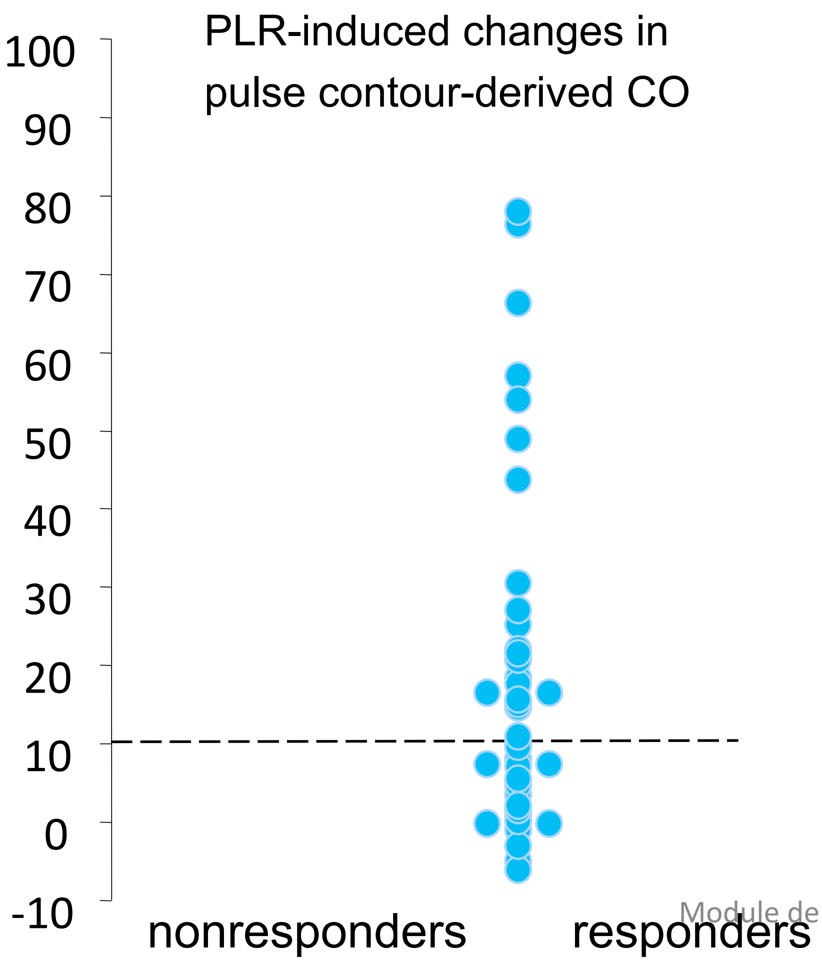
II. Indicateurs prédictifs de remplissage

Predicting volume responsiveness by using the end-expiratory occlusion in mechanically ventilated intensive care unit patients

Xavier Monnet, MD, PhD; David Osman, MD; Christophe Ridel, MD; Bouchra Lamia, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Crit Care Med 2009

34 patients with cardiac arrhythmias or SB



- Fiabilité +++
- Applicabilité +
- Demande le monitoring du DC

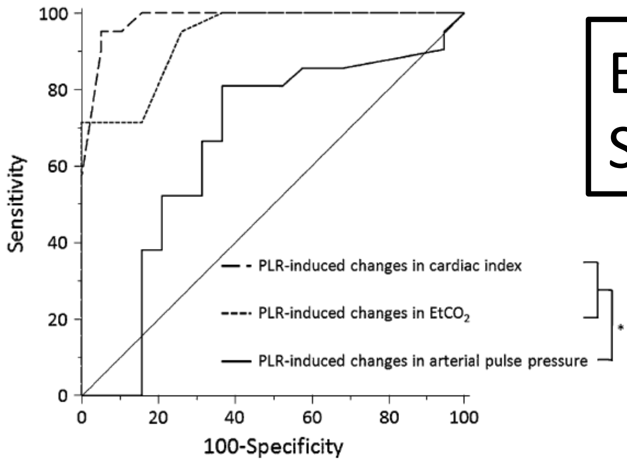
Seuil 10%

Se = 95%

Sp = 97%

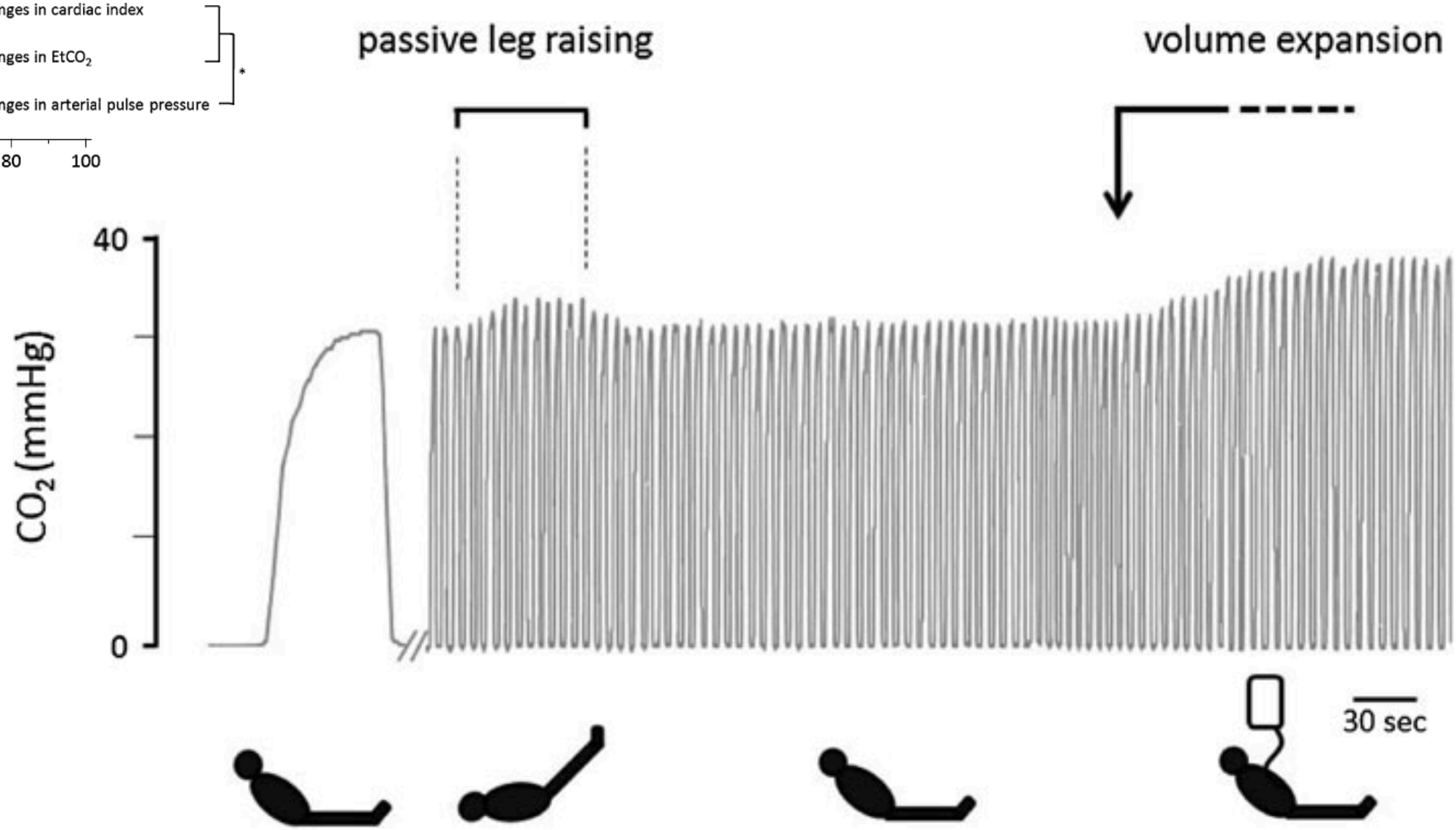
X. Monnet, SRLF 2015

II. Indicateurs prédictifs de remplissage



EtCO2 ≥ 5 %
Sens : 71% , spéc : 100%

40 pts en VAC



Intensive Care Med (2013) 39:93–100

II. Indicateurs prédictifs de remplissage

D'autres tests … (timing)

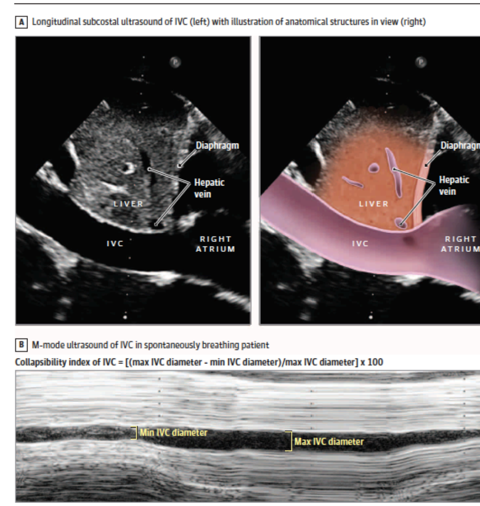
- Variabilité du volume d'éjection systolique



- Variabilité du pic de vélocité aortique

- Variabilité du diamètre de la veine cave inférieur ou supérieur

Figure 4. Inferior Vena Cava (IVC) Ultrasonography

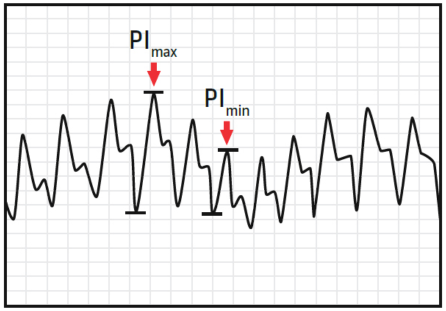


- Variabilité du signal de plethysmographie

D. Osman, SRLF 2015

Indicateurs prédictifs de remplissage

Seuil > 15%



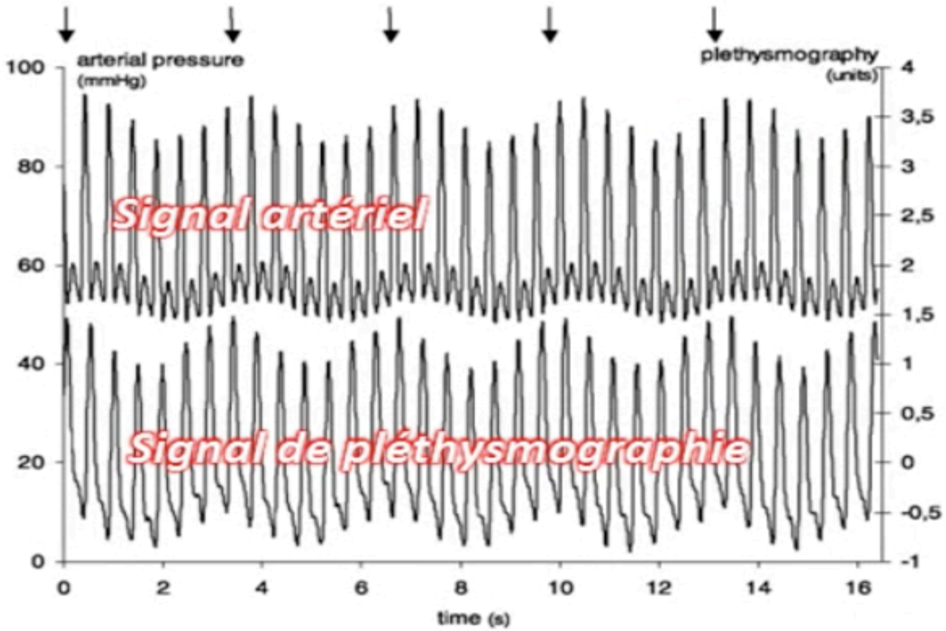
Arterial Versus Plethysmographic Dynamic Indices to Test Responsiveness for Testing Fluid Administration in Hypotensive Patients: A Clinical Trial

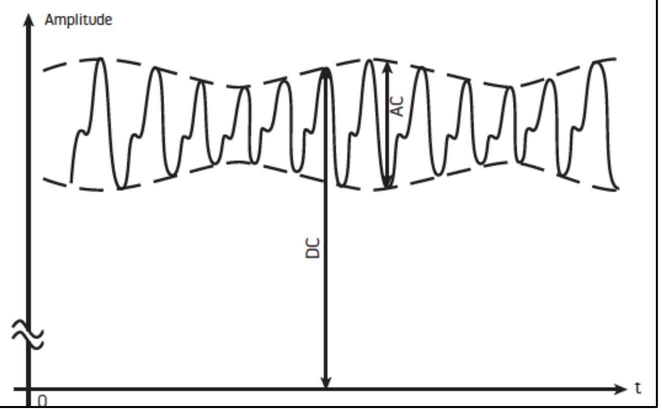
Giuseppe Natalini, Antonio Rosano, Maria Taranto, Barbara Faggian, Elena Vittorielli, Achille Bernardini,

Anesth Analg 2006;103:1478–84

$$PI = \frac{AC}{DC} \times 100\%$$

Equation 2





$$PVI = \frac{PI_{Max} - PI_{Min}}{PI_{Max}} \times 100\%$$

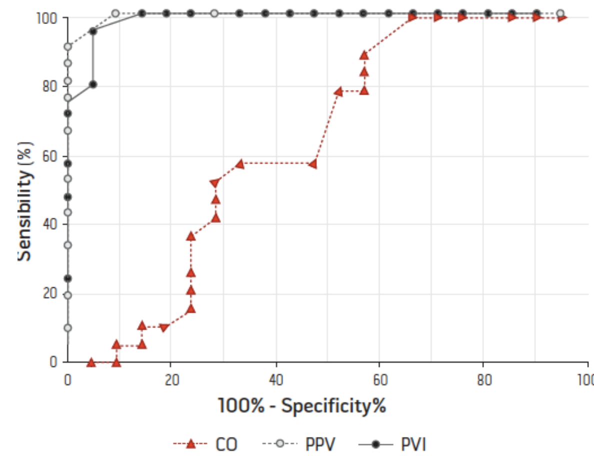
II. Indicateurs prédictifs de remplissage

Intensive Care Med (2012) 38:1429–1437
DOI 10.1007/s00134-012-2621-1

REVIEW

Claudio Sandroni
Fabio Cavallaro
Cristina Marano
Chiara Falcone
Paolo De Santis
Massimo Antonelli

Accuracy of plethysmographic indices as predictors of fluid responsiveness in mechanically ventilated adults: a systematic review and meta-analysis



References (first author)	Index	Number of patients/boluses	% Responders	Best threshold	r	AUC (SE)	Sensitivity	Specificity
Natalini [22]	ΔPOP	22/31	61.0	15.0	–	0.70 (0.094)	0.63	0.83
Solus-Biguenet [23]	ΔPOP	8/54	42.0	9.5	0.29	0.68 (0.071)	0.64	0.68
Cannesson [17]	ΔPOP	25/25	60.0	13.0	0.62	0.85 (0.081)	0.93	0.90
Feissel [19]	ΔPOP	23/28	64.0	14.0	0.70	0.94 (0.050)	0.94	0.80
Wyffels [24]	ΔPOP	32/32	62.5	11.8	0.65	0.89 (0.061)	0.90	0.83
Hoiseth [20]	ΔPOP	25/34	64.7	11.4	–	0.72 (0.082)	0.86	0.67
Cannesson [11]	ΔPOP[b]	25/25	64.0	12.0	0.69	0.94 (0.043)	0.87	0.89
	PVI	25/25	64.0	14.0	0.67	0.93 (0.051)	0.81	1.00
Zimmermann [12]	PVI	20/20	75.0	9.5	0.61	0.97 (0.033)	0.93	1.00
Desgranges [18]	PVI	28/28	68.0	12.0	–	0.84 (0.077)	0.74	0.67
Hood [21] (large bolus)	PVI	25/25	88.0	10.0	–	0.96 (0.031)	0.86	1.00
Hood [21] (small bolus)	PVI	25/63	36.5	10.0	–	0.71 (0.071)	0.65	0.67
Overall[a]		233/365	62.3 ± 14.0	9.5–15.0 (range)	0.58 [0.43–0.70]	0.85 [0.79–0.92]	0.80 [0.74–0.85]	0.76 [0.68–0.82]

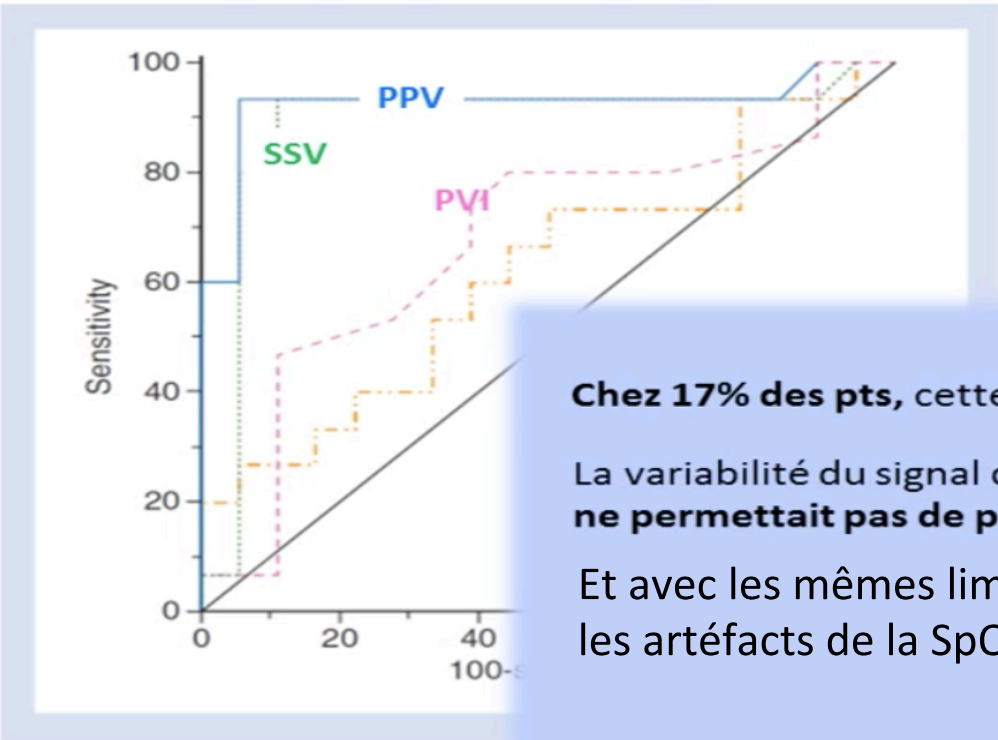
II. Indicateurs prédictifs de remplissage

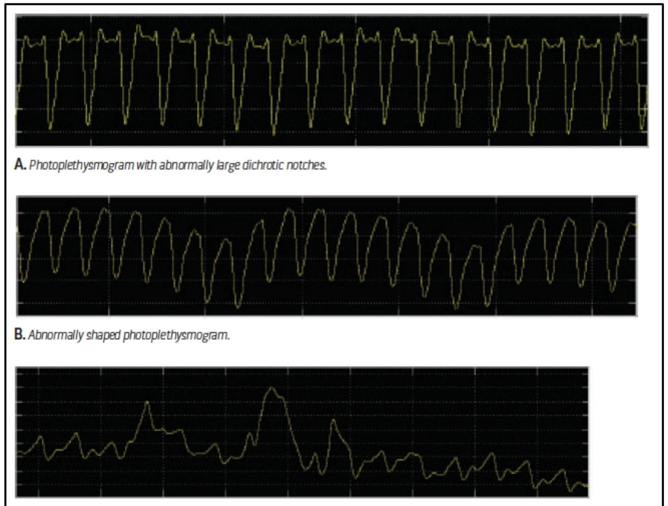
British Journal of Anaesthesia 110 (2): 207–13 (2013)
Advance Access publication 26 October 2012 · doi:10.1093/bja/aes373

BJA

Pleth variability index is a weak predictor of fluid responsiveness in patients receiving norepinephrine

X. Monnet[1,2*], L. Guérin[1,2], M. Jozwiak[1,2], A. Bataille[1,2], F. Julien[1,2], C. Richard[1,2] and J.-L. Teboul[1,2]





A. Photoplethysmogram with abnormally large dichrotic notches.

B. Abnormally shaped photoplethysmogram.

C. Photoplethysmogram corrupted by movement.

Chez 17% des pts, cette variabilité n'était pas mesurable

La variabilité du signal de **pléthysmographie ne permettait pas de prédire la précharge dépendance**

Et avec les mêmes limites que le delta PP +
les artéfacts de la SpO2

D. Osman, SRLF 2015

II. Indicateurs prédictifs de remplissage

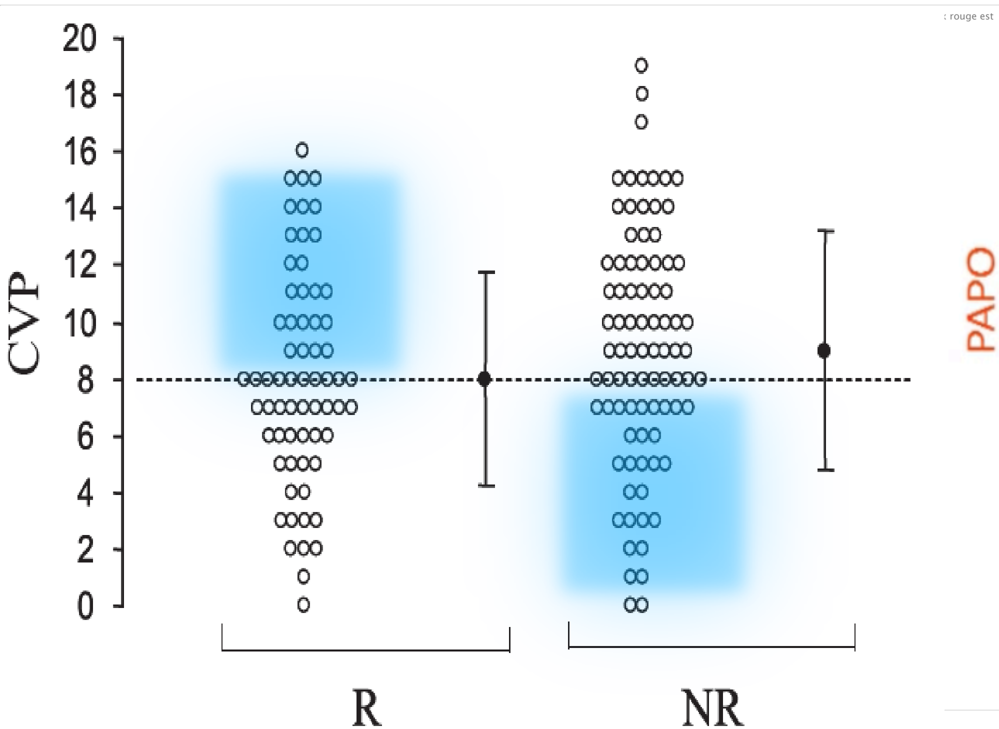
Ce qui ne faut pas faire …

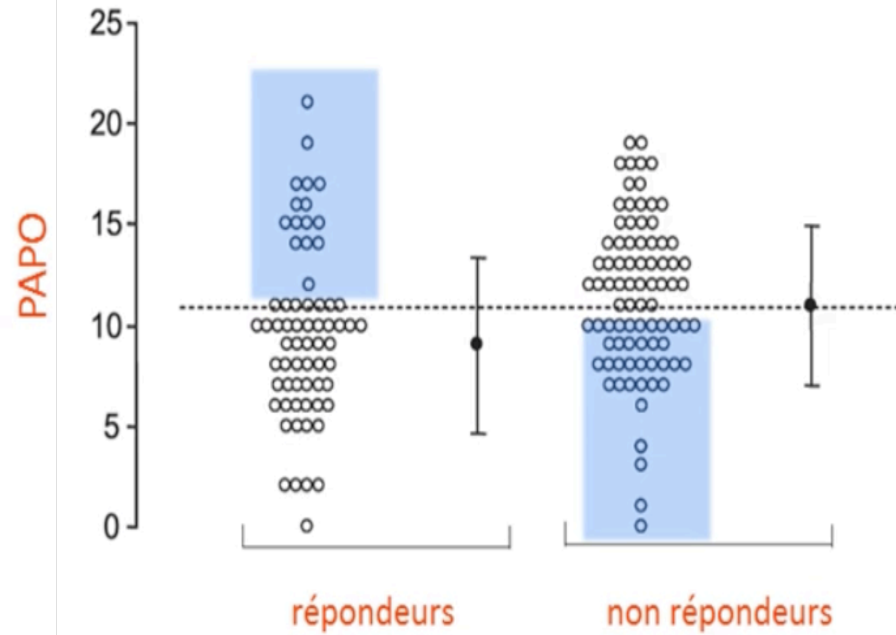
Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge*

David Osman, MD; Christophe Ridel, MD; Patrick Ray, MD; Xavier Monnet, MD, PhD; Nadia Anguel, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Crit Care Med 2007 Vol. 35, No. 1

Rétrospective
150 remplissages vasculaires
réalisés chez 90 patients
PVC et PAPO était mesurés avant RV
la réponse au RV était secondairement évaluée





II. Indicateurs prédictifs de remplissage

Intensive Care Med
DOI 10.1007/s00134-015-4168-4

SYSTEMATIC REVIEW

CrossMark

T. G. Eskesen
M. Wetterslev
A. Perner

Systematic review including re-analyses of 1148 individual data sets of central venous pressure as a predictor of fluid responsiveness

Table 2 Predictive values and likelihood ratios of CVP for fluid responsiveness in 1148 individual patient data sets

CVP cut-off point (mmHg)	Number of data sets for the CVP ranges given	Positive predictive value	Negative predictive value	Positive likelihood ratio	Negative likelihood ratio
0	<2: 72	64 % (39–89)	52 % (49–55)	1.95 (0.66–5.78)	0.99 (0.98–1.00)
2	2–3: 125	65 % (54–76)	53 % (50–56)	2.04 (1.27–3.26)	0.95 (0.93–0.98)
4	4–5: 163	64 % (57–71)	55 % (52–59)	1.92 (1.47–2.51)	0.88 (0.83–0.92)
6	6–7: 177	59 % (54–65)	57 % (54–61)	1.59 (1.33–1.89)	0.81 (0.75–0.88)
8	8–9: 187	56 % (52–61)	59 % (56–63)	1.40 (1.24–1.59)	0.74 (0.66–0.83)
10	10–11: 161	53 % (50–57)	61 % (56–66)	1.24 (1.13–1.35)	0.69 (0.59–0.81)
12	12–13: 108	51 % (47–54)	61 % (55–67)	1.12 (1.05–1.19)	0.69 (0.55–0.85)
14	14–15: 79	50 % (47–53)	66 % (58–73)	1.09 (1.04–1.14)	0.56 (0.41–0.77)
16	16–17: 39	49 % (46–52)	64 % (54–75)	1.04 (1.00–1.07)	0.60 (0.38–0.94)
18	18–19: 22	48 % (45–51)	59 % (44–75)	1.01 (0.99–1.03)	0.74 (0.39–1.41)
20	>19: 15	48 % (45–51)	53 % (28–79)	1.00 (0.99–1.01)	0.95 (0.35–2.60)

The numbers in brackets are 95 % confidence intervals
CVP central venous pressure

II. Indicateurs prédictifs de remplissage

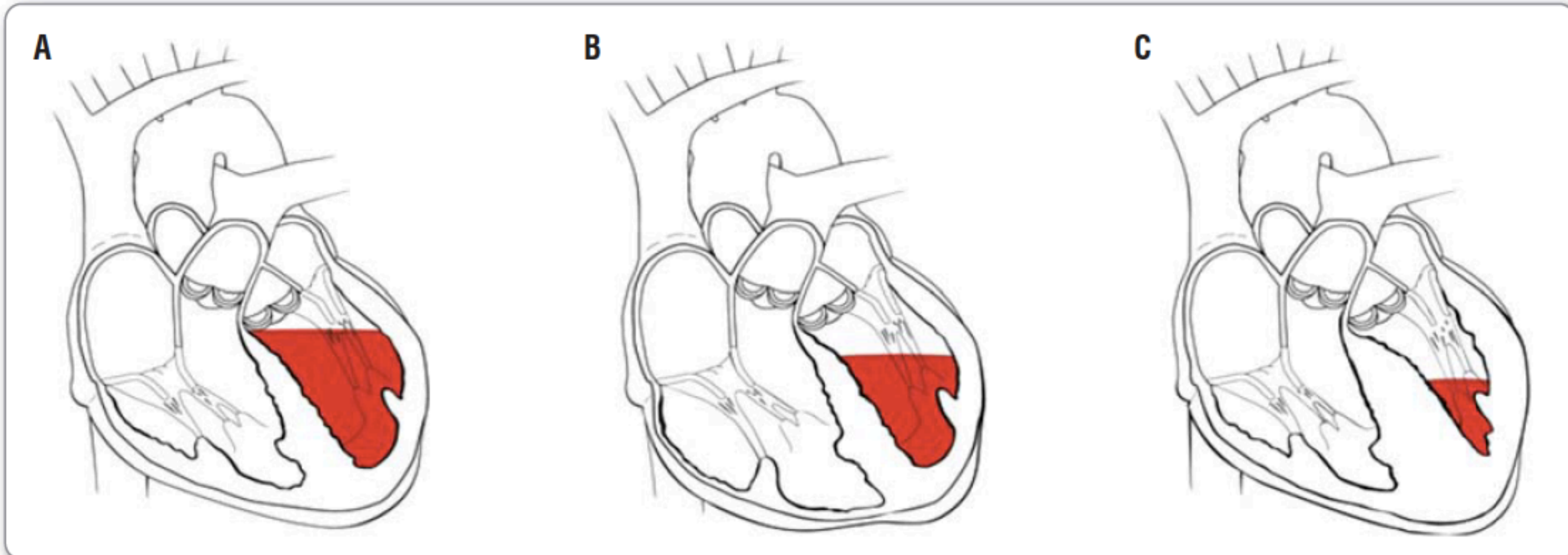


Figure 2 Challenges associated with interpreting pulmonary artery occlusion pressure (PAOP). Left ventricular end-diastolic volume (LVEDV) can be independent of PAOP. A, PAOP is 22 mm Hg. Normal left ventricle has very high LVEDV. B, PAOP is 22 mm Hg. Dilated right ventricle creates increased juxtacardiac pressure; LVEDV is normal. C, PAOP is 22 mm Hg. Left ventricular hypertrophy with noncompliant myocardium creates decreased space within the left ventricle; LVEDV is low. Use of PAOP alone to reflect LVEDV may not be accurate.

Based on data from Marik et al[27] and Turner.[36]
Illustration courtesy of Lisa Merry, RN, Merry Studio, Bloomington, Illinois.

CriticalCareNurse Vol 35, No. 1, FEBRUARY 2015

II. Indicateurs prédictifs de remplissage

La clinique ?

Signals d'alarmes

Méta-analyse
12 études menées en réanimation

Predicting Fluid Responsiveness in ICU Patients*

A Critical Analysis of the Evidence

Frédéric Michard, MD, PhD; and Jean-Louis Teboul, MD, PhD

CHEST 2002, 121:2000-8

Source	Patients, No.	FC, No.	Fluid Infused	Volume Infused, mL	Speed of FC, min	Definition of Response	Rate of Response, %
Calvin et al[2]	28	28	5% Alb	250	20–30	$\Delta SV > 0\%$	71
Schneider et al[3]	18	18	FFP	500	30	$\Delta SV > 0\%$	72
Reuse et al[4]	41	41	4.5% Alb	300	30	$\Delta CO > 0\%$	63
Magder et al[5]	33	33	9% NaCl	100–950		$\Delta CO > 250$ mL/min	52
Diebel et al[6]	15	22	R. lactate Colloids	300–500 500		$\Delta CO > 10\%$	59
Diebel et al[7]	32	65	R. lactate	300–500		$\Delta CO > 20\%$	40
Wagner and Leatherman[8]	25	36	9% NaCl 5% Alb, FFP	938 ± 480 574 ± 187	7–120	$\Delta SV > 10\%$	56
Tavernier et al[9]	15	35	HES	500	30	$\Delta SV > 15\%$	60
Magder and Lagonidis[10]	29	29	25% Alb 9% NaCl	100 150–400	15	$\Delta CO > 250$ mL/min	45
Tousignant et al[11]	40	40	HES	500	15	$\Delta SV > 20\%$	40
Michard et al[12]	40	40	HES	500	30	$\Delta CO > 15\%$	40
Feissel et al[13]	19	19	HES	8 mL/kg	30	$\Delta CO > 15\%$	53
Total	334	406					52

II. Indicateurs prédictifs de remplissage

Fluid challenge

- Quantité ? 300-500mL
- Irréversible !! Hypervolémie possible après quelques jours
- Mini fluid challenge (100 mL) ?
- Prévention (prédire) est peut-être préférable sauf en phase aigue du choc HH et septique

Intensive Care Med (2014) 40:1795–1815
DOI 10.1007/s00134-014-3525-z

Maurizio Cecconi
Daniel De Backer
Massimo Antonelli
Richard Beale
Jan Bakker
Christoph Hofer
Roman Jaeschke
Alexandre Mebazaa
Michael R. Pinsky
Jean Louis Teboul
Jean Louis Vincent
Andrew Rhodes

Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine

Table 5 Summary of the consensus statements—part 3

No.	Statement/recommendation	GRADE level of recommendation; quality of evidence	Type of statement
26.	We recommend to assess volume status and volume responsiveness	Ungraded	Best practice
27	We recommend that immediate fluid resuscitation should be started in shock states associated with very low values of commonly used preload parameters	Ungraded	Best practice
28.	We recommend that commonly used preload measures (such as CVP or PAOP or end diastolic area or global end diastolic volume) alone should not be used to guide fluid resuscitation	Level 1; QoE moderate (B)	Recommendation
29.	We recommend not to target any absolute value of ventricular filling pressure or volume	Level 1; QoE moderate (B)	Recommendation
30.	We recommend that fluid resuscitation should be guided by more than one single hemodynamic variable	Ungraded	Best practice
31.	We recommend using dynamic over static variables to predict fluid responsiveness, when applicable	Level 1; QoE moderate (B)	Recommendation
32.	When the decision for fluid administration is made we recommend to perform a fluid challenge, unless in cases of obvious hypovolemia (such as overt bleeding in a ruptured aneurysm)	Level 1; QoE low (C)	Recommendation
33.	We recommend that even in the context of fluid-responsive patients, fluid management should be titrated carefully, especially in the presence of elevated intravascular filling pressures or extravascular lung water	Ungraded	Best practice
34.	We suggest that inotropic agents should be added when the altered cardiac function is accompanied by a low or inadequate cardiac output, and signs of tissue hypoperfusion persist after preload optimization	Level 2; QoE low (C)	Recommendation

II. Indicateurs prédictifs de remplissage

Est-ce que ça marche ?

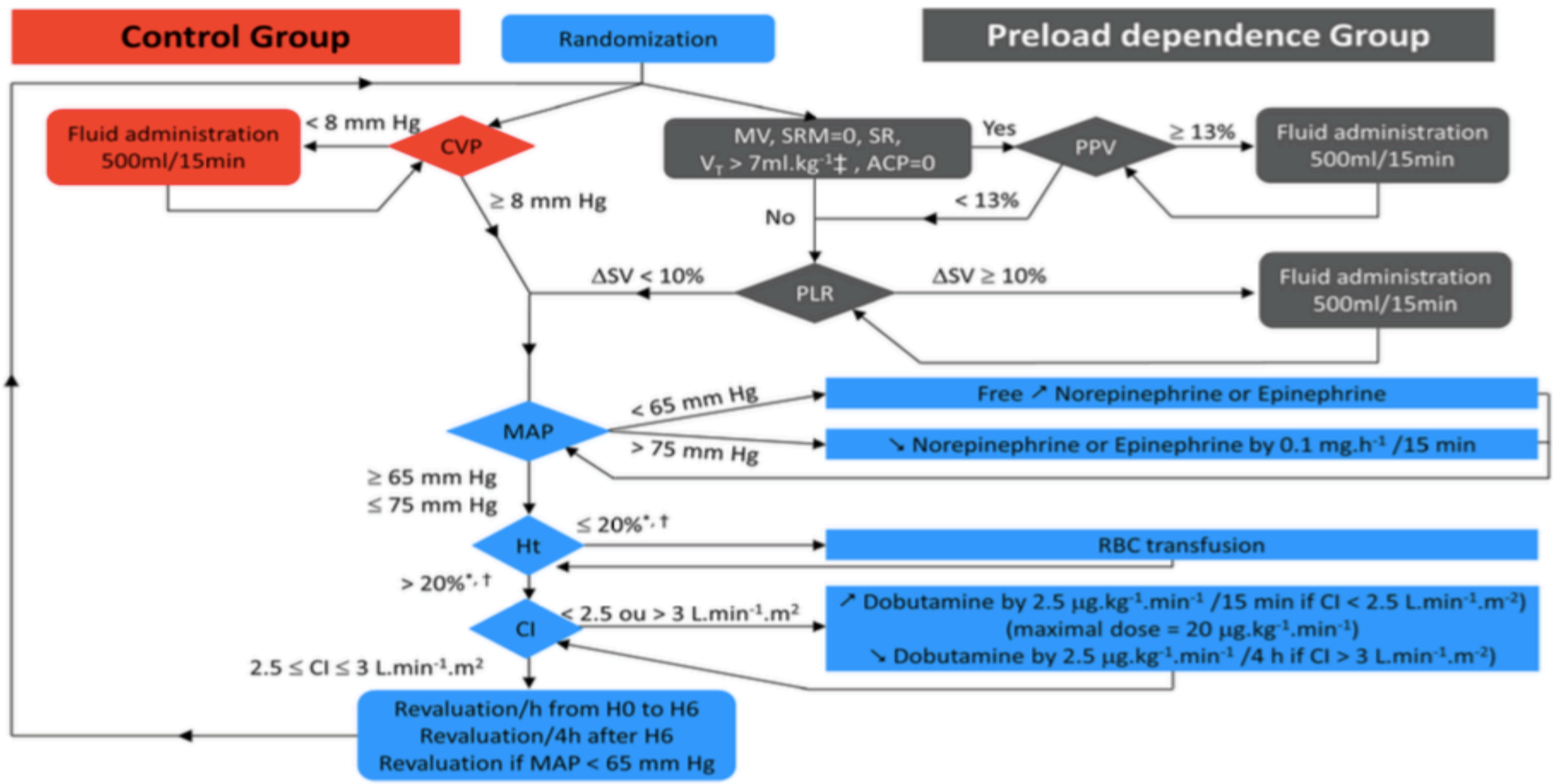


Figure 1 Treatment algorithm. *or hemoglobin <7 g.dL^{-1}; †Ht ≤30% or hemoglobin ≤10 g.dL^{-1} in the first 6 hours following inclusion; ‡ml.kg^{-1} of predicted body weight. ACP, acute cor pulmonale; CI, cardiac index; CVP, central venous pressure; Ht, hematocrit; MAP, mean arterial pressure; MV, mechanical ventilation; PLR, passive leg raising test; PPV, pulse pressure variation; RBC, red blood cells; SR, sinus rhythm; SRM, spontaneous respiratory movements; ΔSV, stroke volume variation after fluid administration; V_T, tidal volume.

Richard et al. Critical Care (2015)

II. Indicateurs prédictifs de remplissage

Table 3 Fluid administration and fluid balance

	Control (n = 30)	Preload dependence (n = 30)	*P*
Intravascular volume expansion ITT (mL.day^{-1})	986 [654-1,624]	446 [295-1,105]	0.04
Intravascular volume expansion PP (mL.day^{-1})	917 [639-1,511]	383 [211-604]	0.01
RBC transfusion (mL.day^{-1})	178 [82-304]	103 (0-183]	0.04
Other blood products (mL.day^{-1})	0 [0-122]	0 [0-125]	0.76
Other fluids (mL.day^{-1})	3151 [2,791-3,456]	2919 [2,533-3,368]	0.70
Fluid intake* (mL.day^{-1})	4096 [3,770-4,677]	3610 [2,982-4,560]	0.16
Diuresis (mL.day^{-1})	2116 [368-3,212]	1854 [513-3,332]	0.95
Fluid output (mL.day^{-1})	2550 [1,914-3,331]	2609 [2,079-3,202]	0.95
Fluid balance (mL.day^{-1})	1749 [146-2,788]	888 [153-2,816]	0.68
Intravascular volume expansion/fluid intake (%)	23%	15%	0.04

Data are median [interquartile range] or number of patients (%). *total volume of fluids administered (intravascular volume expansion + blood products + other fluids). ITT, intention to treat; PP, per protocol; RBC, red blood cells.

Richard et al. Critical Care (2015)

II. Indicateurs prédictifs de remplissage

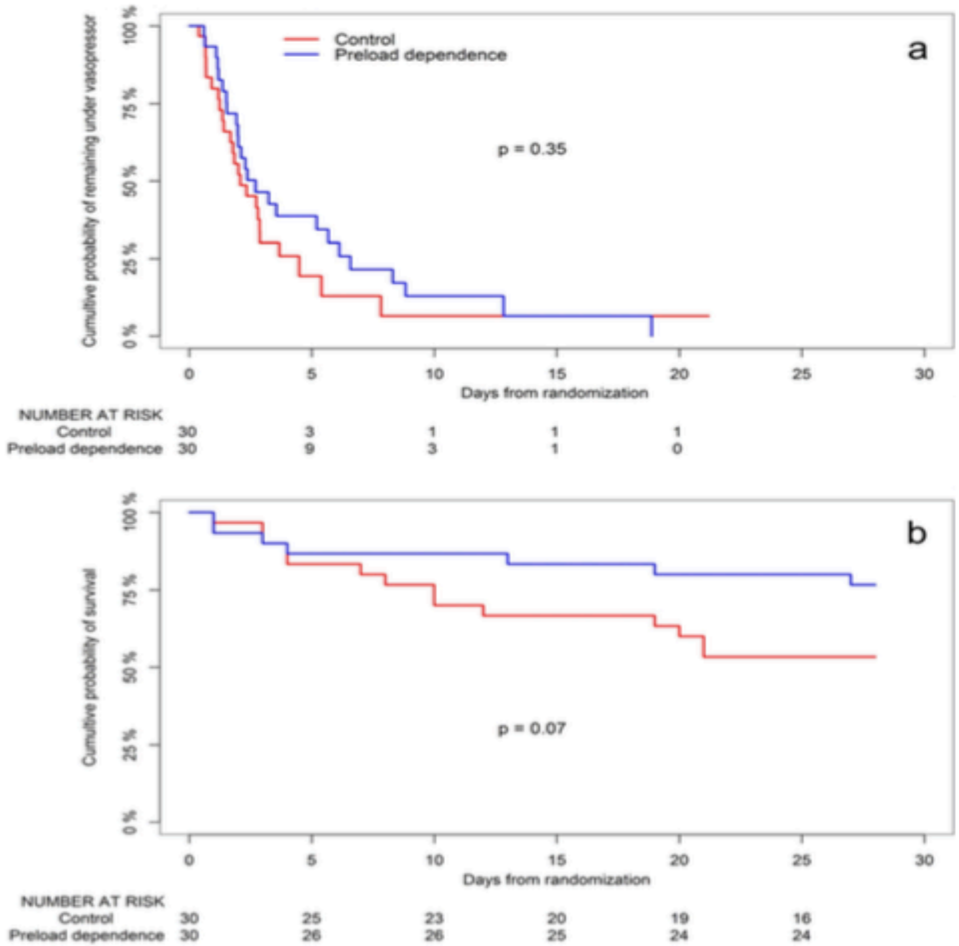
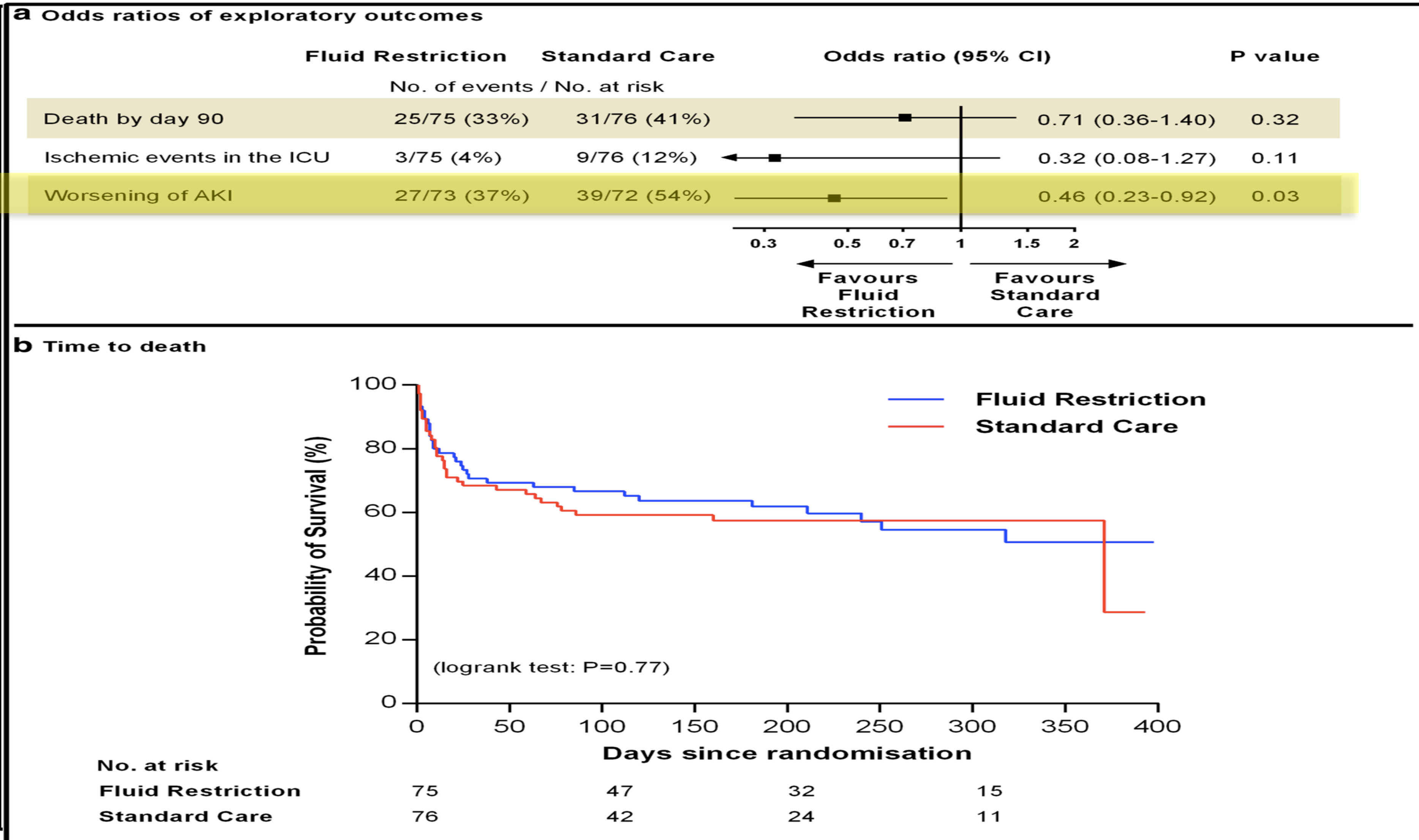


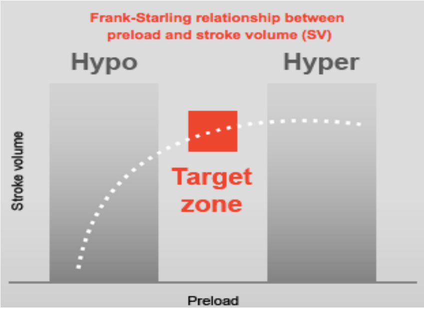
Figure 6 Kaplan-Meier plot of the probability of remaining under vasopressor therapy (a) and survival (b) from inclusion to day 28.

Richard et al. Critical Care (2015)

II. Indicateurs prédictifs de remplissage

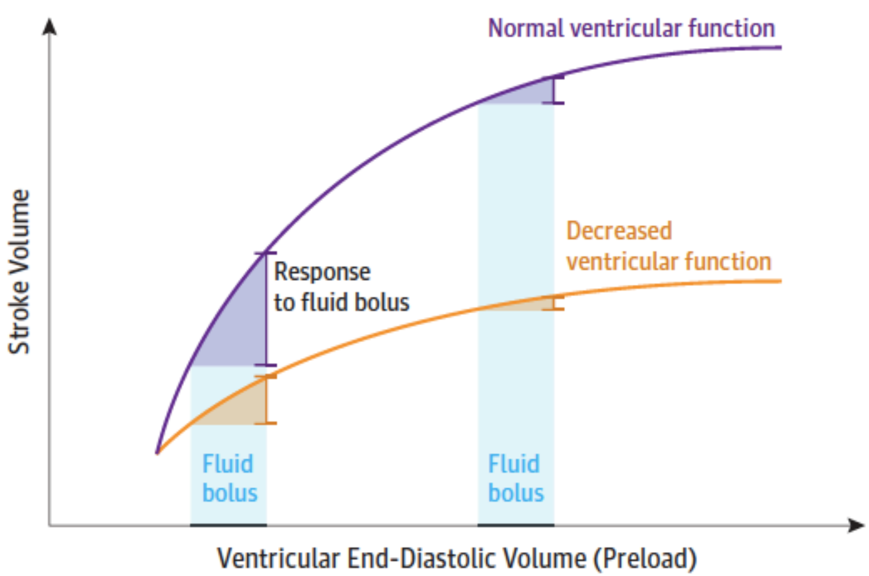


Hjortrup and al. Intensive Care Med (2016)



Keys messsages (2)

Figure 1. Effect of Increase in Preload on Stroke Volume of Ventricles With Normal and Decreased Contractility



Frank-Starling curves illustrate that the effect of a given increase in preload on stroke volume is dependent both on ventricular contractility and on baseline preload.

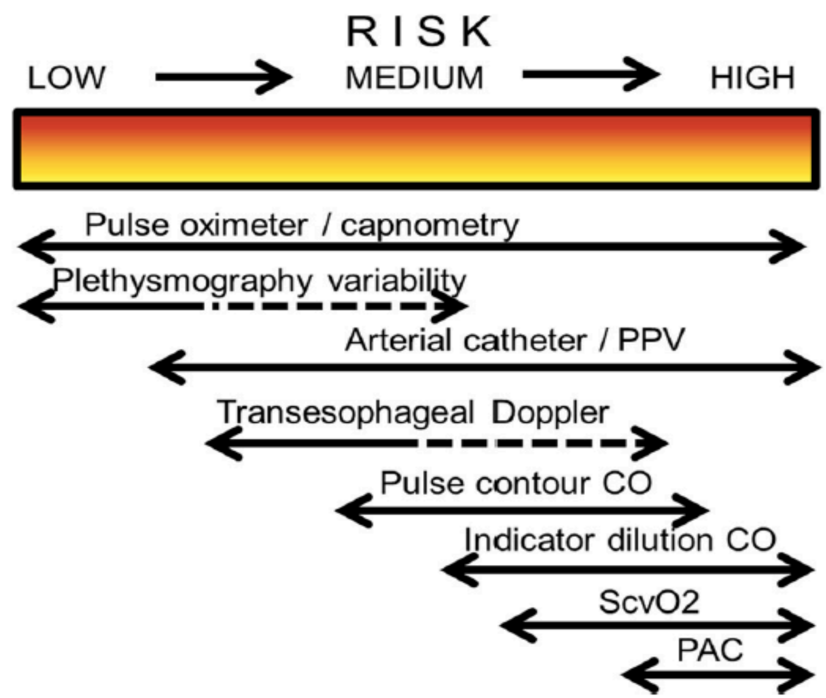


Figure 2 Possible choice of monitoring system in relation to a patient's degree of perioperative risk. CO, cardiac output; PAC, pulmonary artery catheter; PPV, pulse pressure variation; $ScvO_2$, central venous oxygen saturation.

Bentzer et al. JAMA 2016

Vincent et al. Critical Care (2015)

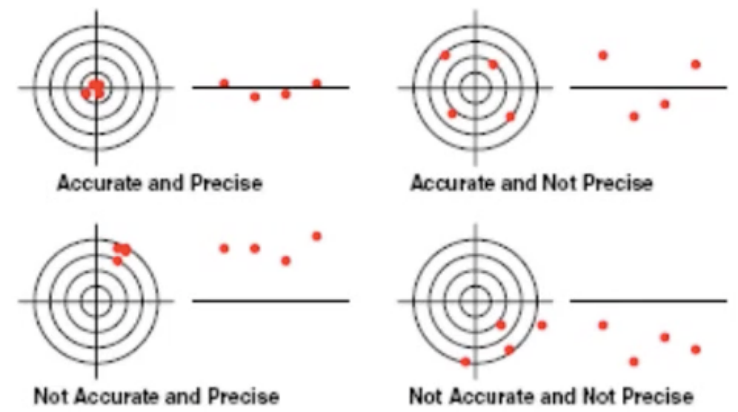
Keys messsages (2)

Table. Summary of Diagnostic Accuracy for Hypovolemia Responsive to Fluids[a]

Measures and Included Studies	No. of Studies	No. of Patients	Cutoff for Measures, Mean (Range)[b]	Sensitivity, % (95% CI)	Specificity, % (95% CI)
Static Measure					
Central venous pressure[44,47,49,71-74]	7	356	8 mm Hg (6-9)	62 (54-69)	76 (60-87)
Dynamic Measures					
Pulse pressure variation					
Controlled ventilation, $V_t \geq 7.0$ mL/kg[36,37,40,66,75-83,92,96,97]	17	768	11 (4-15)[c]	84 (75-90)	84 (77-90)
Controlled ventilation, $V_t < 7.0$ mL/kg[37,84-87]	5	219	8 (5-12)[c]	72 (61-81)	91 (83-95)
Stroke volume variation					
Controlled ventilation[34,36,77,78,80,81,88-90]	9	343	13 (10-20)	79 (67-87)	84 (74-90)
Spontaneous breathing[48,49]	2	53	10-12[d]	57-100[d]	44-57[d]
Inferior vena cava variation					
Controlled ventilation[28,50,51,90]	4	137	15 (12-21)	77 (44-94)	85 (49-97)
Spontaneous breathing[52,53]	2	99	40-42[d]	31-70[d]	80-97[d]
Response to passive leg raising					
Change in cardiac output[24,35,38,39,41,43,45,48,53,60,91-97]	17	788	11 (7-15)	88 (80-93)	92 (89-95)
Change in pulse pressure[24,38,41,43,48]	5	278	10 (9-12)	62 (54-70)	83 (76-88)
Change in cardiac output following passive leg raising					
Controlled ventilation[38,41,92,93,96,97]	6	294	10 (7-12)	92 (82-97)	92 (86-96)
Spontaneous breathing[35,39,43,53,94]	5	181	12 (10-13)	88 (80-94)	88 (80-94)

Bentzer et al. JAMA 2016

Table des matières



III. Quand arrêter le remplissage ?

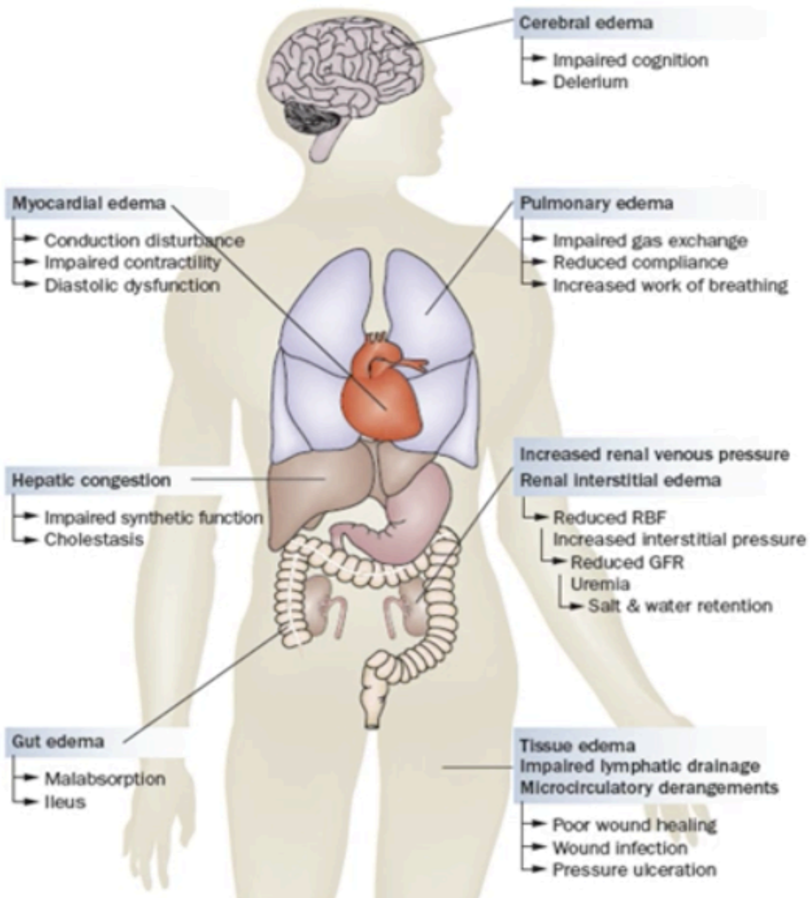
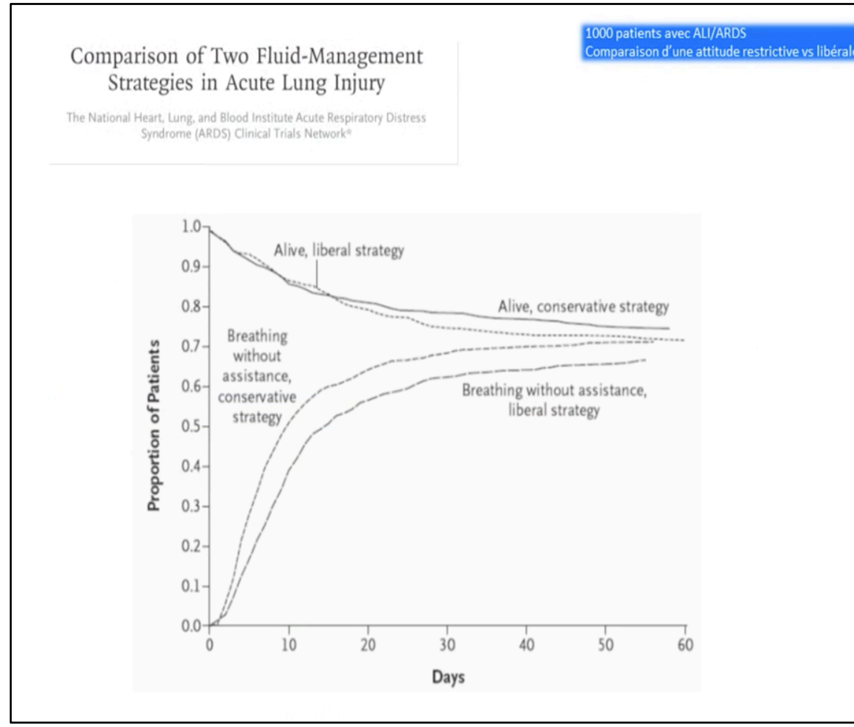
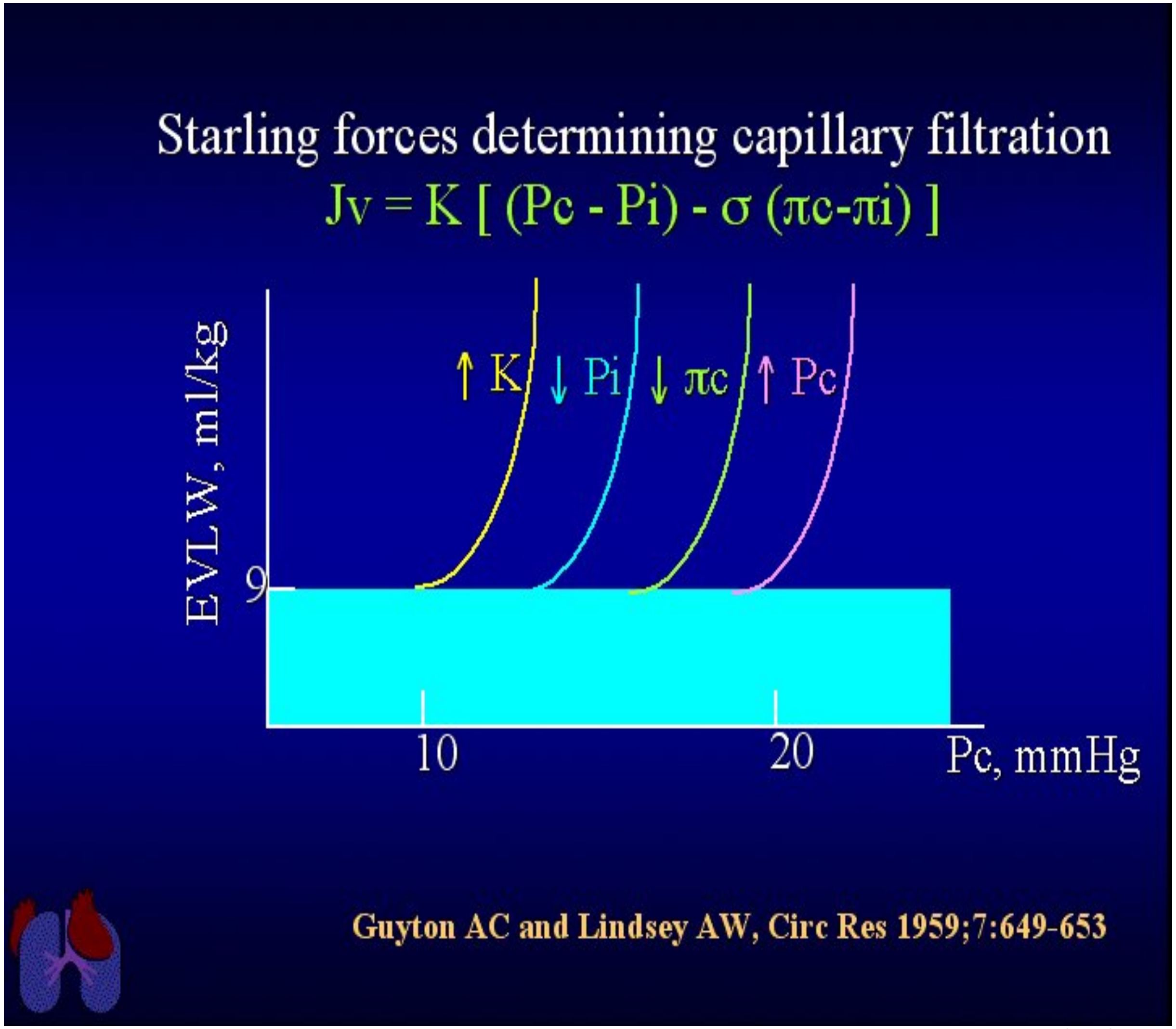


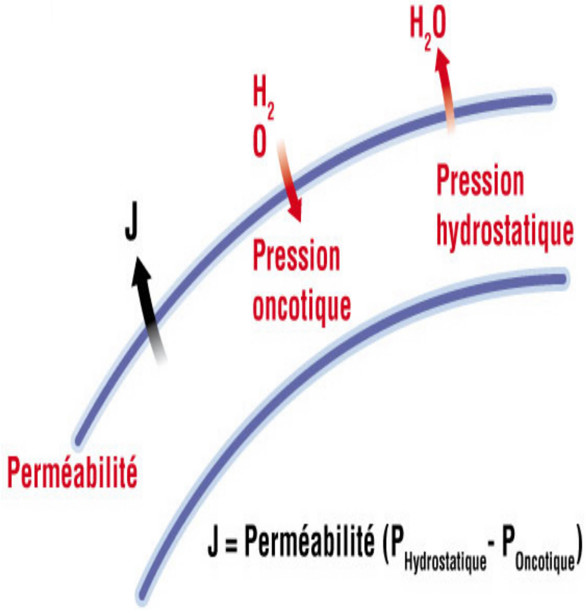
Figure 2 | Pathological sequelae of fluid overload in organ systems. Abbreviations: GFR, glomerular filtration rate; RBF, renal blood flow.



Prowle JR et al. Nat Rev Nephrol 2010

III. Quand arrêter le remplissage ?





III. Quand arrêter le remplissage ?

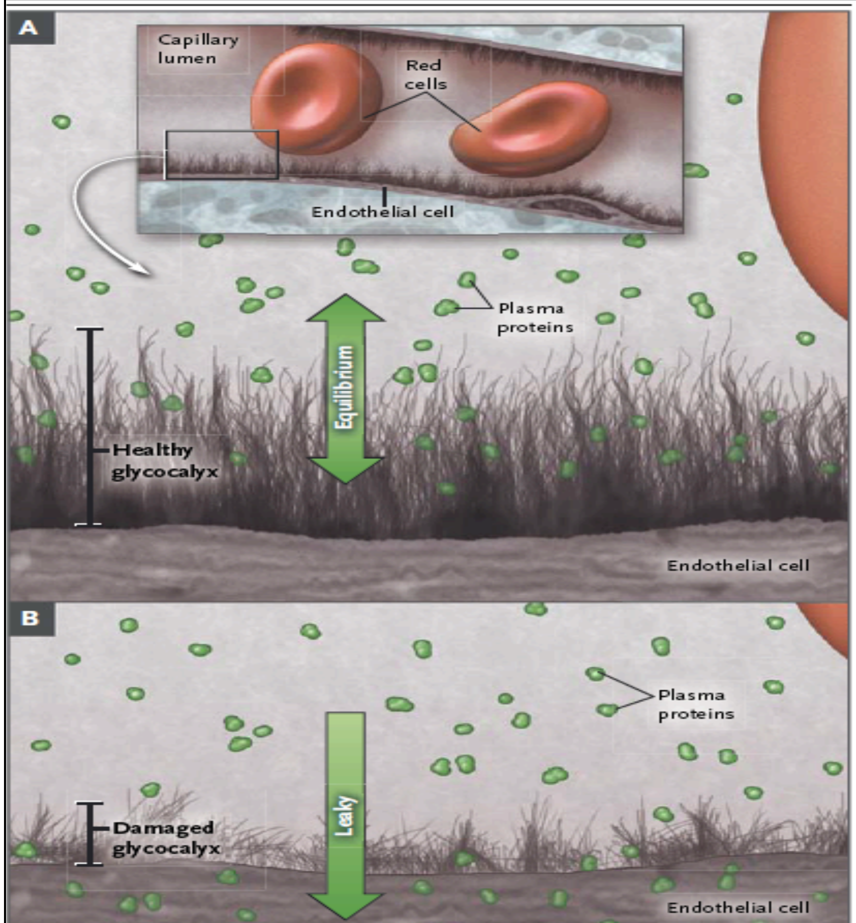


Figure 1. **Role of the Endothelial Glycocalyx Layer in the Use of Resuscitation Fluids.**

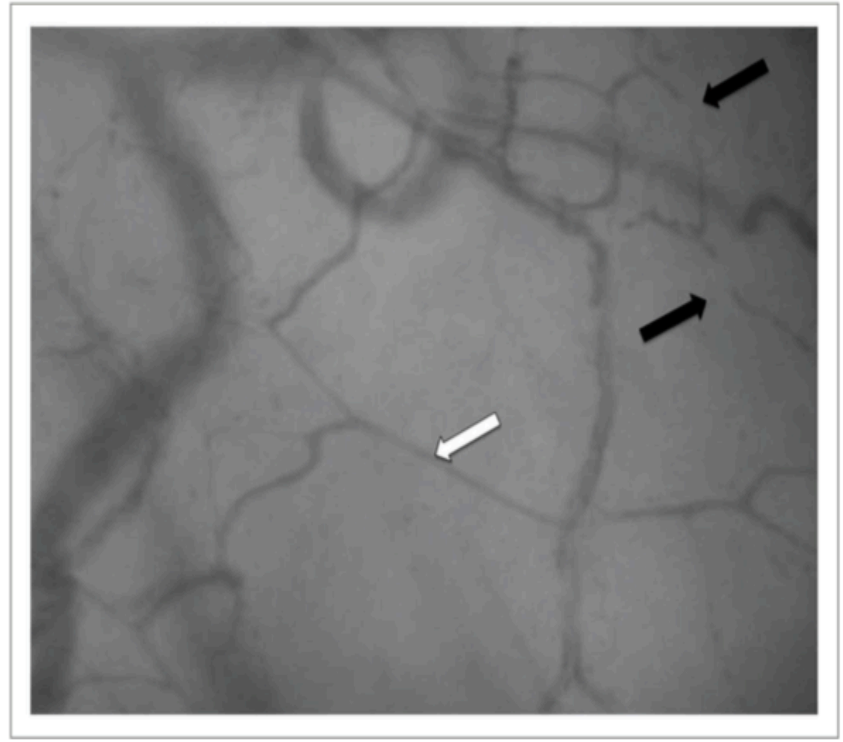


Figure 1. Sublingual microcirculation in sepsis. Photograph of the sublingual microcirculation in a patient with septic shock using a sidestream dark field (SDF) imaging device. The white arrow shows a perfused capillary, the black arrows identify a stopped flow capillary.

nejm.org september 26, 2013

virulence 5:1, 73–79; January 1, 2014

III. Quand arrêter le remplissage ?

Quand s'arrêter ??

- 4 indicateurs :

1. PaO2/FiO2 → Pas spécifique
2. PAPo
3. EPEI : eau pulmonaire extra vasculaire indéxée. < 10 mL/kg
4. IPVP : indice de perméabilité vasculaire pulmonaire. < 3,0

$$\text{Indice de perméabilité vasculaire pulmonaire} = \frac{\text{eau pulmonaire}}{\text{volume sanguin pulmonaire}}$$

III. Quand arrêter le remplissage ?

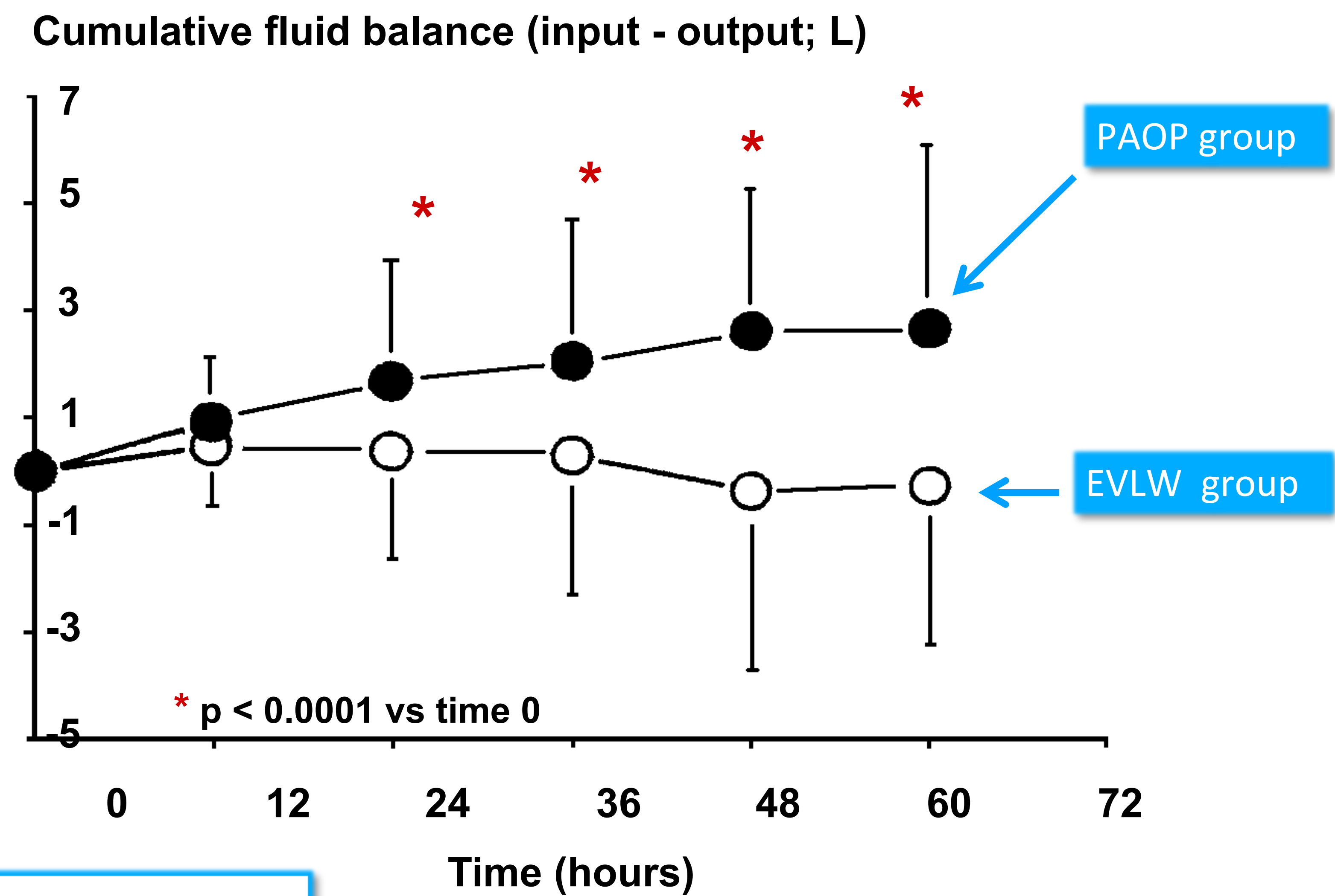
Extra-vascular lung water and pulmonary vascular permeability index are independent prognostic factors in patients with acute respiratory distress syndrome

Jozwiak M, Silva S, Persichini R, Anguel N, Osman D, Richard C, Teboul JL, Monnet X *submitted*

200 pts with ARDS
EVLW measured by PiCCO device

	Odds Ratio (CI 95%)		p value
Maximal blood lactate	0.81	(0.71 - 0.93)	0.002
Mean PEEP	1.25	(1.07 - 1.47)	0.005
$EVLWI_{max}$	0.94	(0.87 - 0.98)	0.01
SAPS II	0.97	(0.95 - 0.99)	0.02
Mean fluid balance	0.9996	(0.9993 - 0.9999)	0.02
Minimal P/F ratio	1.01	(1.00 - 1.02)	0.02
Minimal pH	35.97	(0.47 - 2769.52)	0.10

III. Quand arrêter le remplissage ?

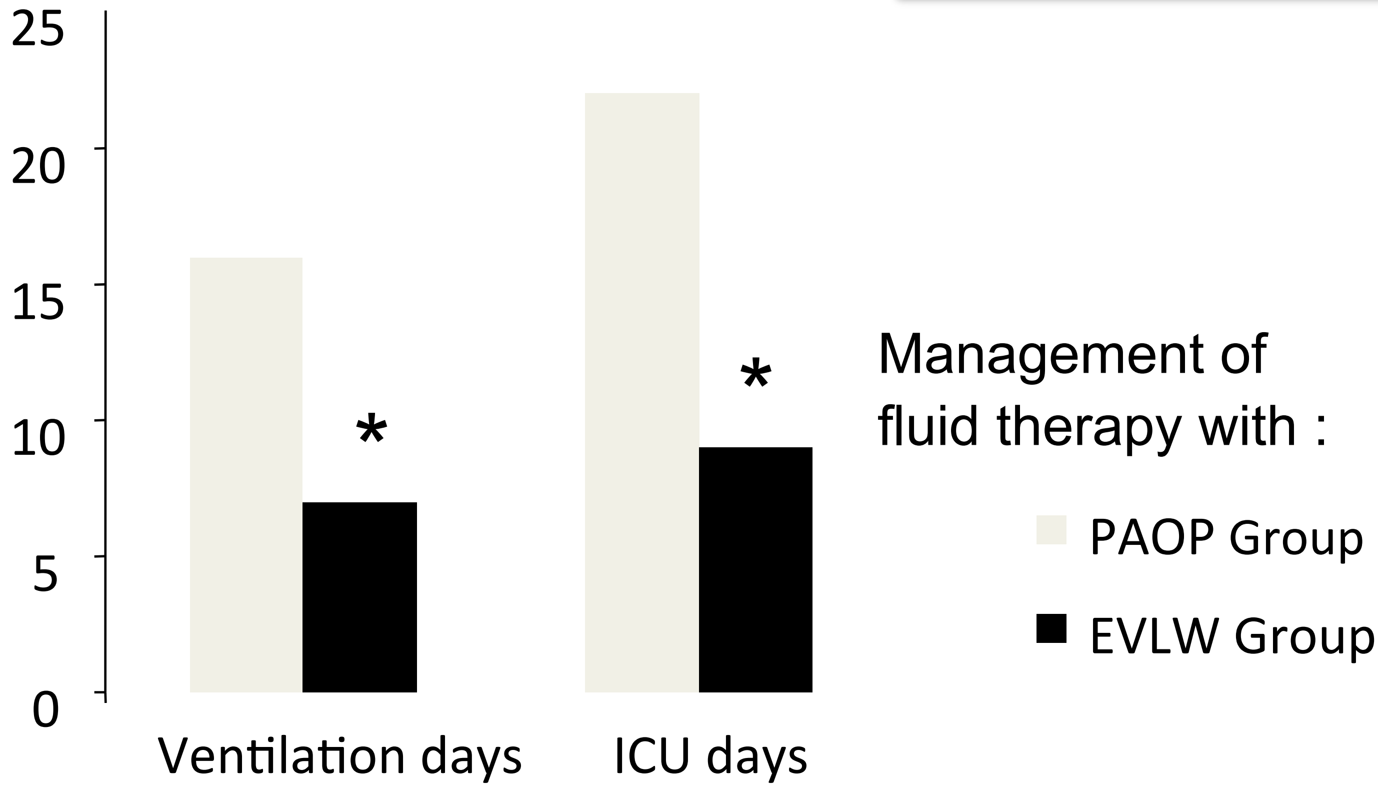


101 ARDS patients
randomized to EVLW-guided management vs.
PAOP-guided management

Mitchell JP et al., Am Rev Respir Dis 1992

III. Quand arrêter le remplissage ?

101 ARDS patients
randomized to EVLW-guided management vs.
PAOP-guided management



Mitchell JP et al., Am Rev Respir Dis 1992

III. Quand arrêter le remplissage ?

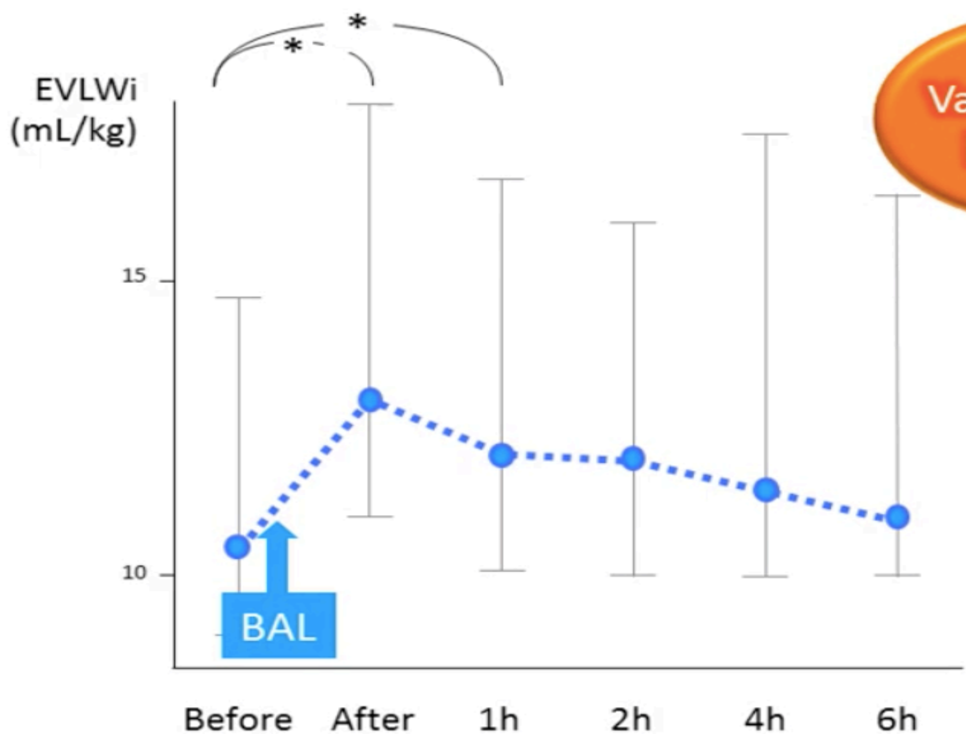
Transpulmonary Thermodilution Enables to Detect Small Short-Term Changes in Extravascular Lung Water Induced by a Bronchoalveolar Lavage

Martin Dres, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]; Laurent Guerin, MD[1,2]; Nadia Anguel, MD[1,2]; Virginie Amilien, MD[1,2]; Marie-Philippine Clair, MD[1,2]; Aurélie Grüner, MD[1,2]; Christian Richard, MD[1,2]; Xavier Monnet, MD, PhD[1,2]

(*Crit Care Med* 2014; 42:1869–1873)

28 LBA

Eau pulmonaire mesurée par PiCCO

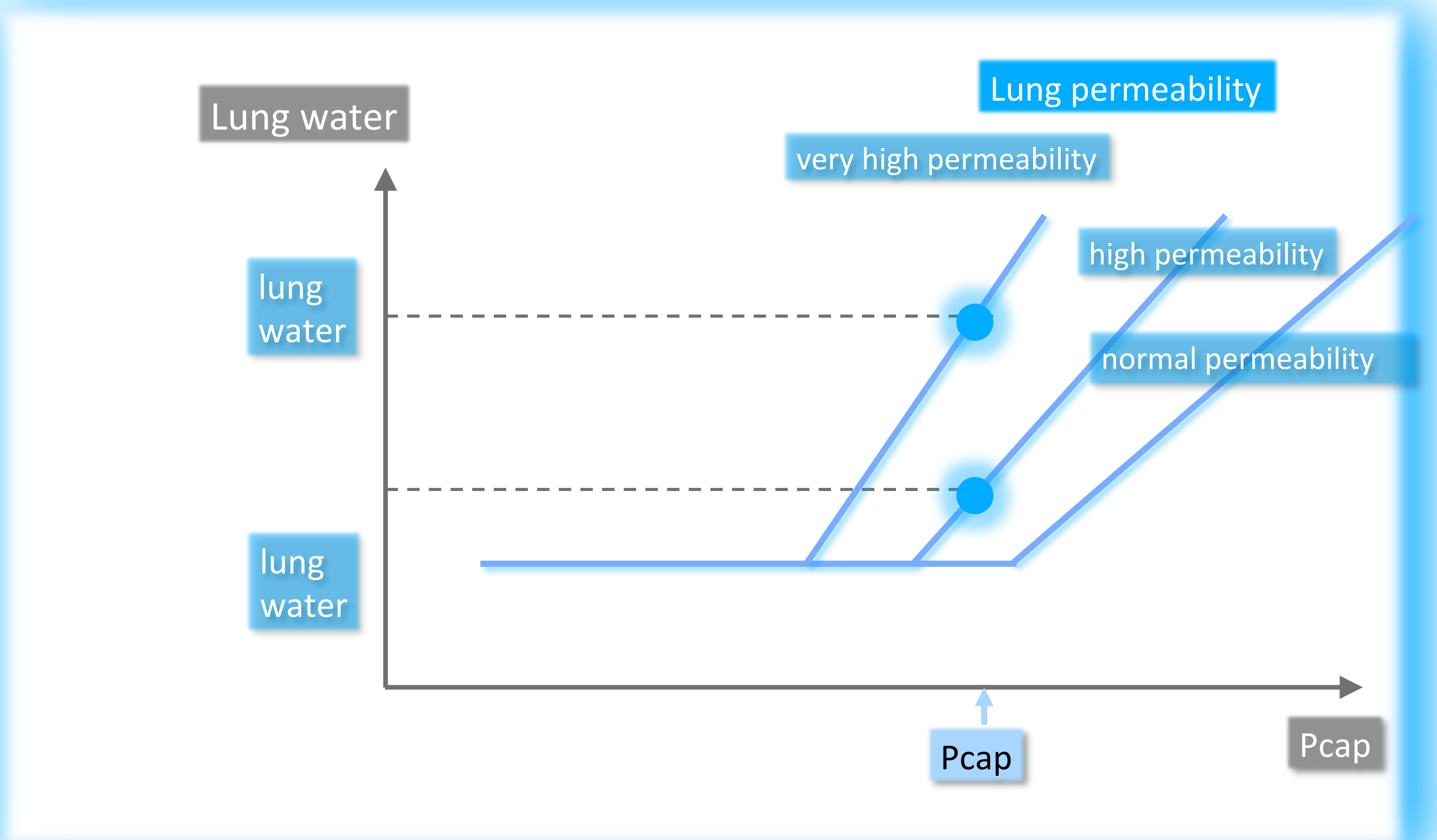


Validée chez l'homme

Permet une estimation précise

X. Monnet, SRLF 2015

III. Quand arrêter le remplissage ?

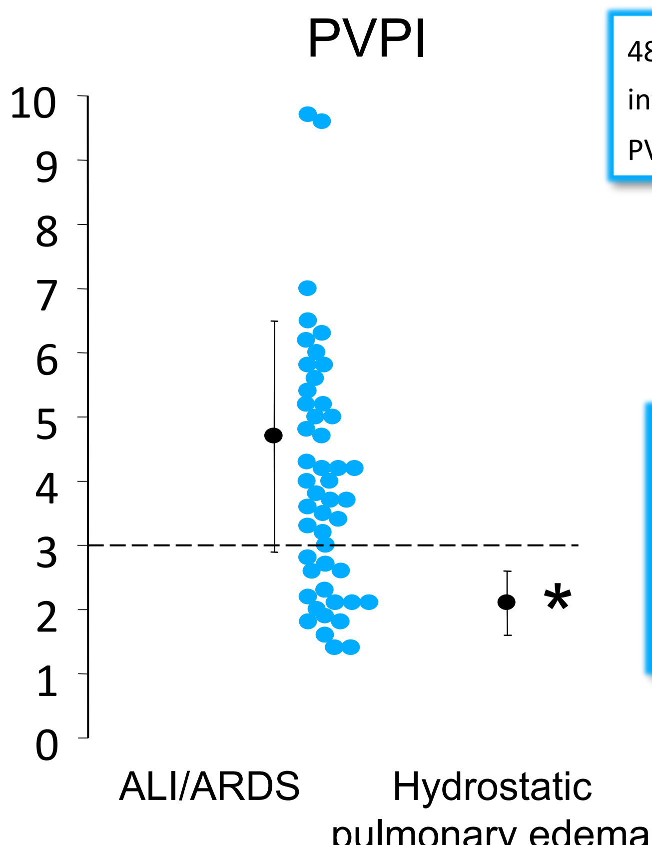


Intensive Care Med 2007

Xavier Monnet
Nadia Anguel
David Osman
Olfa Hamzaoui
Christian Richard
Jean-Louis Teboul

ORIGINAL

Assessing pulmonary permeability by transpulmonary thermodilution allows differentiation of hydrostatic pulmonary edema from ALI/ARDS



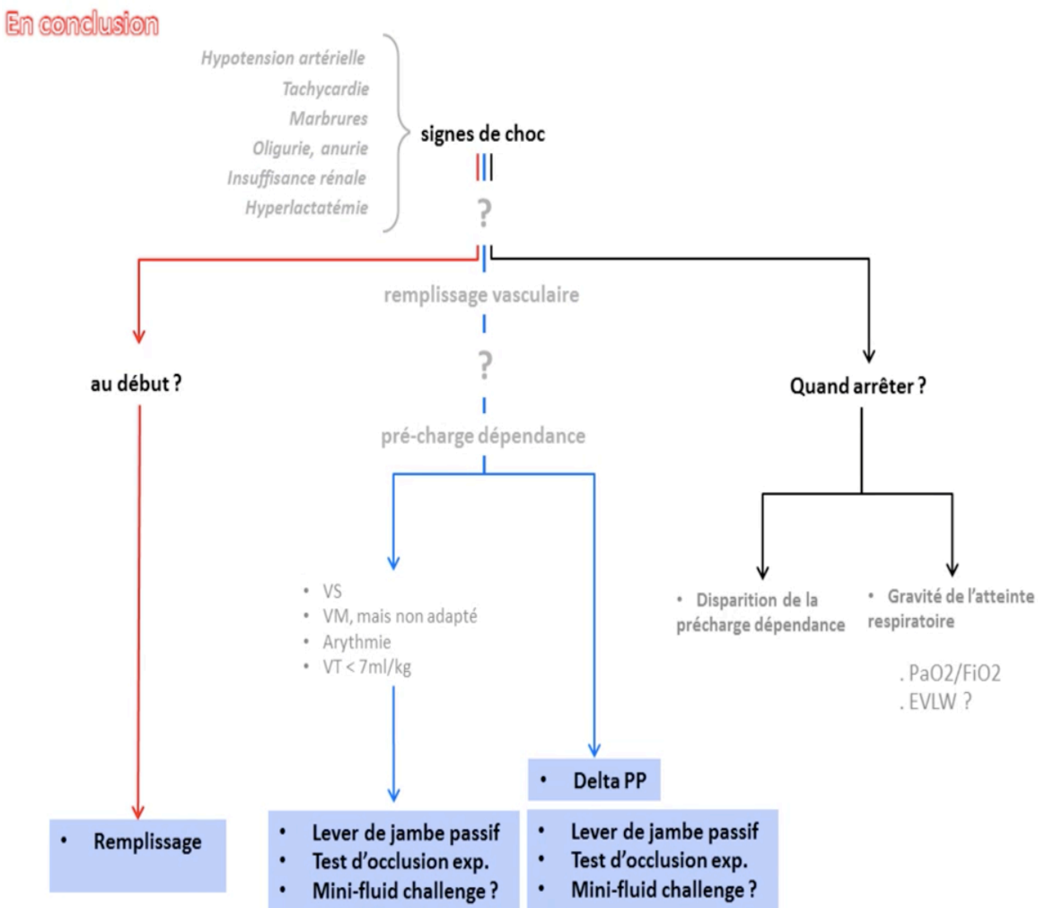
48 patients with pulmonary edema
inflammatory vs. hydrostatic discriminated by experts
PVPI by the PiCCO device

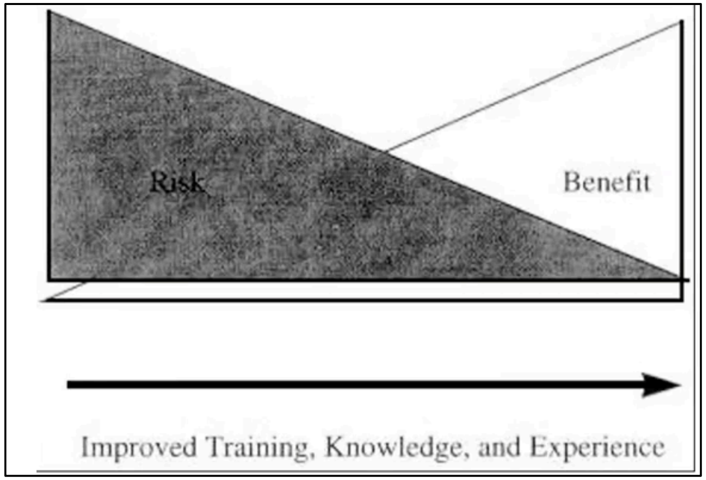
Cut-off : 3

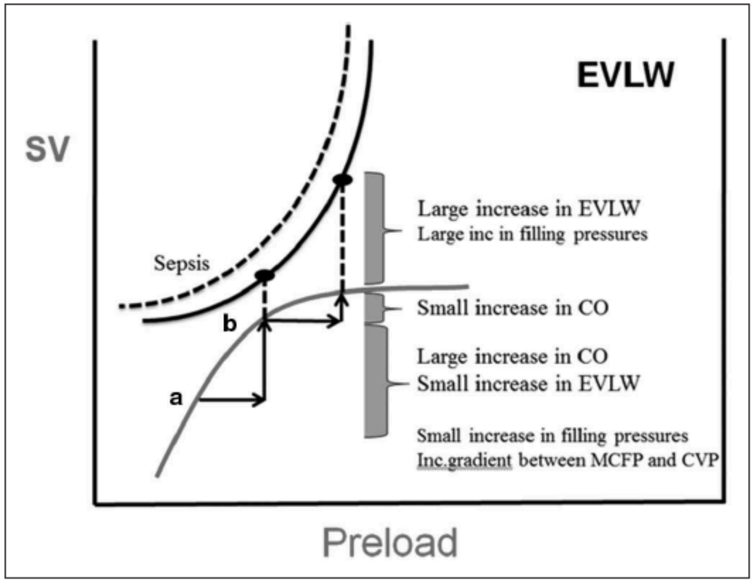
Se = 85 %

Sp = 100 %

Keys messages (3)







- Attention aux effets secondaires !!
- Calibration +++

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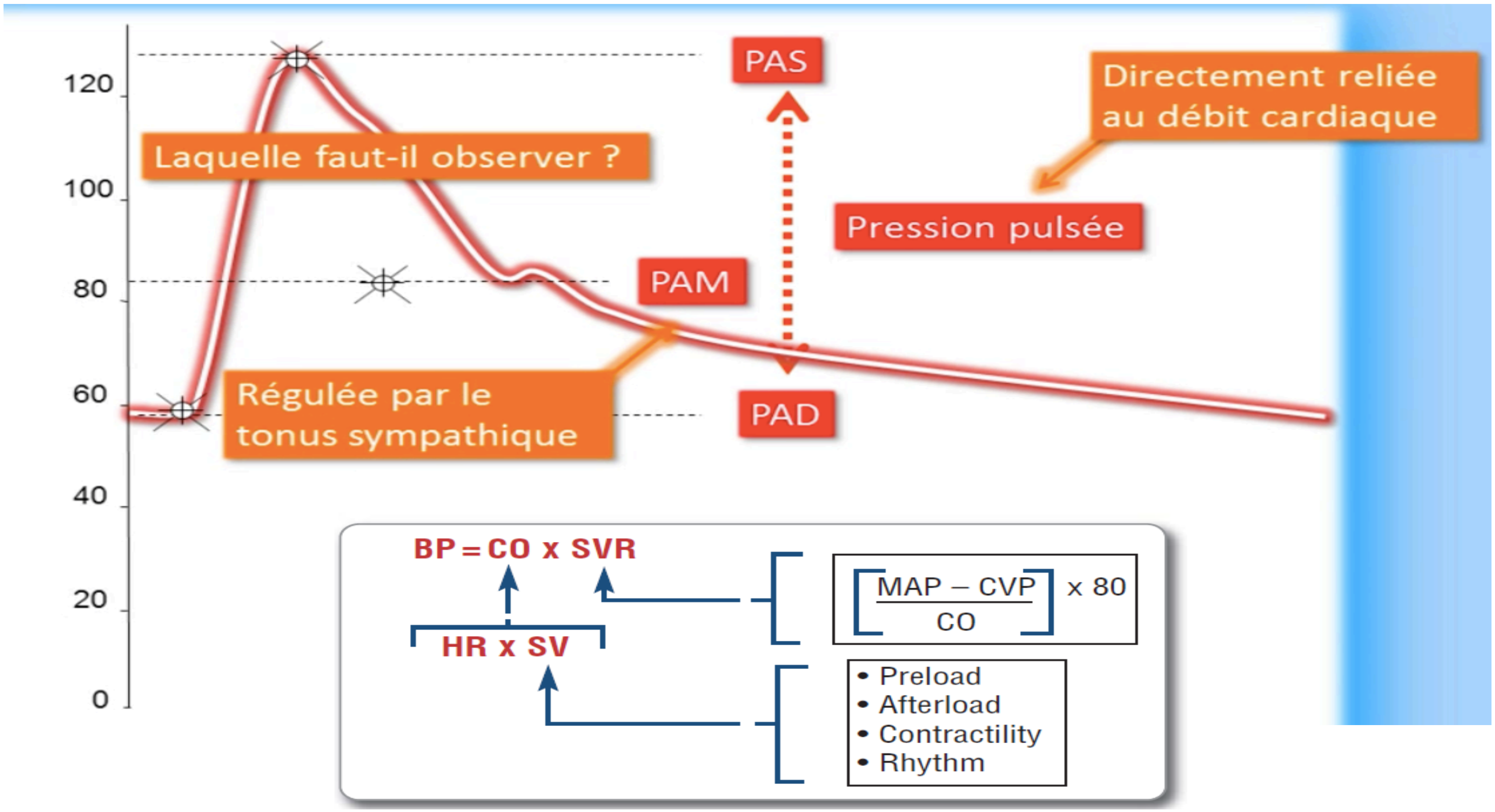
IV. Appréciation de la réponse au remplissage

Pression artérielle



X. Monnet, SRLF 2016

IV. Appréciation de la réponse au remplissage

A
in

Xa
Na

Arterial pressure allows monitoring the changes in cardiac output induced by volume expansion but not by norepinephrine*

Xavier Monnet, MD, PhD; Alexia Letierce, PhD; Olfa Hamzaoui, MD; Denis Chemla, MD, PhD; Nadia Anguel, MD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Crit Care Med 2011

228 patients recevant un remplissage vasculaire
145 patients recevant de la noradrénaline

Changements de la « simple »

Variable	Best Cutoff Value	Positive Predictive Value	Negative Predictive Value
Changes in arterial pulse pressure	17%	88 [80–93]	59 [50–68]
Changes in systolic arterial pressure	8%	79 [71–85]	61 [51–71]
Changes in mean arterial pressure	13%	82 [72–90]	49 [40–57]
Changes in diastolic arterial pressure	11%	78 [66–87]	44 [37–52]

X. Monnet, SRLF 2016

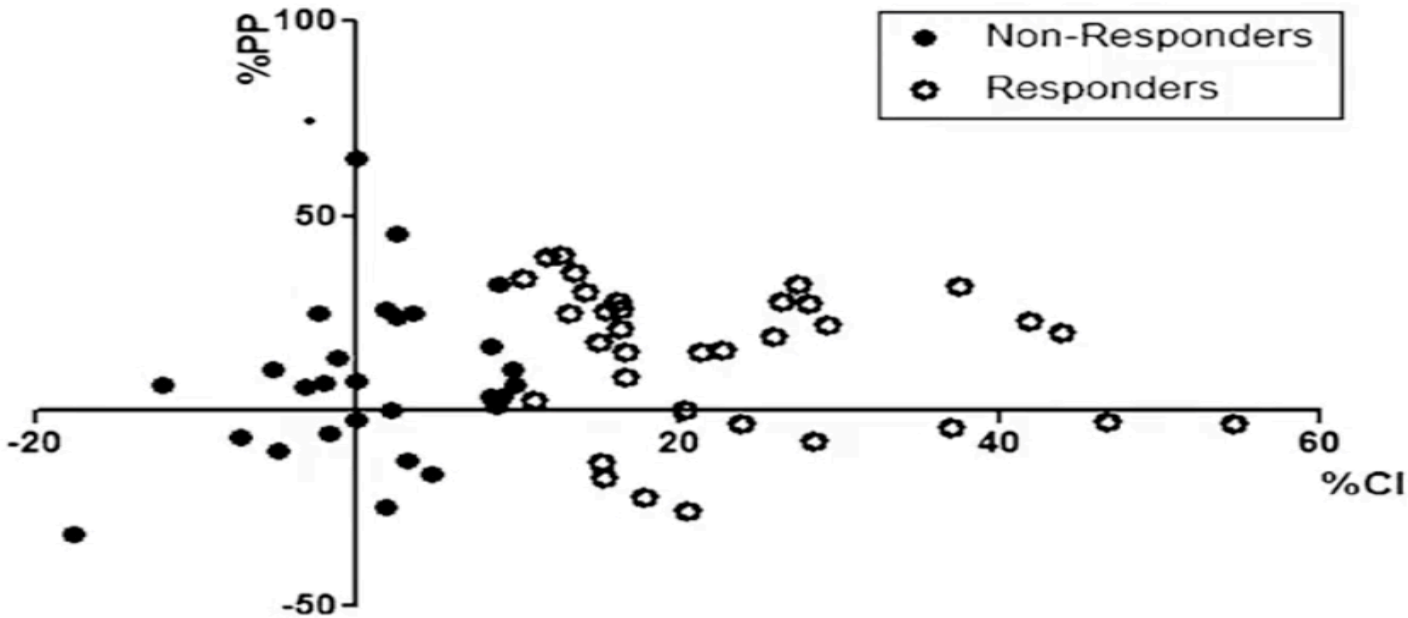
IV. Appréciation de la réponse au remplissage

Intensive Care Med (2012) 38:422–428
DOI 10.1007/s00134-011-2457-0

ORIGINAL

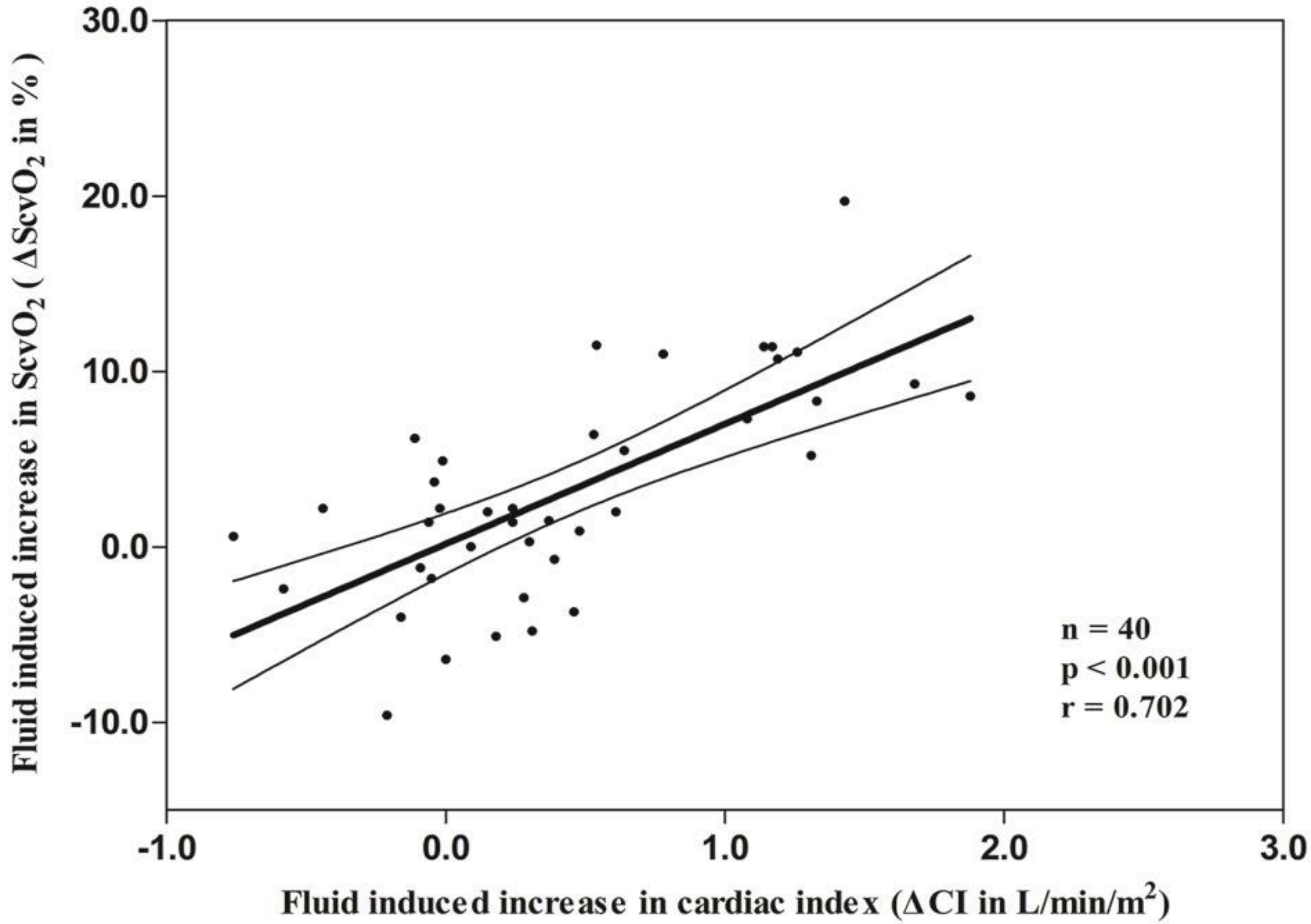
Charalampos Pierrakos
Dimitrios Velissaris
Sabino Scolletta
Sarah Heenen
Daniel De Backer
Jean-Louis Vincent

Can changes in arterial pressure be used to detect changes in cardiac index during fluid challenge in patients with septic shock?



IV. Appréciation de la réponse au remplissage

SvO2 ?



Xu et al. Journal of Critical Care (2016)

IV. Appréciation de la réponse au remplissage

Lactate and Veno-Arterial Carbon Dioxide Difference/Arterial-Venous Oxygen Difference Ratio, but Not Central Venous Oxygen Saturation, Predict Increase in Oxygen Consumption in Fluid Responders

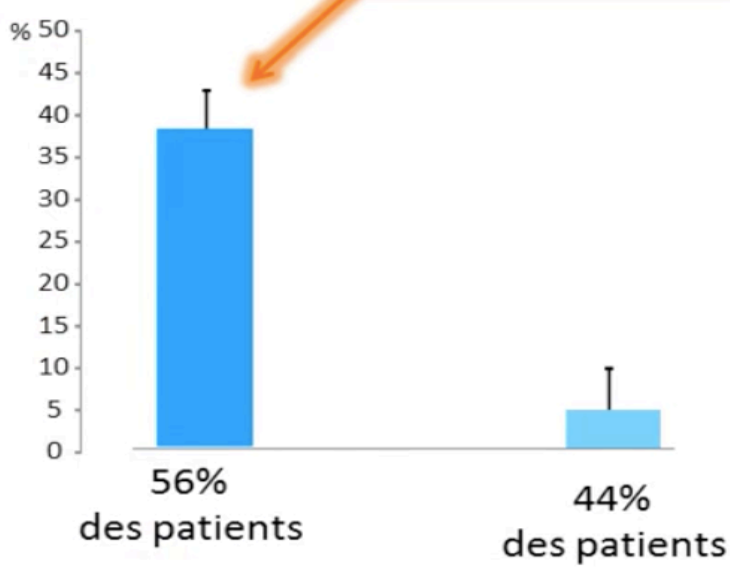
Xavier Monnet, MD, PhD[1,2]; Florence Julien, MD[1,2]; Nora Ait-Hamou, MD[1]; Marie Lequoy, MD[1,2]; Clément Gosset, MD[1,2]; Mathieu Jozwiak, MD[1,2]; Romain Persichini, MD[1,2]; Nadia Anguel, MD[1,2]; Christian Richard, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]

Crit Care Med

$$SvO2 = SaO2 - \frac{Vo2}{(IC \times hb \times 13{,}4)}$$

Le remplissage vasculaire n'améliorait la consommation en O_2 que chez la moitié des patients

Amélioration de la consommation en O_2



X. Monnet, SRLF 2016

IV. Appréciation de la réponse au remplissage

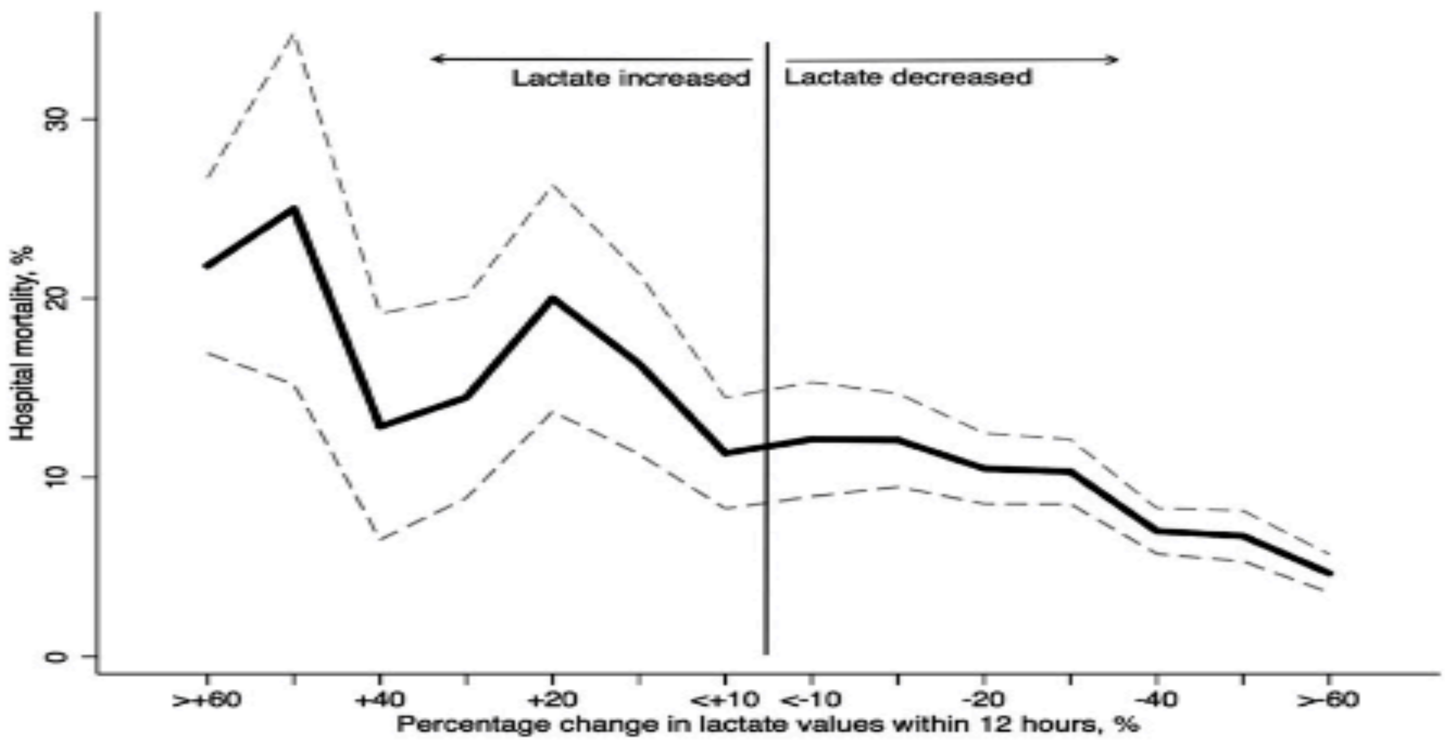


Figure 1. Mean hospital mortality (*solid line*) and 95% confidence interval (*dotted lines*) based on the magnitude of lactate change within 12 hours compared with index values. Patients with decreased lactate (across percentage strata) are represented toward the *right* of the figure, whereas those with increased lactate are toward the *left*. The *vertical line* demarcates increased and decreased repeat lactate values.

Annals ATS October 2013

Keys Messages (4)

Indicateur :

Débit cardiaque

Et éventuellement ….

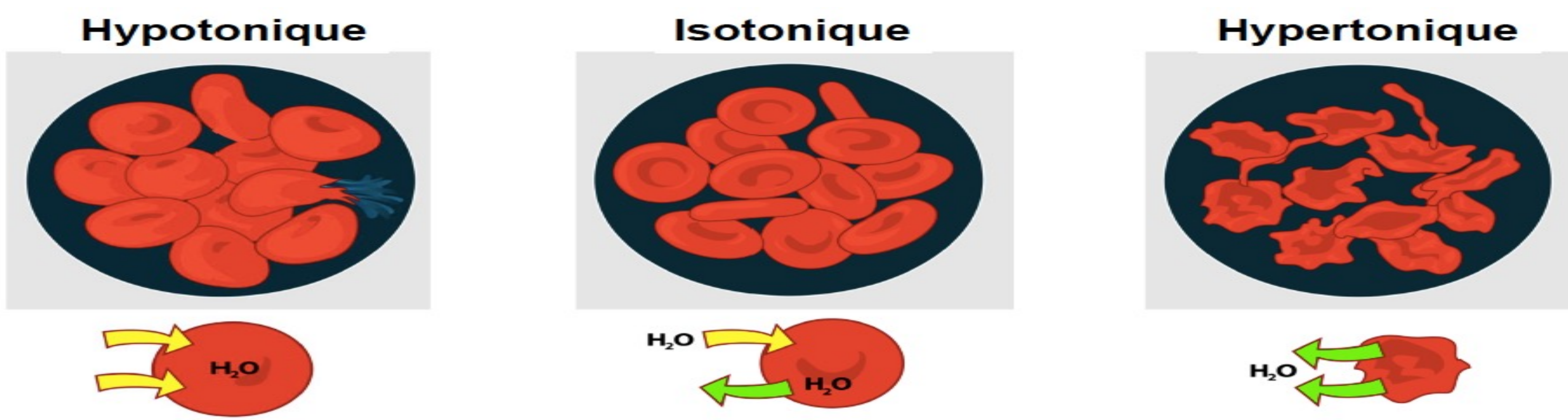
1. La lactatémie
2. Pression artérielle
3. SvO2 ou ScvO2
4. La clinique

+ indicateurs prédictifs

Table des matières

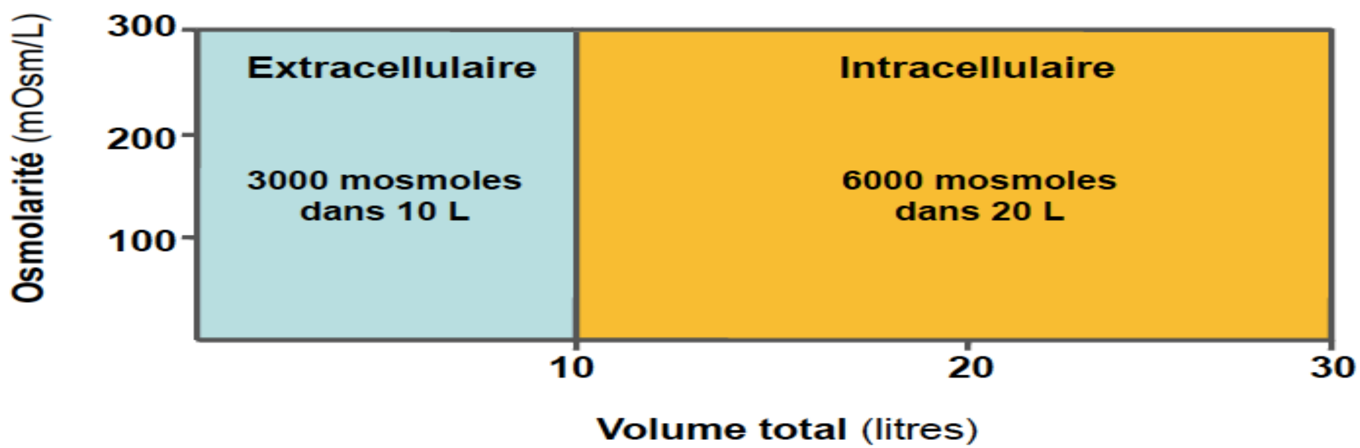
V. Solutés de remplissage

- Tonicité : effet de l'osmolarité d'une solution sur le volume cellulaire
- Le nombre de molécules non diffusibles dissoutes dans un 1 kg d'eau
- Natrémie : reflet de la tonicité du LEC



V. Solutés de remplissage

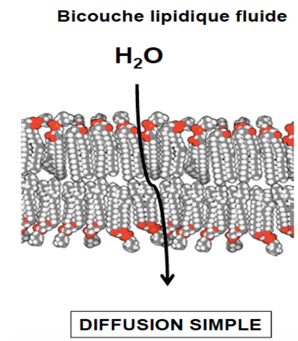
- L' osmolarité est mesurable : nombre de molécule diffusibles ou non, dissoutes par litre (kg) de solution
- Urée et glucose : diffusent facilement en situation physiologique

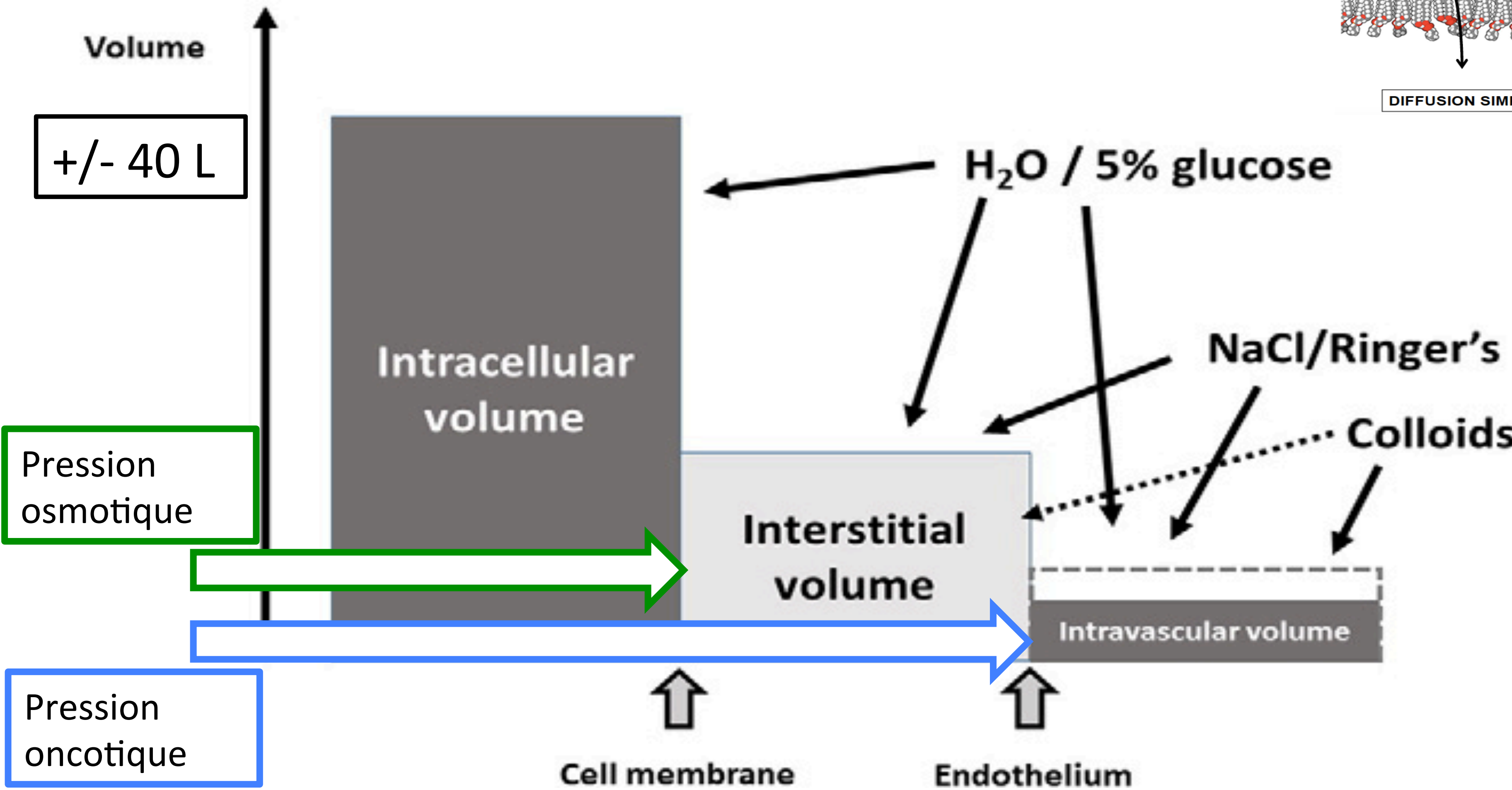


~ 300 mOsm/L dans tous les liquides corporels

V. Solutés de remplissage

Hydratation ≠ remplissage vasculaire





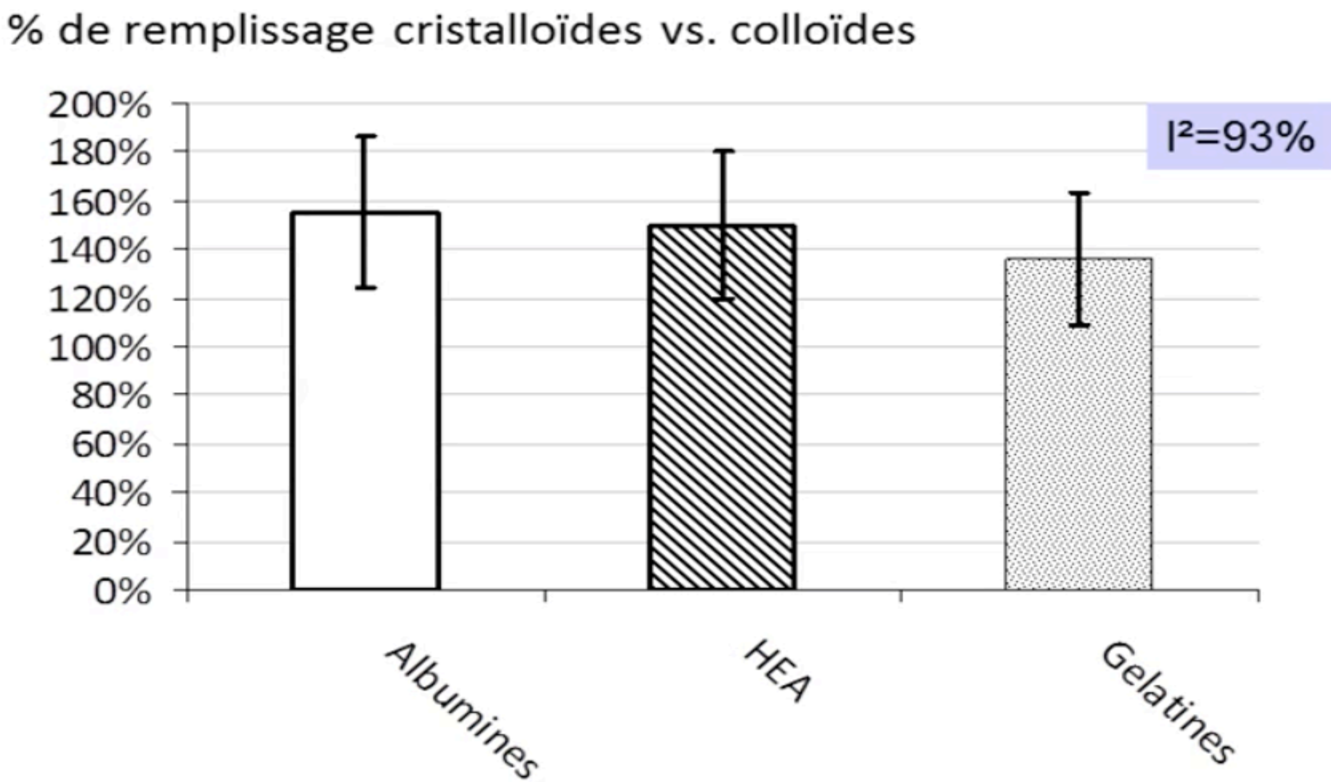
J.L. Vincent et al. / Journal of Critical Care 35 (2016) 161–167

V. Solutés de remplissage

3 questions ?

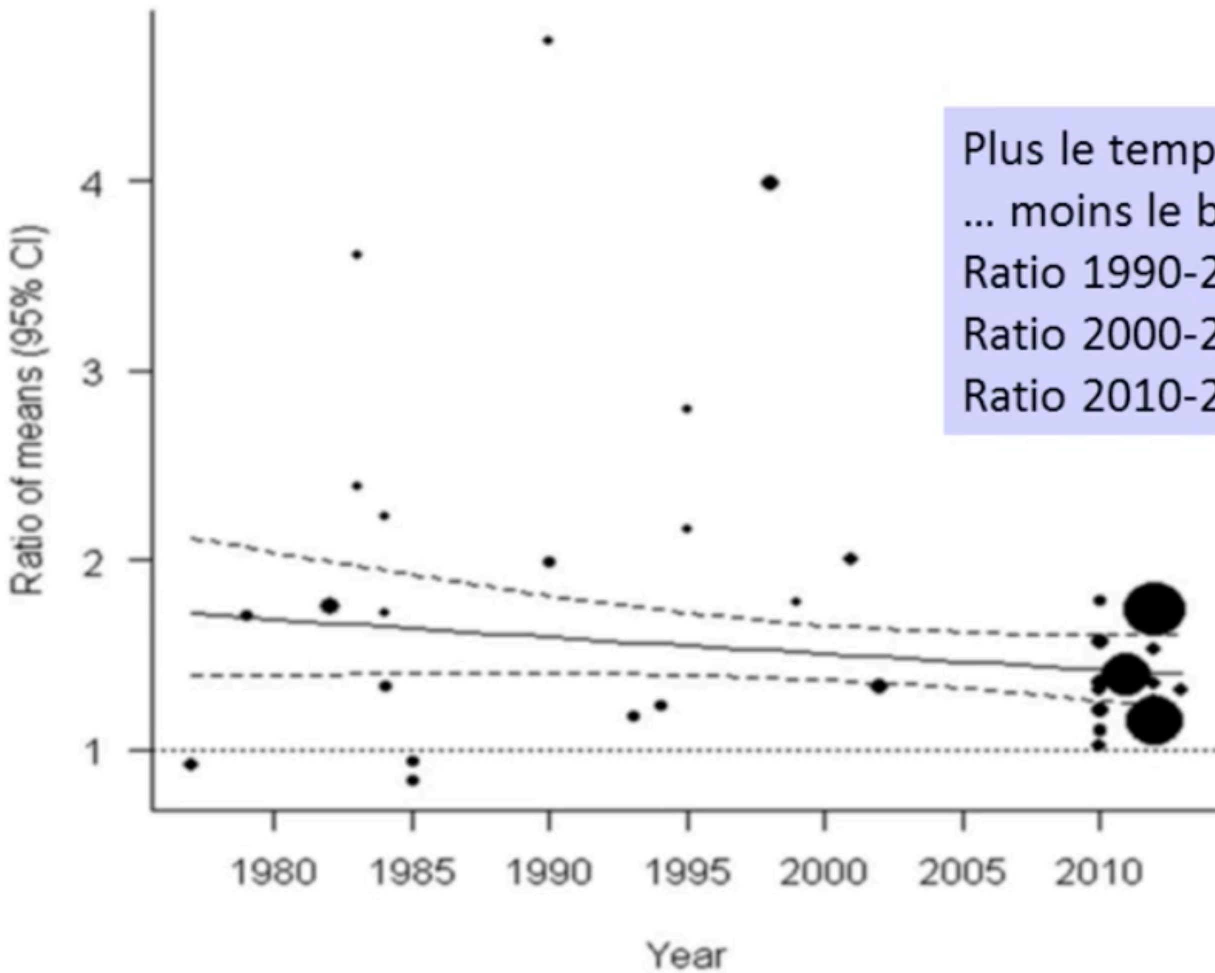
1. Cristalloïdes vs colloïdes synthétiques?
2. Cristalloïdes vs colloïdes naturels ?
3. Quel type de cristalloïde ?

V. Solutés de remplissage



Cortes et al. Anesthesia Analgesia 2015

V. Solutés de remplissage



Plus le temps passe…
… moins le bénéfice est net :
Ratio 1990-2000: 2.17 (1.76-2.68)
Ratio 2000-2009: 1.62 (1.13-2.31)
Ratio 2010-2013: 1.33 (1.17-1.50)

Cortes et al. Anesthesia Analgesia 2015

V. Solutés de remplissage

British Journal of Anaesthesia 92 (6): 821–6 (2004)
DOI: 10.1093/bja/aeh111 Advance Access publication April 2, 2004

BJA

Changes in serum albumin concentration and volume expanding effects following a bolus of albumin 20% in septic patients

M. P. Margarson* and N. C. Soni

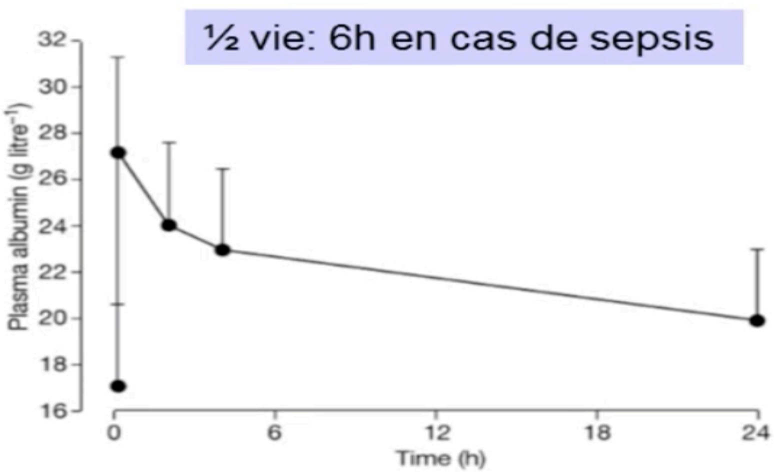


Fig 1 Twenty-four h albumin concentrations after albumin 20%, 200 ml bolus in the first 44 septic patients studied. Data are mean and SD.

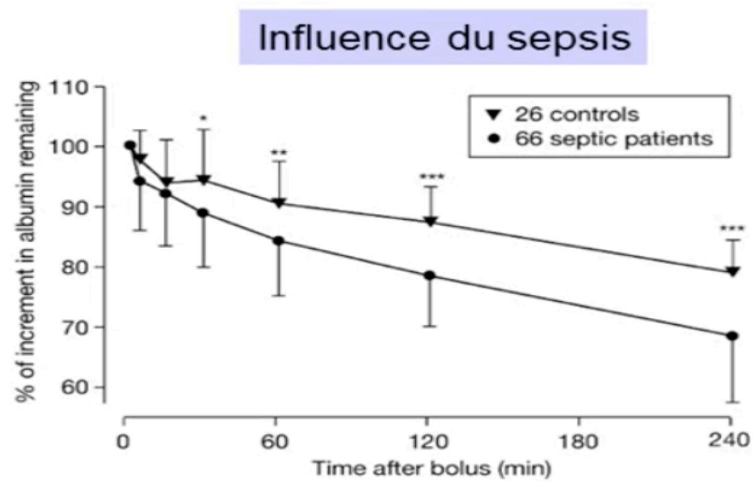
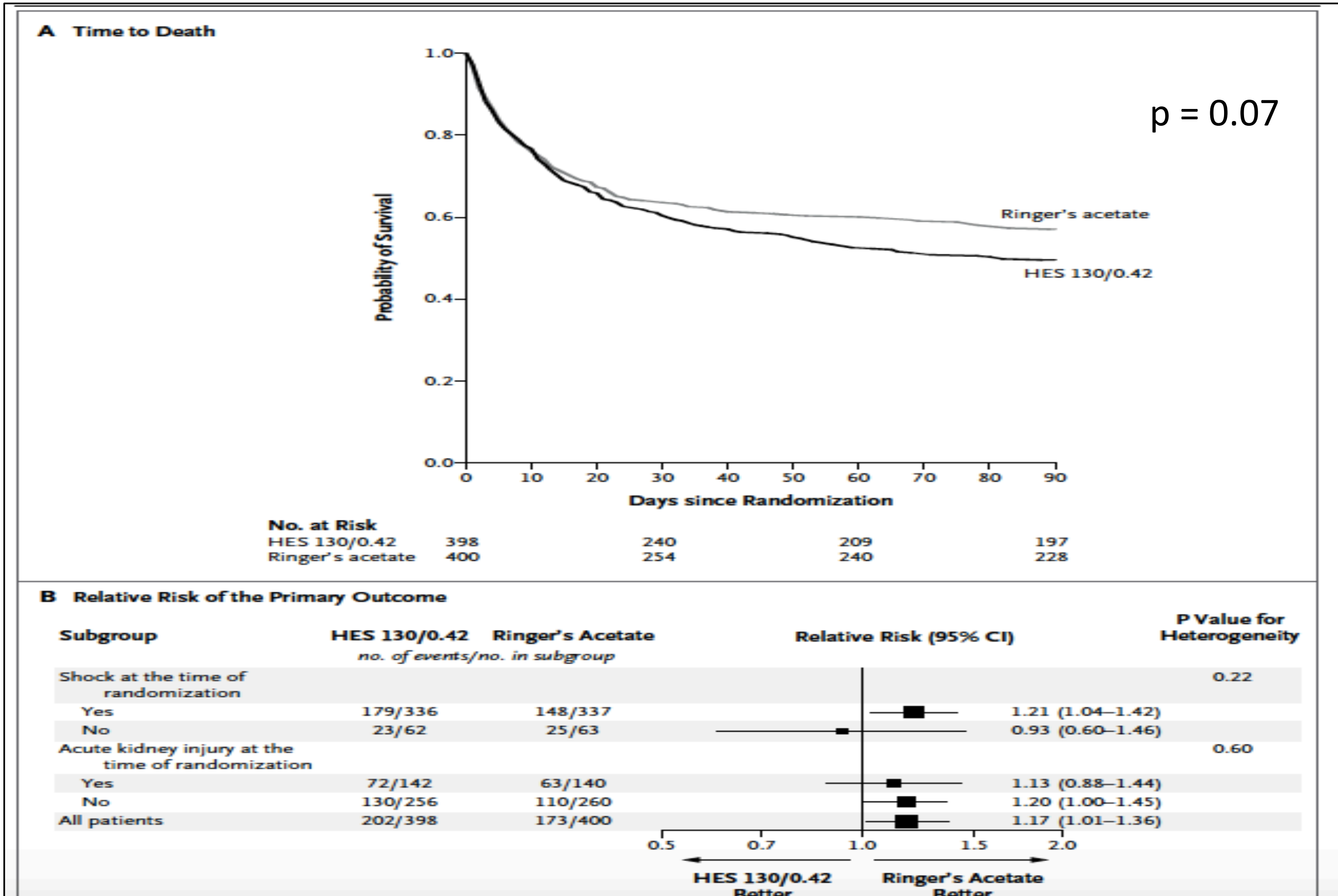


Fig 6 Changes in the albumin increment (% of initial increase) in 26 controls and 66 septic patients after albumin 20%, 200 ml.

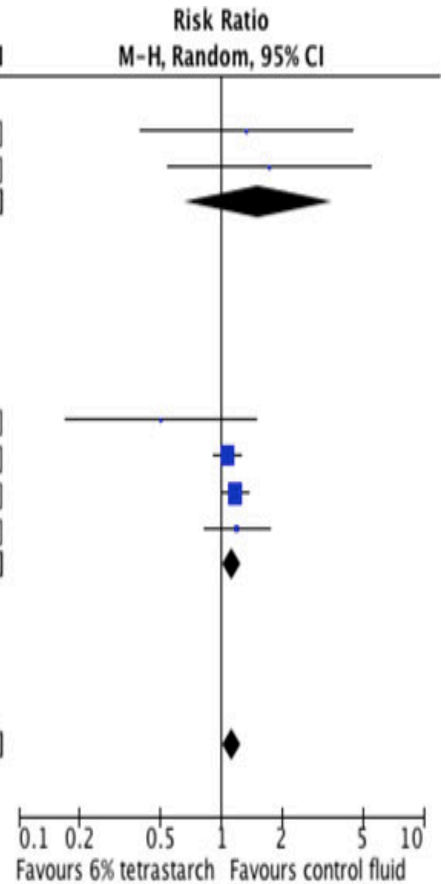
V. Solutés de remplissage



6S NEJM july 12, 2012

V. Solutés de remplissage

Study or Subgroup	Favours 6% tetrastarch Events	Total	Control fluid Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
1.2.1 Colloid control fluid						
Palumbo et al. 2006	4	10	3	10	0.7%	1.33 [0.40, 4.49]
Dolecek et al. 2009	6	26	4	30	0.8%	1.73 [0.55, 5.47]
Subtotal (95% CI)		**36**		**40**	**1.5%**	**1.53 [0.66, 3.53]**
Total events	10		7			
Heterogeneity: Tau² = 0.00; Chi² = 0.09, df = 1 (P = 0.76); I² = 0%						
Test for overall effect: Z = 1.00 (P = 0.32)						
1.2.1 Crystalloid control fluid						
Dubin et al. 2010	3	11	7	13	0.9%	0.51 [0.17, 1.50]
CHEST trial 2012	248	976	224	945	42.6%	1.07 [0.92, 1.25]
6S trial 2012	201	398	172	400	47.3%	1.17 [1.01, 1.36]
CRYSTMAS trial 2012	40	99	32	95	7.7%	1.20 [0.83, 1.74]
Subtotal (95% CI)		**1484**		**1453**	**98.5%**	**1.12 [1.01, 1.24]**
Total events	492		435			
Heterogeneity: Tau² = 0.00; Chi² = 2.89, df = 3 (P = 0.41); I² = 0%						
Test for overall effect: Z = 2.19 (P = 0.03)						
Total (95% CI)		**1520**		**1493**	**100.0%**	**1.13 [1.02, 1.25]**
Total events	502		442			
Heterogeneity: Tau² = 0.00; Chi² = 3.49, df = 5 (P = 0.62); I² = 0%						
Test for overall effect: Z = 2.30 (P = 0.02)						
Test for subgroup differences: Chi² = 0.52, df = 1 (P = 0.47), I² = 0%						



V. Solutés de remplissage

1,522 surgical intensive care patients

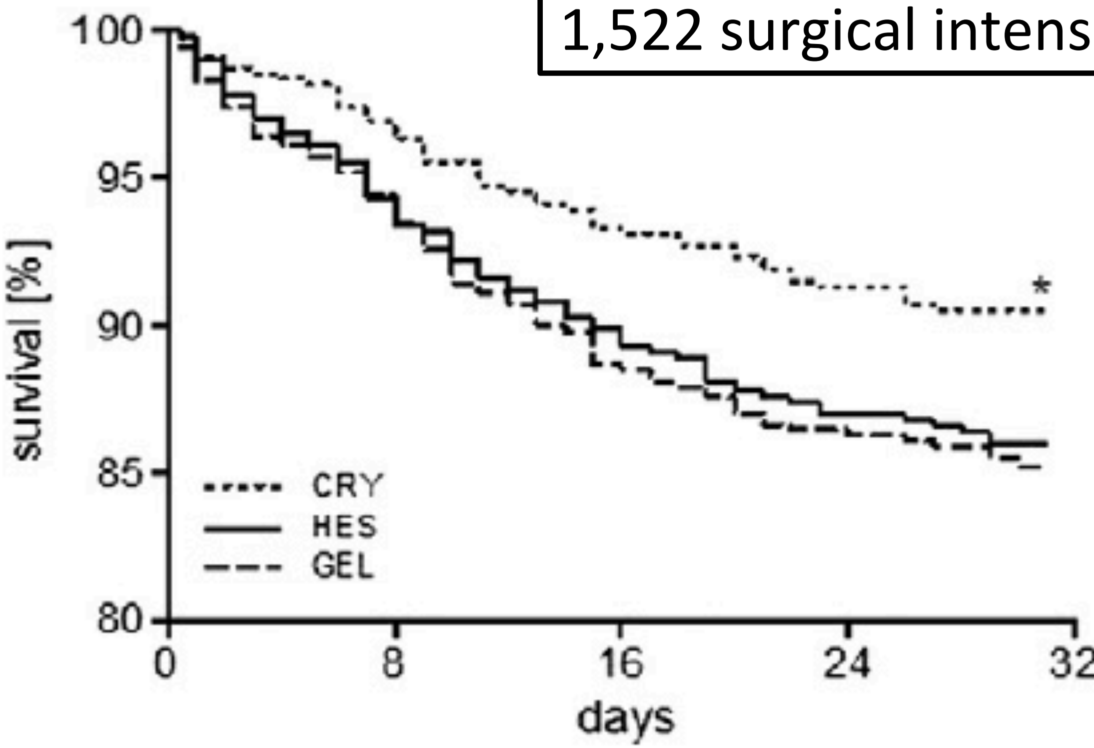


Fig. 3. Thirty-day survival rate. There was no significant difference in 30-day survival rate between both HES and GEL colloids. An asterisk (*) indicates *P* < .05 vs both colloid cohorts (HES and GEL).

F.W. Albrecht et al. / Journal of Critical Care 36 (2016)

V. Solutés de remplissage

1,024 pts, choc septique
3 groupes : HES vs Gel vs Crist

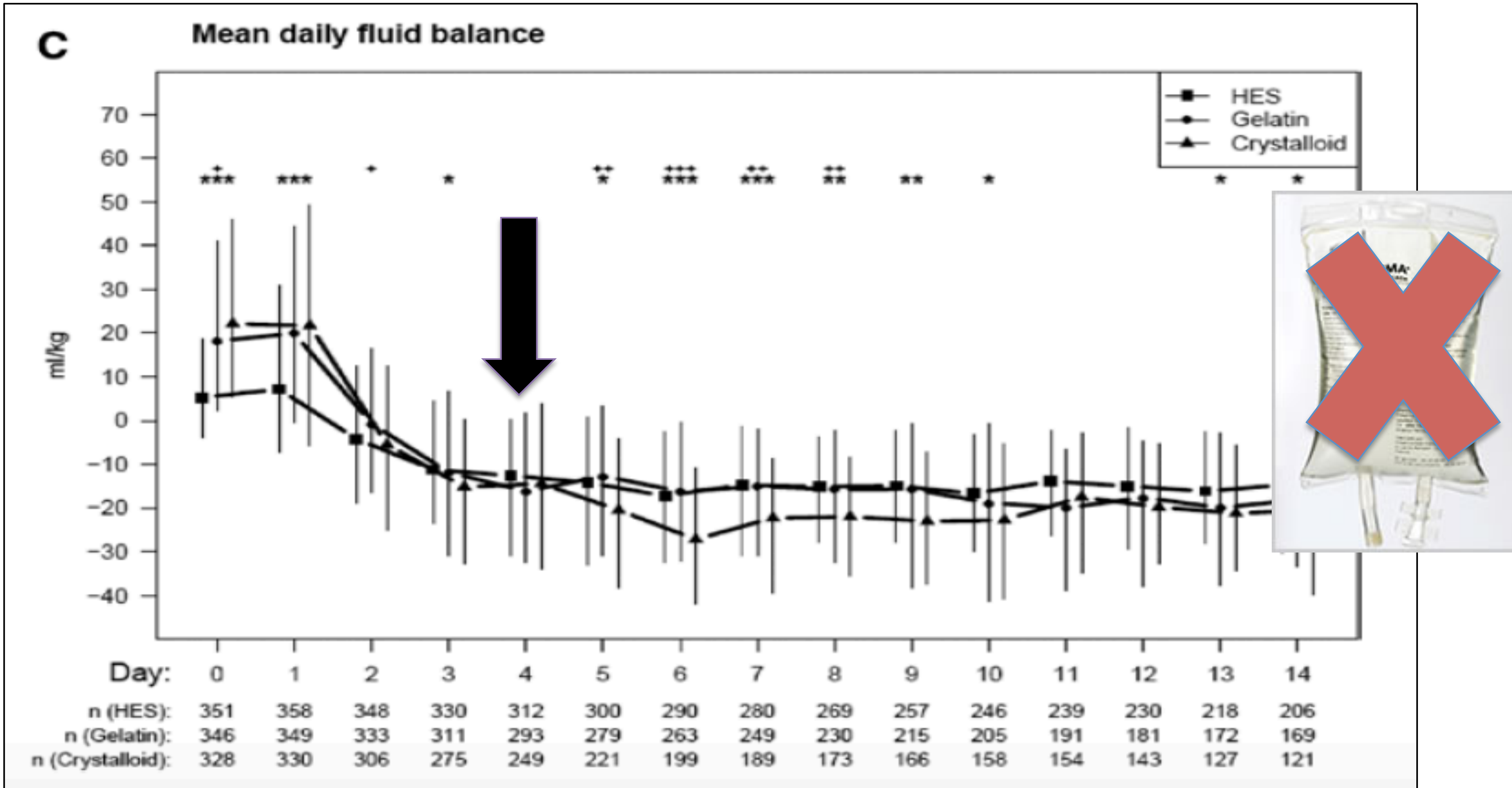
Table 4. Multiple logistic regression analysis with acute kidney injury by Risk, Injury, Failure, Loss, and End-stage kidney disease as dependent binary variable

	n	Adjusted Odds Ratio (95% Confidence Interval)	*p*
Age (per year)	1024	1.02 (1.01, 1.03)	<.001
Baseline creatinine: (per µmol/L)	1024	1.0023 (1.0002, 1.0043)	.031
Baseline Simplified Acute Physiology Score-II: (per point)	1024	1.02 (1.01, 1.03)	<.001
Cardiac/thoracic surgery: yes vs. no	1024	1.70 (1.23, 2.75)	.001
Liver cirrhosis: yes vs. no	1024	2.30 (1.21, 4.38)	.011
Diabetes: yes vs. no	1024	1.43 (1.03, 1.99)	.030
Antimycotics: yes vs. no	1024	1.58 (0.97, 2.57)	.067
Vancomycin: yes vs. no	1024	1.96 (1.38, 2.78)	<.001
Iodinated contrast media: yes vs. no	1024	1.84 (1.23, 2.75)	.003
Human albumin 20%: yes vs. no	1024	1.54 (1.15, 2.08)	.004
Added after model selection			
Period effects			
Period: ref.=Crystalloids			
Gelatin 4%	1024	1.85 (1.31, 2.62)	<.001
Hydroxyethyl starch 6% (130/0.4)	1024	2.55 (1.76, 3.69)	<.001

Pas de différence sur : lactacte, vasopresseur, PAM, SvcO2

Crit Care Med 2012 Vol. 40, No. 9

V. Solutés de remplissage



V. Solutés de remplissage

164 *J.L. Vincent et al. / Journal of Critical Care 35 (2016) 161–167*

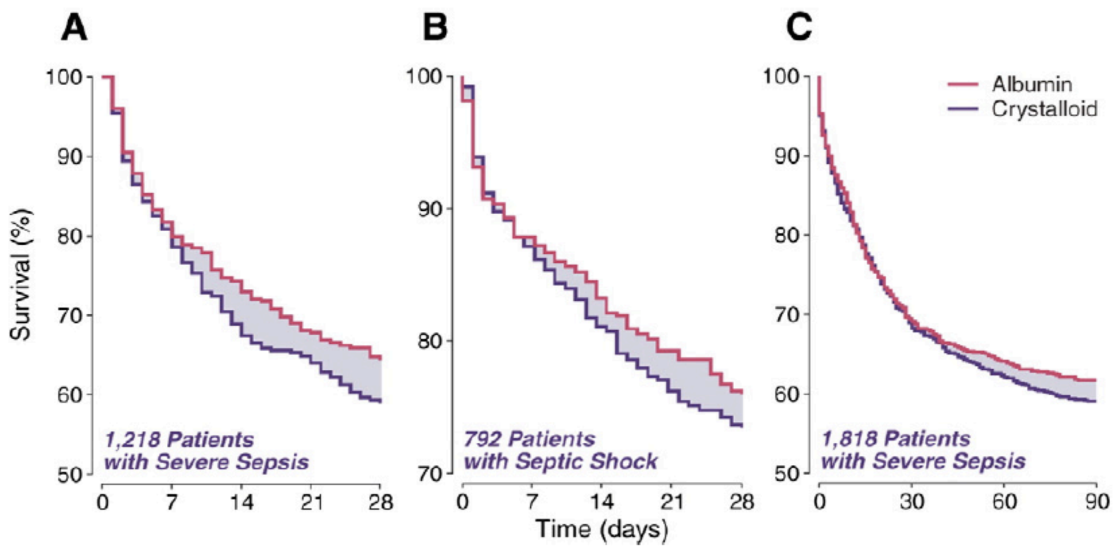


Fig. 2. Survival curves of 3 large studies of volume resuscitation with human albumin solutions in severe sepsis with no adverse effects on renal function: SAFE [55] (A), EARSS [58] (B), and ALBIOS [14] (C). Copyright permission obtained from original sources.

- Données contradictoires et controversées
- C'est délétère dans le traumatisme crânien
- Pas néphrotoxique contrairement aux HES et GEL
- Facilite des bilans hydriques équilibrés dans le sepsis
- Indications : Cirrhose et sepsis avec une albumine basse (3,0 g/dL)

V. Solutés de remplissage

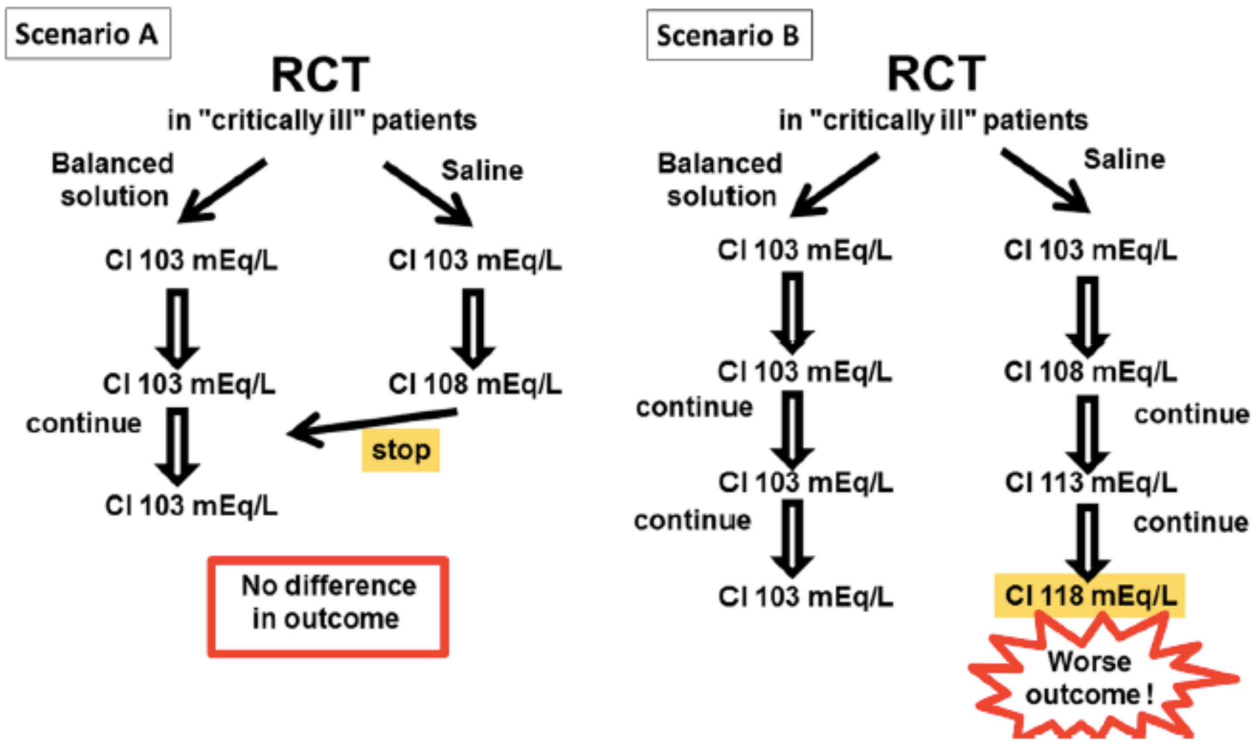


Fig. 1 The likely results from a hypothetical randomized clinical trial (*RCT*) comparing a saline solution with a balanced solution in critically ill patients. *Scenario A*: saline solutions are discontinued as soon as hyperchloremia appears, thus preventing the harmful effects of a further increase in chloremia and there will likely be no difference in outcomes in the two arms. *Scenario B*: the administration of saline solutions is continued despite the development of hyperchloremia and the saline group will have worse outcomes than the balanced group

Vincent and De Backer Critical Care (2016) 20:250

V. Solutés de remplissage

4,710 pts, 1 USI

TABLE 2. Outcomes Stratified by Chloride Load

Quartile mEq	Q1 (323–491)	Q2 (492–635)	Q3 (636–848)	Q4 (849–5,432)	*p*
Hyperchloremic acidosis within 24 hr of large-volume fluid resuscitation, *n* (%)					
Missing	758 (64.4)	748 (63.5)	737 (62.6)	651 (55.3)	< 0.001
No	335 (28.5)	341 (28.9)	321 (27.2)	296 (25.1)	
Yes	84 (7.1)	89 (7.6)	120 (10.2)	230 (19.5)	
Maximum Kidney Disease: Improving Global Outcomes, *n* (%)					
No acute kidney injury	329 (27.9)	245 (20.8)	226 (19.2)	163 (13.9)	< 0.001
Stage 1	221 (18.8)	211 (17.9)	165 (14.0)	151 (12.8)	
Stage 2	371 (31.5)	421 (35.7)	433 (36.8)	362 (30.8)	
Stage 3	256 (21.7)	301 (25.5)	354 (30.1)	499 (42.5)	
Hospital mortality, *n* (%)	226 (19.2)	285 (24.2)	298 (25.3)	417 (35.4)	< 0.001
Mortality after ICU admission, days, *n* (%)					
30	207 (17.6)	266 (22.6)	289 (24.5)	387 (32.9)	< 0.001
90	294 (24.9)	343 (29.1)	374 (31.7)	480 (40.8)	< 0.001
365	407 (34.6)	432 (36.7)	481 (40.8)	553 (46.9)	< 0.001

Q1–Q4 = quartiles 1 through 4.

Seuil < 60 mL/kg

Sen et al. CCM 2016

V. Solutés de remplissage

NaCl vs cristalloïde solution

- Développement d'acidose hyperchlorémique + IRA + mortalité ?
- Quelques indications du NaCl : alcalose métabolique, hyponatrémie et le traumatisme crânien
- Pas plus d'1 litre par 24h

V. Solutés de remplissage

Intensive Care Med
DOI 10.1007/s00134-015-3850-x
SEVEN-DAY PROFILE PUBLICATION

CrossMark

Maurizio Cecconi
Christoph Hofer
Jean-Louis Teboul
Ville Pettila
Erika Wilkman
Zsolt Molnar
Giorgio Della Rocca
Cesar Aldecoa
Antonio Artigas
Sameer Jog
Michael Sander
Claudia Spies
Jean-Yves Lefrant
Daniel De Backer

Fluid challenges in intensive care: the FENICE study

A global inception cohort study

Table 2 Fluid challenge ($N = 2213$) characteristics

Volume (ml), median [IQR]	500 [500–999]		
Rate (ml/h), median [IQR]	1000 [500–1333]		
Type of fluids	*n*	% Of category	% All fluids
Crystalloids	1713		74.3 [72.5–76.1]
NaCl 0.9 %	786	45.9 [43.5–48.3]	34.1 [32.1–36.1]
Balanced	916	53.5 [51.1–55.9]	39.8 [37.8–41.8]
G5 % DW	4	0.2 [0.0–0.4]	0.2 [0.0–0.4]
G5 % NaCl 0.45 %	7	0.4 [0.1–0.7]	0.3 [0.1–0.5]
Colloids	591		25.6 [23.8–27.4]
HES	249	42.1 [38.1–46.1]	10.8 [9.5–12.1]
Albumin 4–5 %	101	17.1 [14.1–20.1]	4.3 [3.5–5.2]
Gelatin	203	34.3 [30.5–38.1]	8.8 [7.6–10.0]
Dextran	13	2.2 [1.0–3.4]	0.5 [0.2–0.8]
Albumin 20 %	25	4.2 [2.6–5.8]	1.1 [0.7–1.5]

NaCl saline, *balanced* crystalloids with chloride concentration lower than saline (i.e., Plasma Lyte, Hartman's), *G5 %* glucose 5 %, *DW* dextrose in water, *HES* hydroxyethyl starch

Keys message (5)

Rossaint *et al. Critical Care* (2016) 20:100
DOI 10.1186/s13054-016-1265-x

Critical Care

RESEARCH Open Access

The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition

Rolf Rossaint[1], Bertil Bouillon[2], Vladimir Cerny[3,4,5,6], Timothy J. Coats[7], Jacques Duranteau[8], Enrique Fernández-Mondéjar[9], Daniela Filipescu[10], Beverley J. Hunt[11], Radko Komadina[12], Giuseppe Nardi[13], Edmund A. M. Neugebauer[14], Yves Ozier[15], Louis Riddez[16], Arthur Schultz[17], Jean-Louis Vincent[18] and Donat R. Spahn[19*]

Type of fluid

Recommendation 16 **We recommend that fluid therapy using isotonic crystalloid solutions be initiated in the hypotensive bleeding trauma patient. (Grade 1A)**

We suggest that excessive use of 0.9 % NaCl solution be avoided. (Grade 2C)

We recommend that hypotonic solutions such as Ringer's lactate be avoided in patients with severe head trauma. (Grade 1C)

We suggest that the use of colloids be restricted due to the adverse effects on haemostasis. (Grade 2C)

Table des matières

Conclusion

- Le remplissage vasculaire excessif influence la mortalité du patient → Utilisation d'indicateurs prédictifs dynamiques précis de précharge
- Analyser l'efficacité après chaque remplissage et vérifier les indicateurs d'œdème pulmonaire
- Utilisation du monitoring en fonction de la gravité du patient et des risques éventuels du remplissage
- Personnaliser la quantité de liquide à administrer
- Utilisation en première intention des cristalloïdes et administrer des colloïdes naturels dans certaines indications

MERCI DE VOTRE ATTENTION

QUESTIONS ?