AER 2019

AER

ACTUALITÉS EN RÉANIMATION

25ème AER : 19 & 20 novembre 2020

Que retenir de 2019…
… en hémodynamique ?

Pr Xavier MONNET

Service de médecine intensive-réanimation

Hôpital de Bicêtre

xavier.monnet@aphp.fr

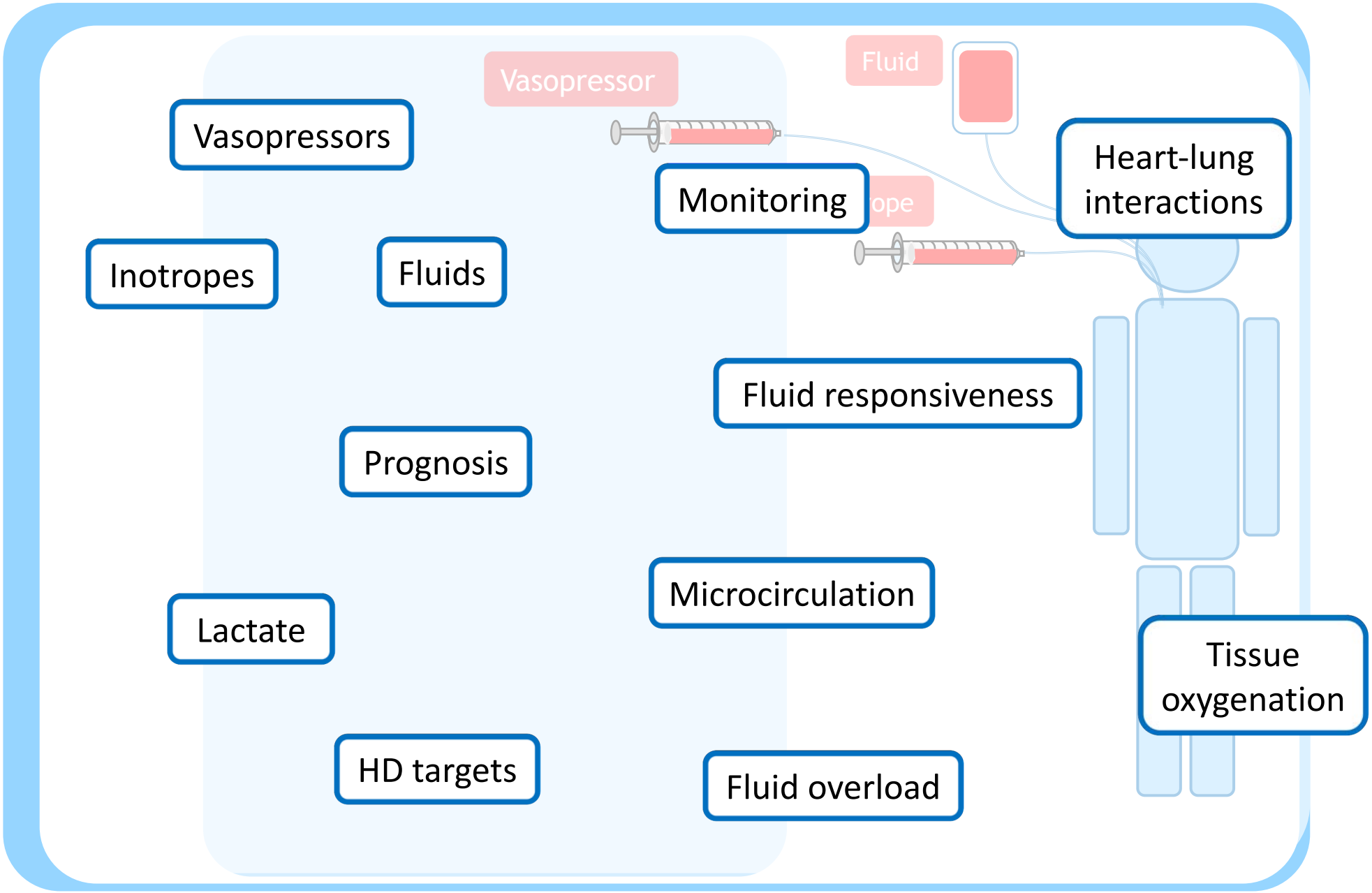
Conflits d'intérêt

Pulsion Medical Systems

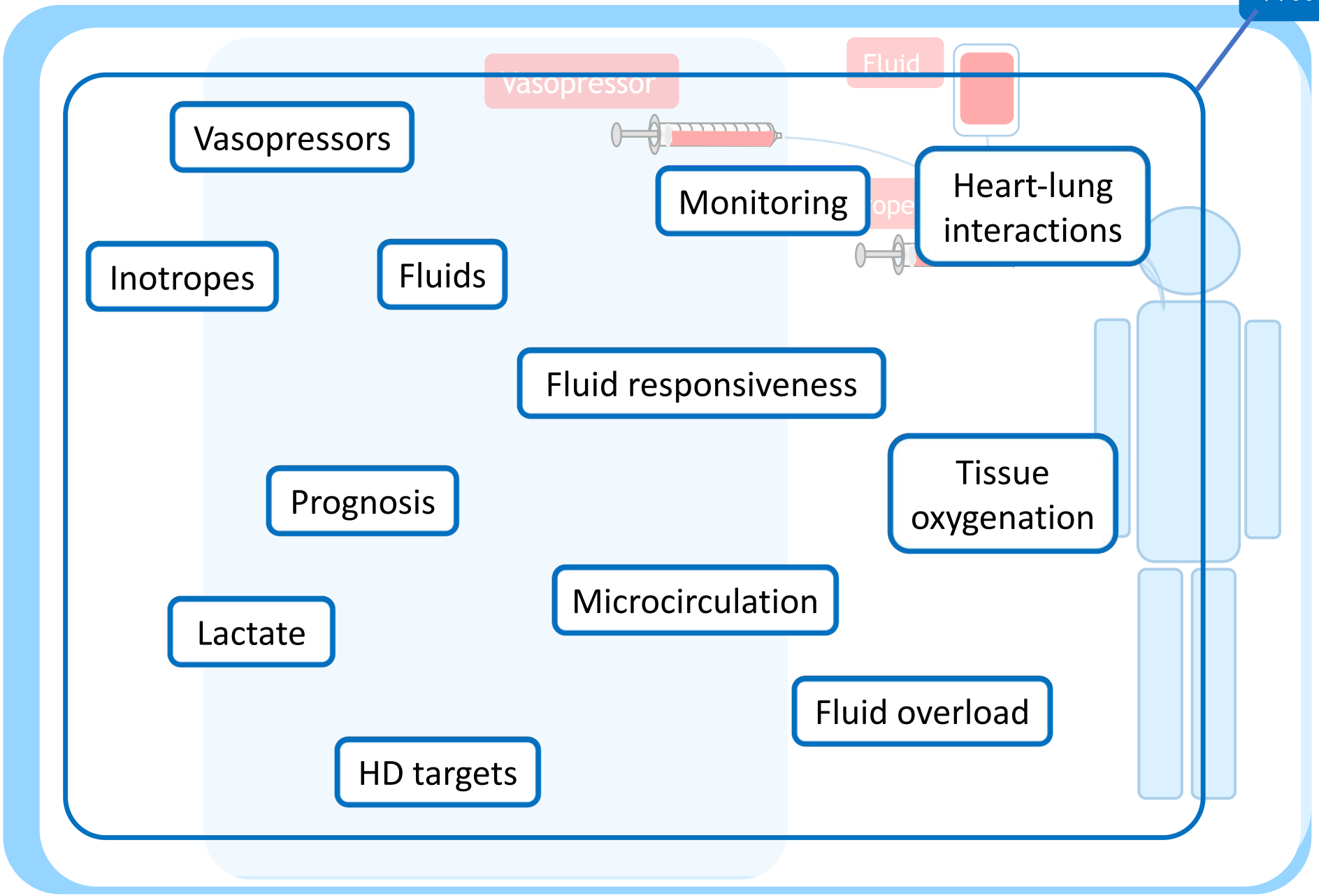
(Membre du medical advisory board)

Cheetah Medical

(Consultant)


Vasopressor
Fluid
Vasopressors
Monitoring
ope
Heart-lung interactions
Inotropes
Fluids
Fluid responsiveness
Prognosis
Microcirculation
Lactate
Tissue oxygenation
HD targets
Fluid overload

What's new in 2019 ?



What's new in 2019 ?

Vasopressors

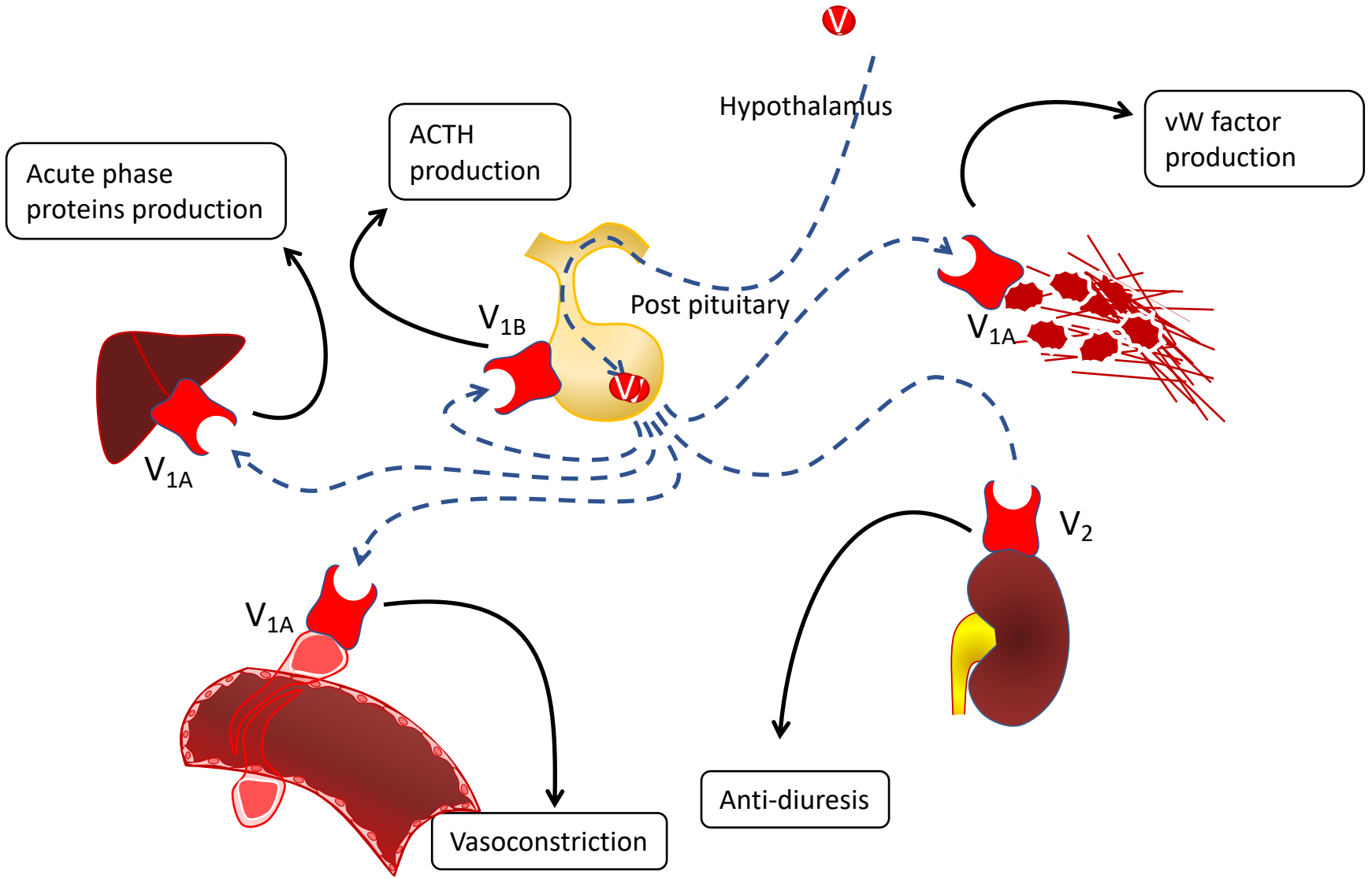
Selepressin

Vasopressor

- Phenylephrine
- Dopamine
- Epinephrine
- Norepinephrine
- Vasopressin
- Terlipressin
- **Selepressin**
- Angiotensin II

More selective of V_1 receptors

What's new in 2019 ? Vasopressors Selepressin



What's new in 2019 ?

Vasopressors

Selepressin ?

Human studies ?

A Selective V_{1A} Receptor Agonist, Selepressin, Is Superior to Arginine Vasopressin and to Norepinephrine in Ovine Septic Shock*

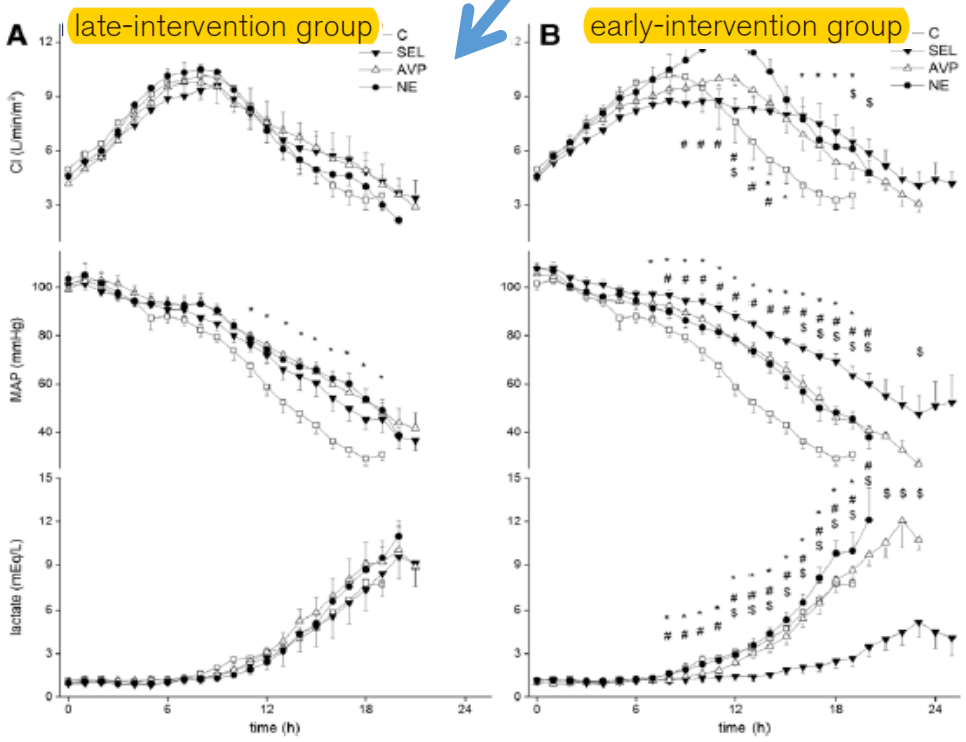
Xinrong He, MD[1,2]; Fuhong Su, MD, PhD[1]; Fabio Silvio Taccone, MD, PhD[1]; Régent Laporte, DVM, MSc, PhD[3]; Anne Louise Kjølbye, MSc, PhD, MBA[4]; Jing Zhang, MSc, PhD[5]; Keliang Xie, MD[1]; Mouhamed Djahoum Moussa, MD[1]; Torsten Michael Reinheimer, MSc, PhD[4]; Jean-Louis Vincent, MD, PhD, FCCM[1]

Crit Care Med 2016

46 sheep

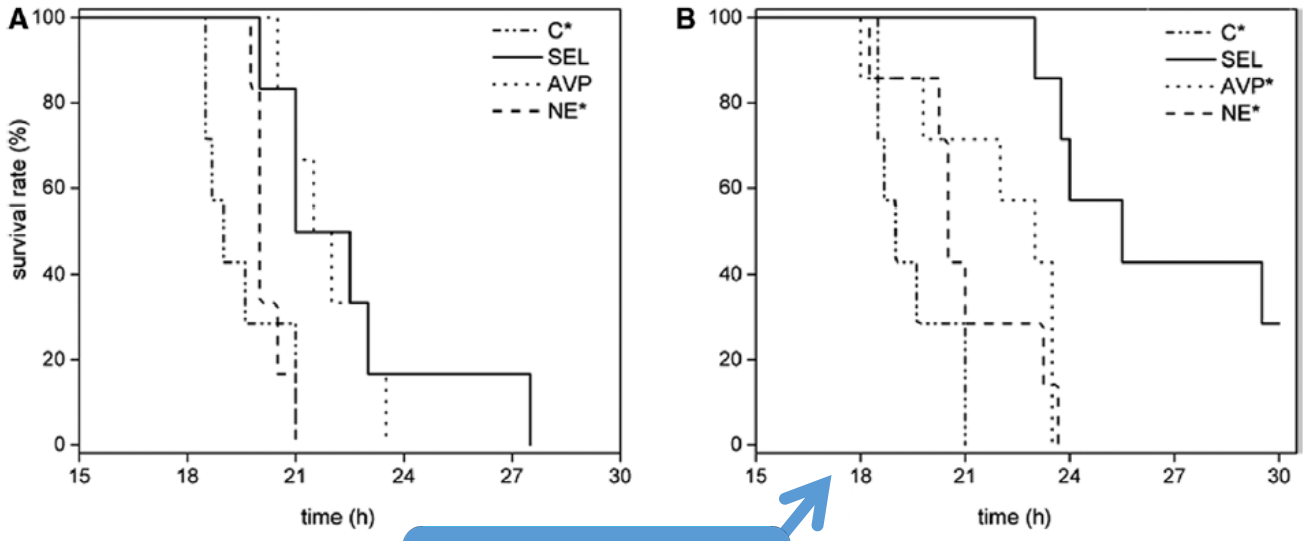
Selepressin vs. Arginin-vasopressin vs. Norepinephrine

Better haemodynamic improvement



late-intervention group

early-intervention group



Better survival

Which vasopressor ? Selepressin ?

Russell et al. Critical Care (2017) 21:213
DOI 10.1186/s13054-017-1798-7

Critical Care

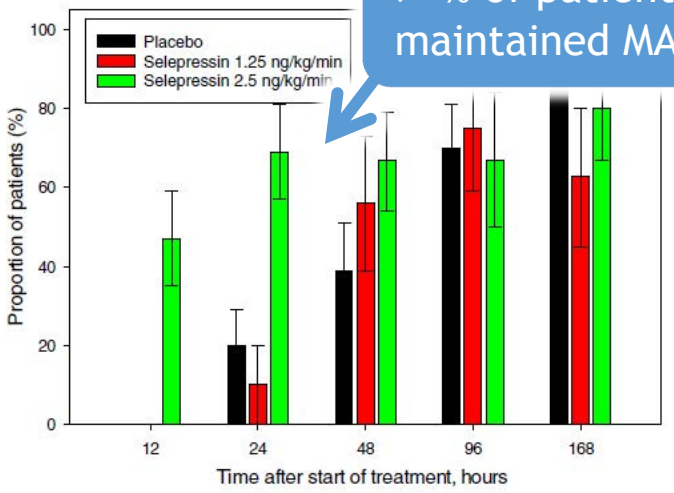
RESEARCH Open Access

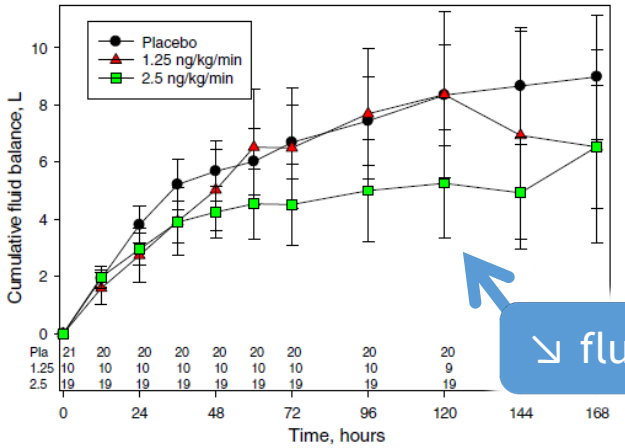
Selepressin, a novel selective vasopressin V_{1A} agonist, is an effective substitute for norepinephrine in a phase IIa randomized, placebo-controlled trial in septic shock patients

James A. Russell[1*], Jean-Louis Vincent[2], Anne Louise Kjølbye[3], Håkan Olsson[3], Allan Blemings[3], Herbert Spapen[4], Peder Carl[5], Pierre-François Laterre[6] and Lars Grundemar[3]

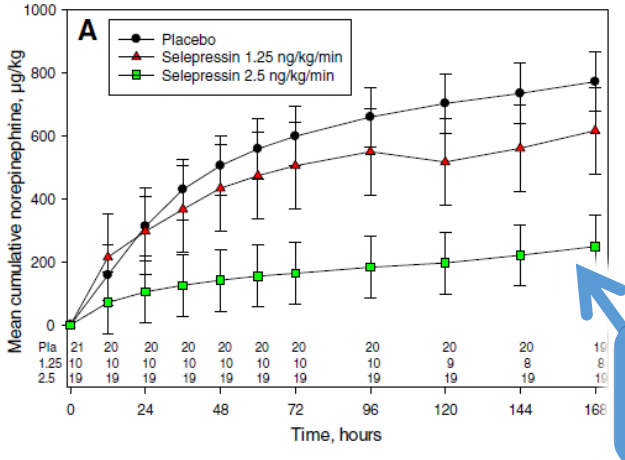
53 pts with early septic shock
3 doses of selepressin
NE in addition if needed

↗ % of patients with maintained MAP





↘ fluid balance



↘ requirement of NE

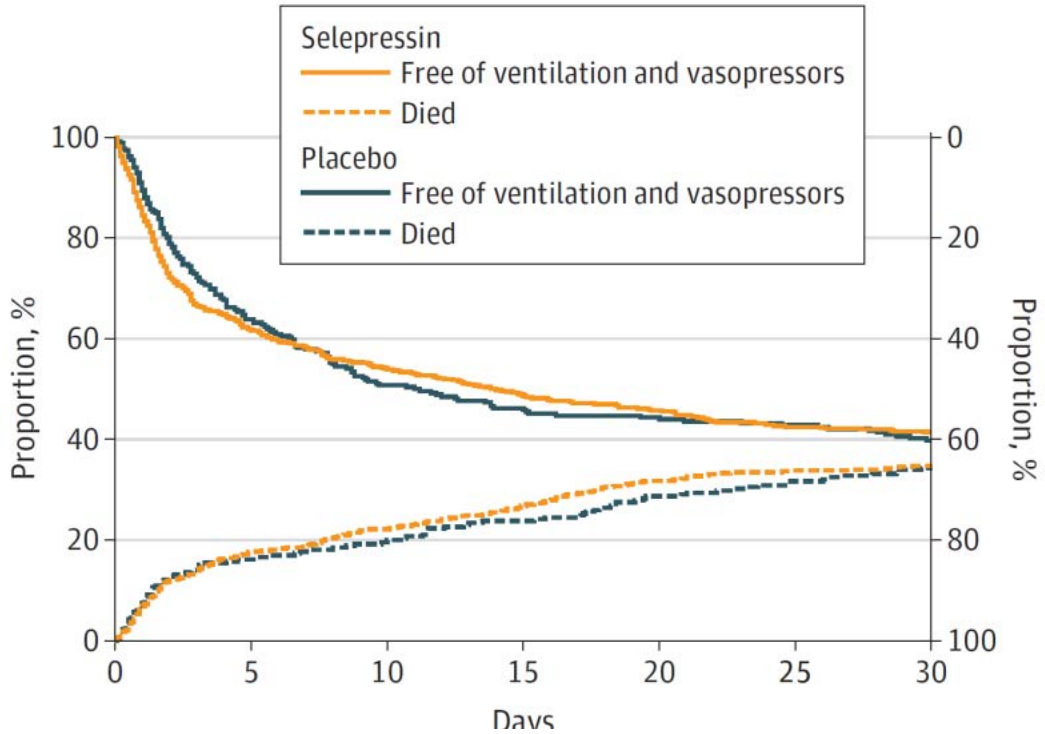
What's new in 2019 ? Vasopressors Selepressin

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

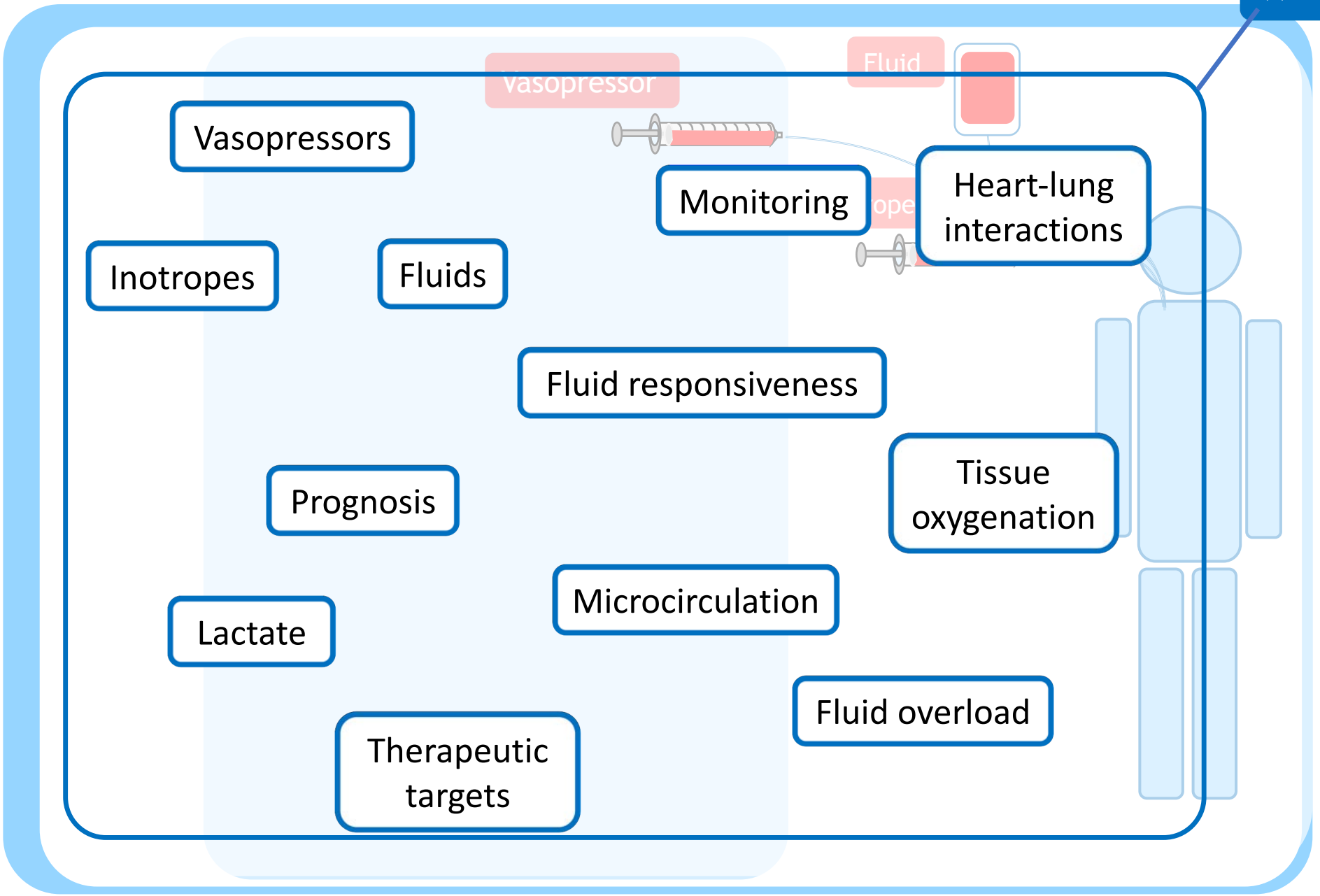
Effect of Selepressin vs Placebo on Ventilator- and Vasopressor-Free Days in Patients With Septic Shock
The SEPSIS-ACT Randomized Clinical Trial

Pierre-Francois Laterre, MD; Scott M. Berry, PhD; Allan Blemings, MS; Jan E. Carlsen, MD; Bruno François, MD; Todd Graves, PhD; Karsten Jacobsen, MD; Roger J. Lewis, MD, PhD; Steven M. Opal, MD; Anders Perner, MD, PhD; Peter Pickkers, MD, PhD; James A. Russell, MD; Nis A. Windeløv, MD, PhD; Donald M. Yealy, MD; Pierre Asfar, MD; Morten H. Bestle, MD, PhD; Grégoire Muller, MD; Cédric Bruel, MD; Noëlle Brulé, MD; Johan Decruyenaere, MD; Alain-Michel Dive, MD, PhD; Thierry Dugernier, MD, PhD; Kenneth Kroll, MD; Jean-Yves Lefrant, MD; Bruno Megarbane, MD, PhD; Emmanuelle Mercier, MD; Jean-Paul Mira, MD, PhD; Jean-Pierre Quenot, MD; Bodil Steen Rasmussen, MD, PhD; Hans-Christian Thorsen-Meyer, MD; Margot Vander Laenen, MD; Marianne Lauridsen Vang, MD; Philippe Vignon, MD, PhD; Isabelle Vinatier, MD; Sine Wichmann, MD, PhD; Xavier Wittebole, MD; Anne Louise Kjølbye, MS, PhD; Derek C. Angus, MD, MPH; for the SEPSIS-ACT Investigators

2b/3 RCT
868 pts with septic shock
1.7, 2.5 or 3.5 ng/kg/min vs. placebo



What's new in 2019 ?



What's new in 2019 ? | Vasopressors | Microcirculatory effects

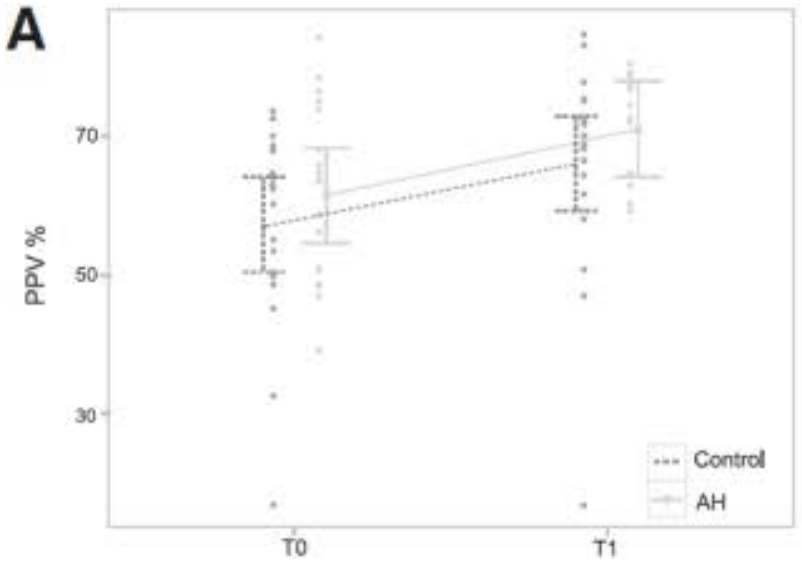
Effect of Increasing Blood Pressure With Noradrenaline on the Microcirculation of Patients With Septic Shock and Previous Arterial Hypertension

Crit Care Med 2019

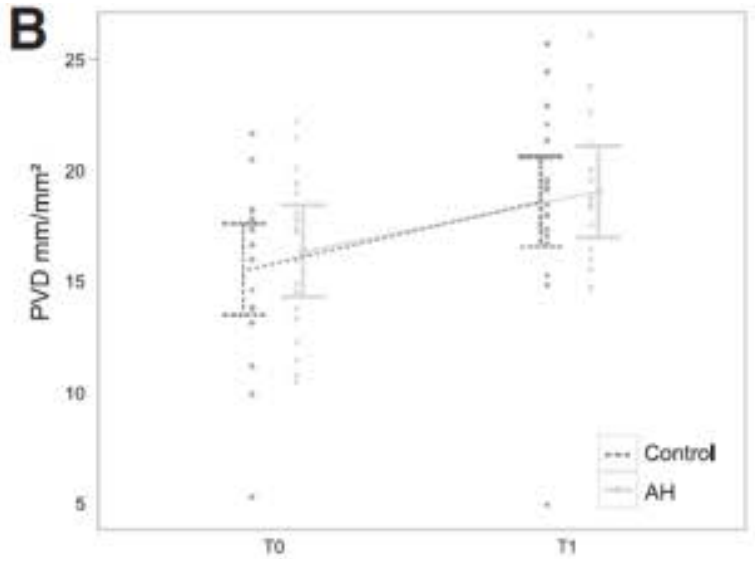
Karla Tuanny Fiorese Coimbra, MD; Flávio Geraldo Rezende de Freitas, MD, PhD; Antônio Tonete Bafi, MD; Tuanny Teixeira Pinheiro, MSc; Nathaly Fonseca Nunes, MD, MSc; Luciano César Pontes de Azevedo, MD, PhD; Flávia Ribeiro Machado, MD, PhD

40 septic shock patients
With/without hypertension
↗ NE to reach MAP 85-90 mmHg

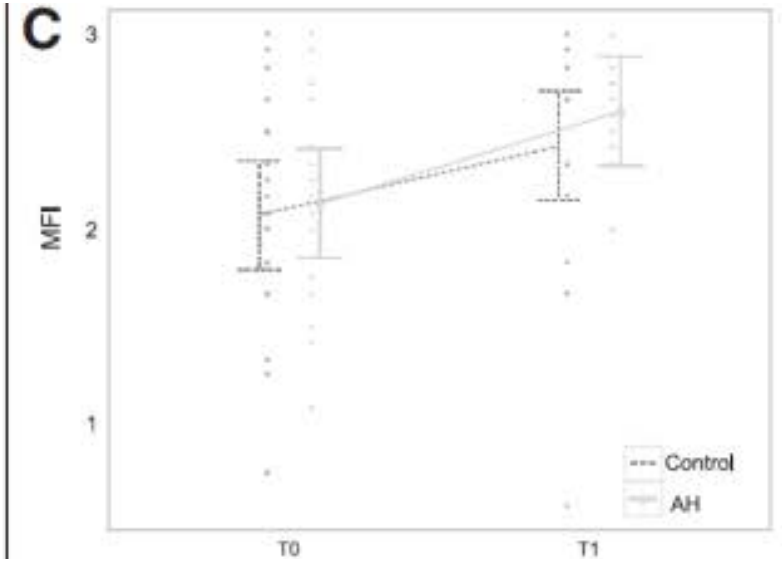
Proportion of perfused vessels



Perfused vessels density



Microcirculatory flow index



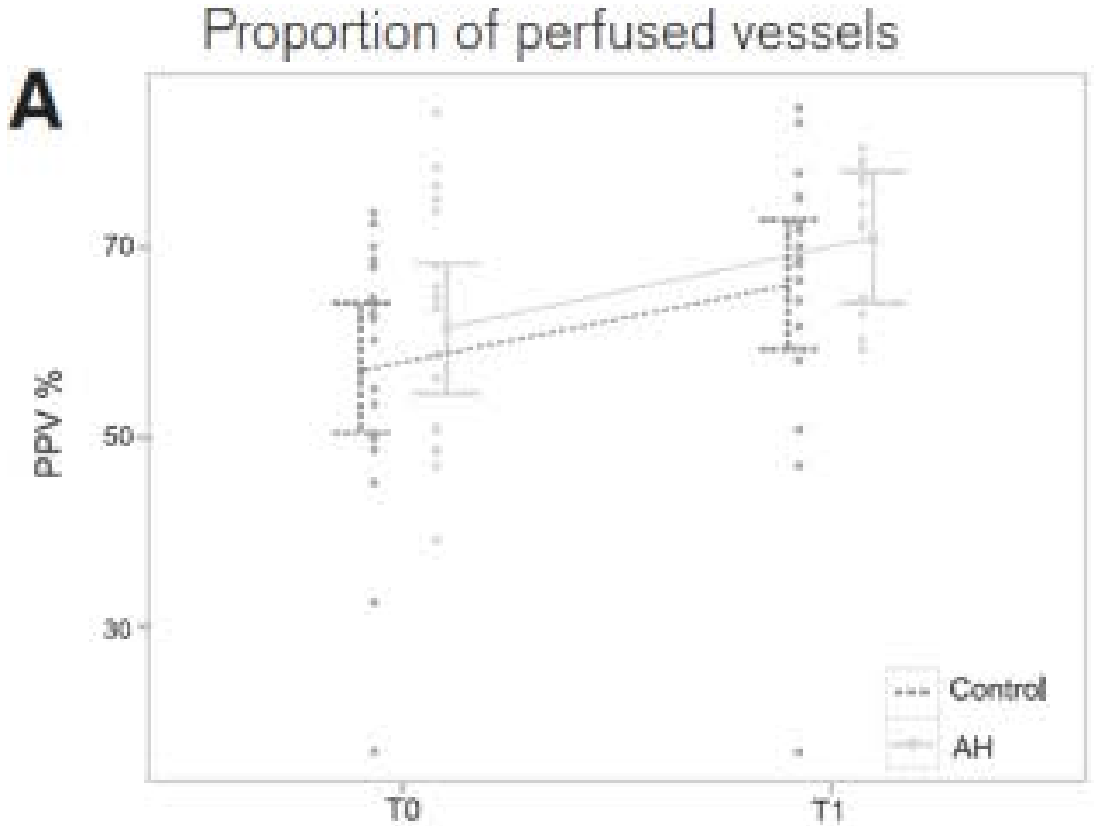
What's new in 2019 ? | Vasopressors | Microcirculatory effects

Effect of Increasing Blood Pressure With Noradrenaline on the Microcirculation of Patients With Septic Shock and Previous Arterial Hypertension

Crit Care Med 2019

Karla Tuanny Fiorese Coimbra, MD; Flávio Geraldo Rezende de Freitas, MD, PhD; Antônio Tonete Bafi, MD; Tuanny Teixeira Pinheiro, MSc; Nathaly Fonseca Nunes, MD, MSc; Luciano César Pontes de Azevedo, MD, PhD; Flávia Ribeiro Machado, MD, PhD

40 septic shock patients
With/without hypertension
↗ NE to reach MAP 85-90 mmHg



What's new in 2019 ? Vasopressors Microcirculatory effects

Research

Open Access

Increasing arterial blood pressure with norepinephrine does not improve microcirculatory blood flow: a prospective study

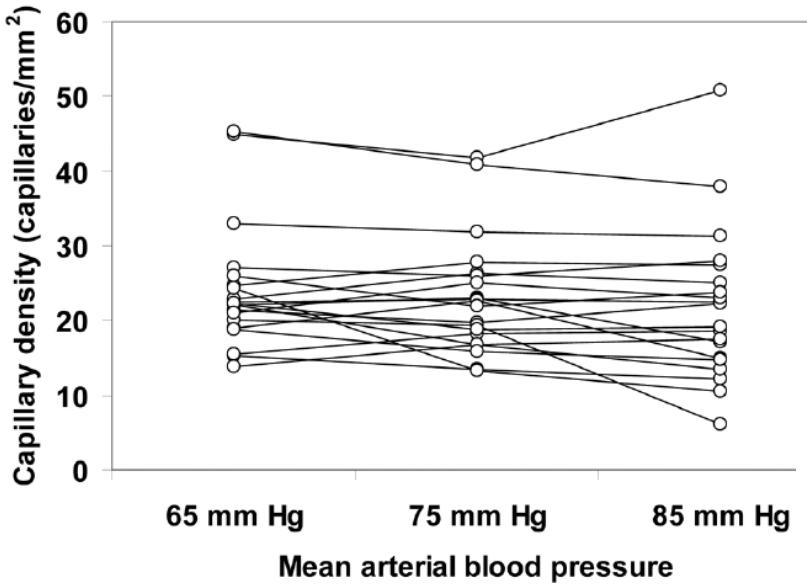
Arnaldo Dubin[1,2], Mario O Pozo[3], Christian A Casabella[1], Fernando Pálizas Jr[3], Gastón Murias[3], Miriam C Moseinco[1], Vanina S Kanoore Edul[1,2], Fernando Pálizas[3], Elisa Estenssoro[4] and Can Ince[5]

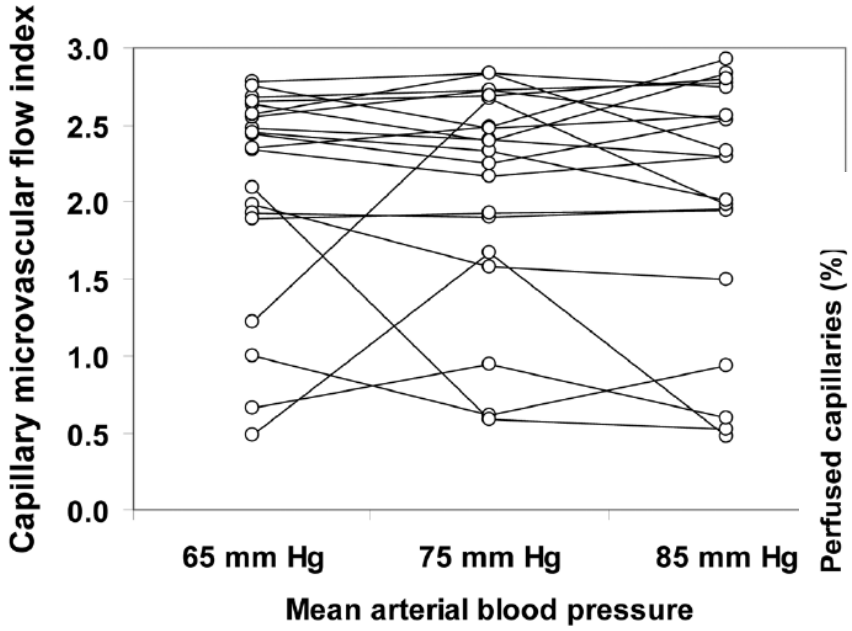
Critical Care 2009

20 pts with septic shock

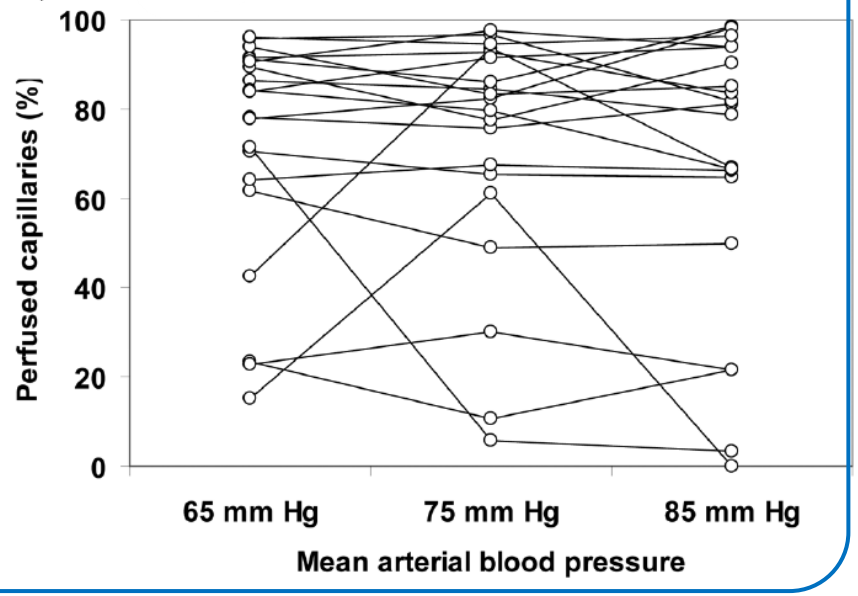
↗ dose of NE for reaching MAP of 65 to 95 mmHg

sublingual microcirculation (SDF)





Effects of NE heterogeneous



What's new in 2019 ?

Vasopressors

Microcirculatory effects

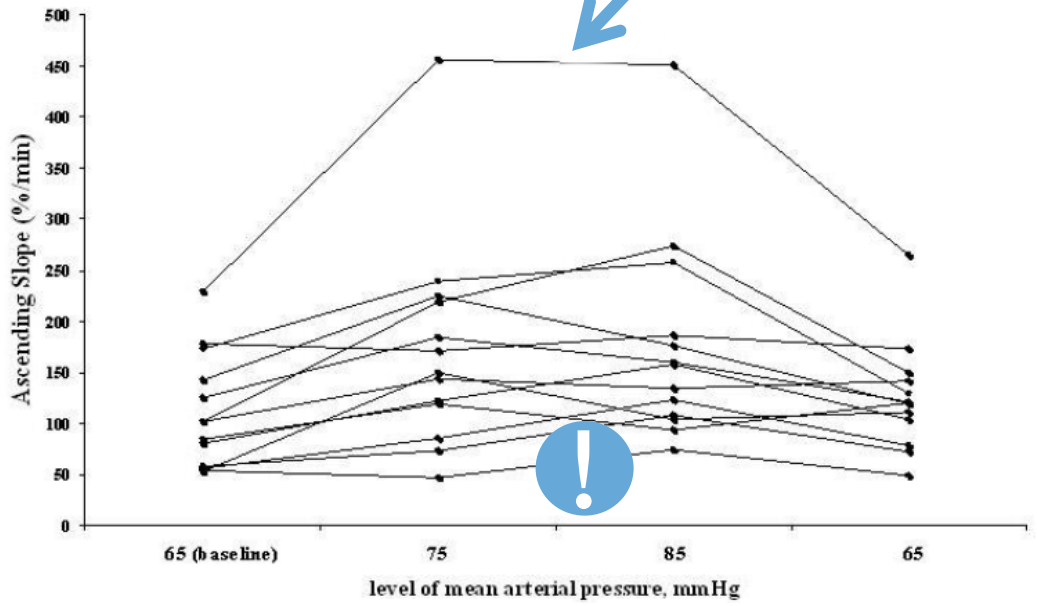
RESEARCH Open Access

Effects of changes in arterial pre*Critical Care* 2011an perfusion during septic shock

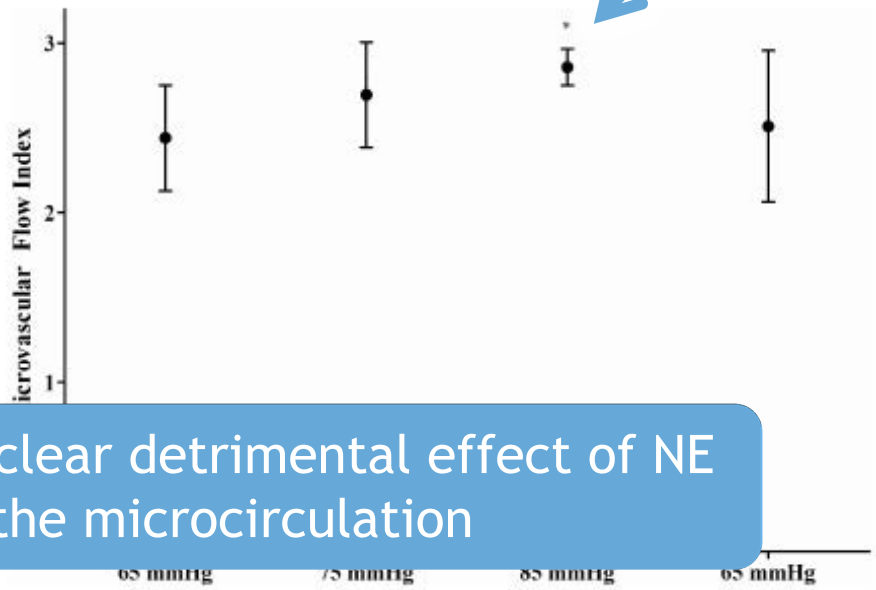
Aurélie Thooft, Raphaël Favory, Diamantino Ribeiro Salgado, Fabio S Taccone, Katia Donadello, Daniel De Backer, Jacques Creteur and Jean-Louis Vincent*

13 pts with septic shock
↗ dose of NE for reaching MAP of 65 to 85 mmHg
sublingual microcirculation (SDF) and NIRS

NE ↗ recovery slope

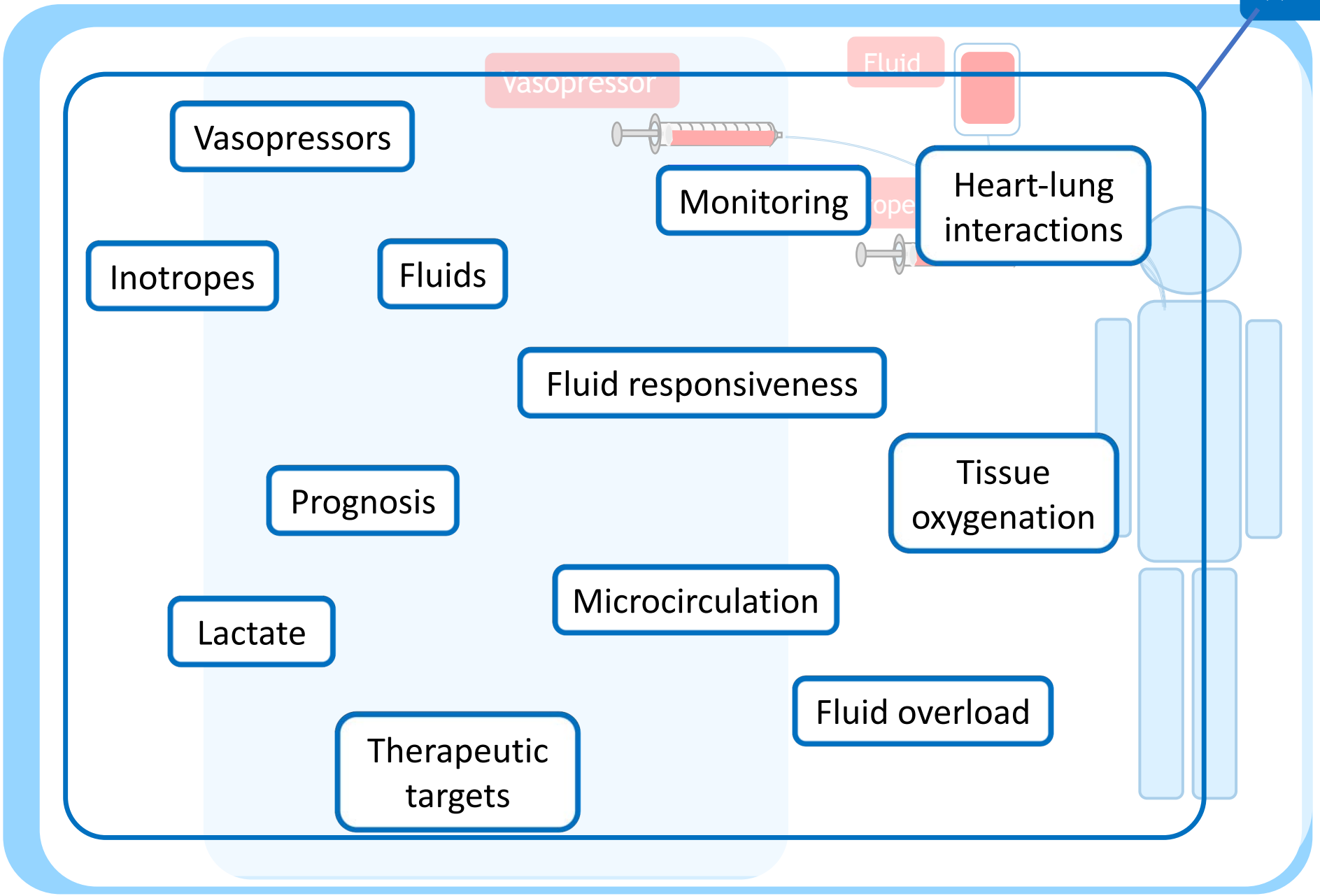


NE ↗ microvascular density



No clear detrimental effect of NE on the microcirculation

What's new in 2019 ?



What's new in 2019 ?

Therapeutic targets

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

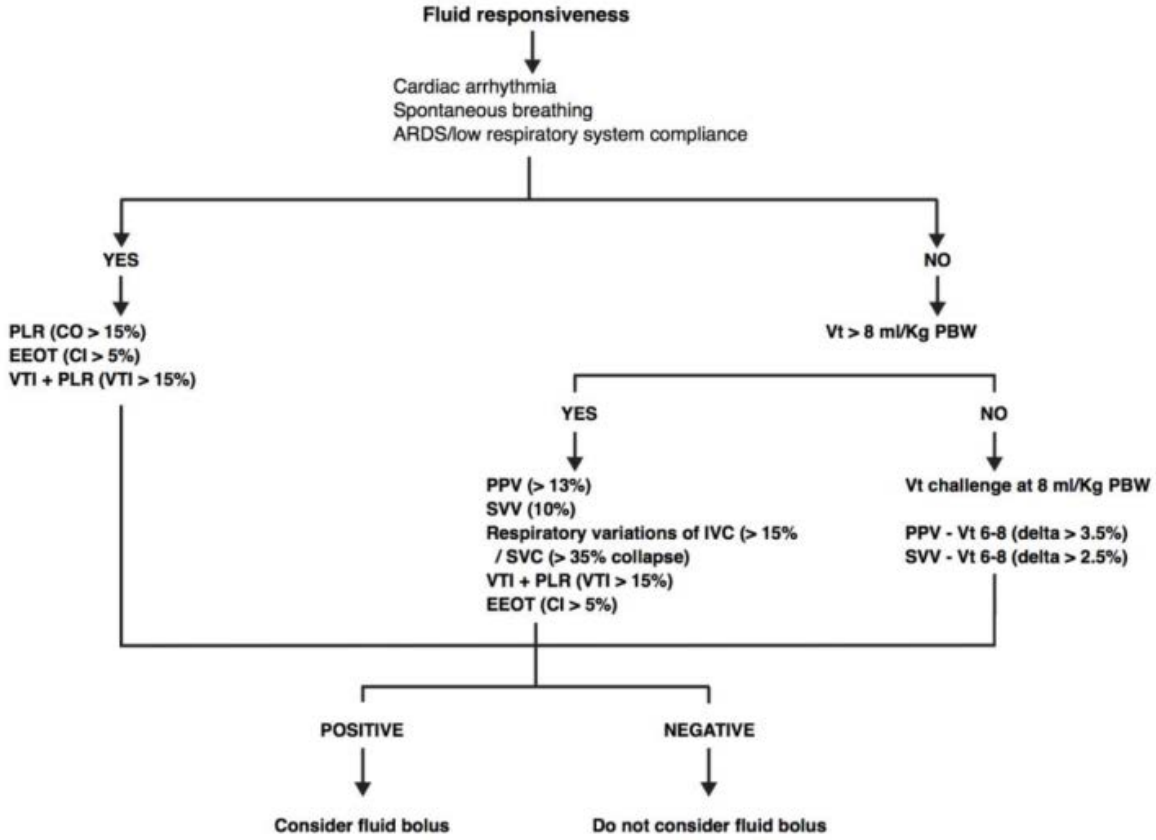
Effect of a Resuscitation Strategy Targeting Peripheral Perfusion Status vs Serum Lactate Levels on 28-Day Mortality Among Patients With Septic Shock

The ANDROMEDA-SHOCK Randomized Clinical Trial

Glenn Hernández, MD, PhD; Gustavo A. Ospina-Tascón, MD, PhD; Lucas Petri Damiani, MSc; Elisa Estenssoro, MD; Arnaldo Dubin, MD, PhD; Javier Hurtado, MD; Gilberto Friedman, MD, PhD; Ricardo Castro, MD, MPH; Leyla Alegría, RN, MSc; Jean-Louis Teboul, MD, PhD; Maurizio Cecconi, MD, FFICM; Giorgio Ferri, MD; Manuel Jibaja, MD; Ronald Pairumani, MD; Paula Fernández, MD; Diego Barahona, MD; Vladimir Granda-Luna, MD, PhD; Alexandre Biasi Cavalcanti, MD, PhD; Jan Bakker, MD, PhD; for the ANDROMEDA-SHOCK Investigators and the Latin America Intensive Care Network (LIVEN)

424 patients with septic shock

Peripheral perfusion vs. lactate level-targeted resuscitation



What's new in 2019 ?

Therapeutic targets

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of a Resuscitation Strategy Targeting Peripheral Perfusion Status vs Serum Lactate Levels on 28-Day Mortality Among Patients With Septic Shock

The ANDROMEDA-SHOCK Randomized Clinical Trial

Glenn Hernández, MD, PhD; Gustavo A. Ospina-Tascón, MD, PhD; Lucas Petri Damiani, MSc; Elisa Estenssoro, MD; Arnaldo Dubin, MD, PhD; Javier Hurtado, MD; Gilberto Friedman, MD, PhD; Ricardo Castro, MD, MPH; Leyla Alegría, RN, MSc; Jean-Louis Teboul, MD, PhD; Maurizio Cecconi, MD, FFICM; Giorgio Ferri, MD; Manuel Jibaja, MD; Ronald Pairumani, MD; Paula Fernández, MD; Diego Barahona, MD; Vladimir Granda-Luna, MD, PhD; Alexandre Biasi Cavalcanti, MD, PhD; Jan Bakker, MD, PhD; for the ANDROMEDA-SHOCK Investigators and the Latin America Intensive Care Network (LIVEN)

424 patients with septic shock

Peripheral perfusion vs. lactate level-targeted resuscitation

Characteristic	Peripheral Perfusion-Targeted Resuscitation (n = 212)	Lactate Level-Targeted Resuscitation (n = 212)
Age, mean (SD), y	62 (17)	64 (17)
SOFA, mean (SD)[d]	9.7 (3.4)	9.6 (3.5)
Hemodynamic and perfusion-related variables		
Heart rate, mean (SD), /min	103 (24)	104 (23)
Arterial blood pressure, mean (SD), mm Hg	69 (14)	68 (13)
Norepinephrine dose, median (IQR), µg/kg/min	0.24 (0.11-0.40)	0.20 (0.10-0.35)
Serum lactate, mean (SD), mmol/L	4.6 (4.3)	4.5 (2.5)
Capillary refill time		
Median (IQR), s	5 (4-6)	4 (3-6)
≤3 s, No. (%)	48 (22.6)	60 (28.3)

What's new in 2019 ?

Therapeutic targets

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

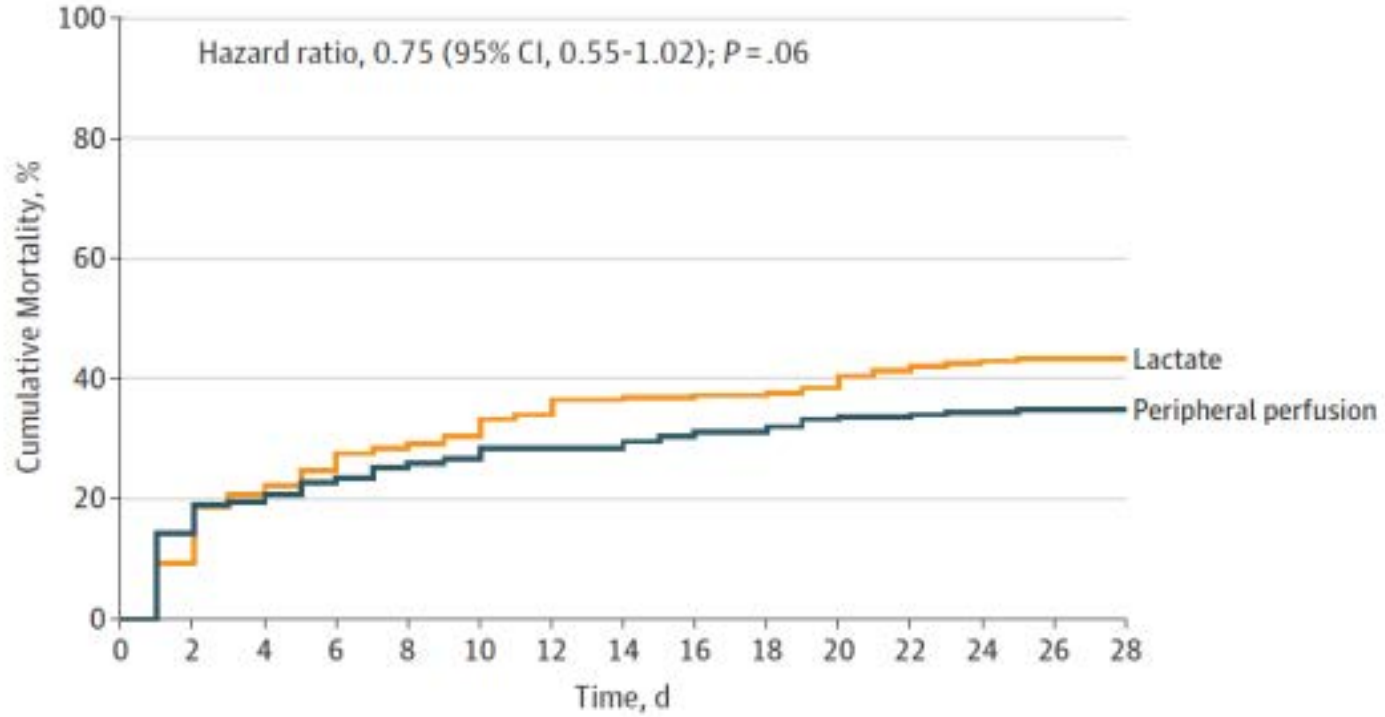
Effect of a Resuscitation Strategy Targeting Peripheral Perfusion Status vs Serum Lactate Levels on 28-Day Mortality Among Patients With Septic Shock

The ANDROMEDA-SHOCK Randomized Clinical Trial

Glenn Hernández, MD, PhD; Gustavo A. Ospina-Tascón, MD, PhD; Lucas Petri Damiani, MSc; Elisa Estenssoro, MD; Arnaldo Dubin, MD, PhD; Javier Hurtado, MD; Gilberto Friedman, MD, PhD; Ricardo Castro, MD, MPH; Leyla Alegria, RN, MSc; Jean-Louis Teboul, MD, PhD; Maurizio Cecconi, MD, FFICM; Giorgio Ferri, MD; Manuel Jibaja, MD; Ronald Pairumani, MD; Paula Fernández, MD; Diego Barahona, MD; Vladimir Granda-Luna, MD, PhD; Alexandre Biasi Cavalcanti, MD, PhD; Jan Bakker, MD, PhD; for the ANDROMEDA-SHOCK Investigators and the Latin America Intensive Care Network (LIVEN)

424 patients with septic shock

Peripheral perfusion vs. lactate level-targeted resuscitation



No. at risk															
Lactate	212	192	168	160	152	148	140	135	134	133	130	124	122	120	120
Peripheral perfusion	212	182	171	164	159	155	152	152	148	146	142	141	139	138	138

What's new in 2019 ?

Therapeutic targets

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

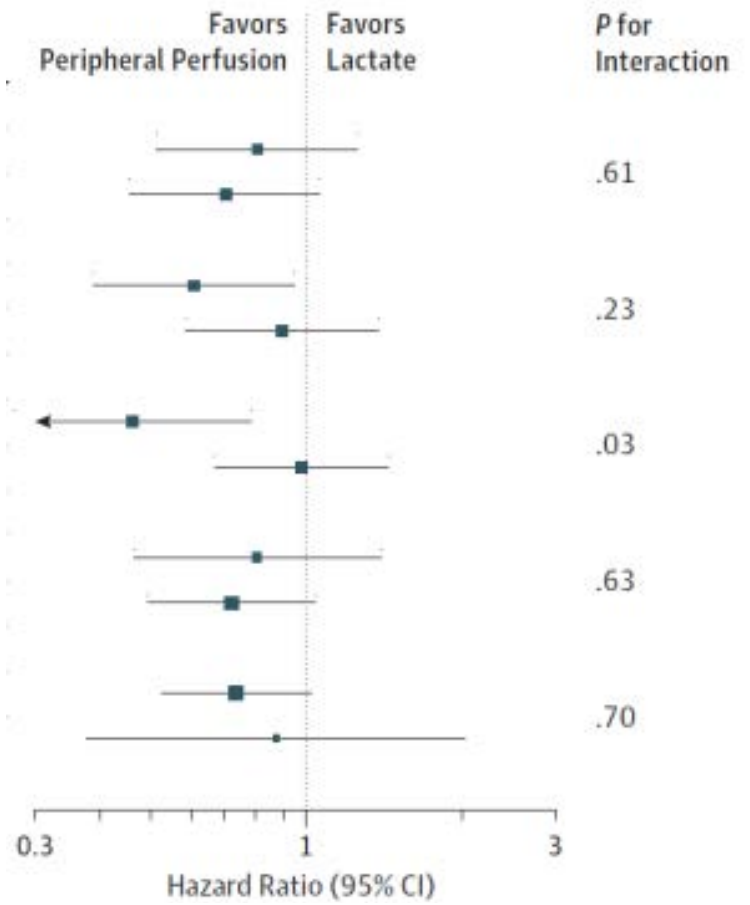
Effect of a Resuscitation Strategy Targeting Peripheral Perfusion Status vs Serum Lactate Levels on 28-Day Mortality Among Patients With Septic Shock

The ANDROMEDA-SHOCK Randomized Clinical Trial

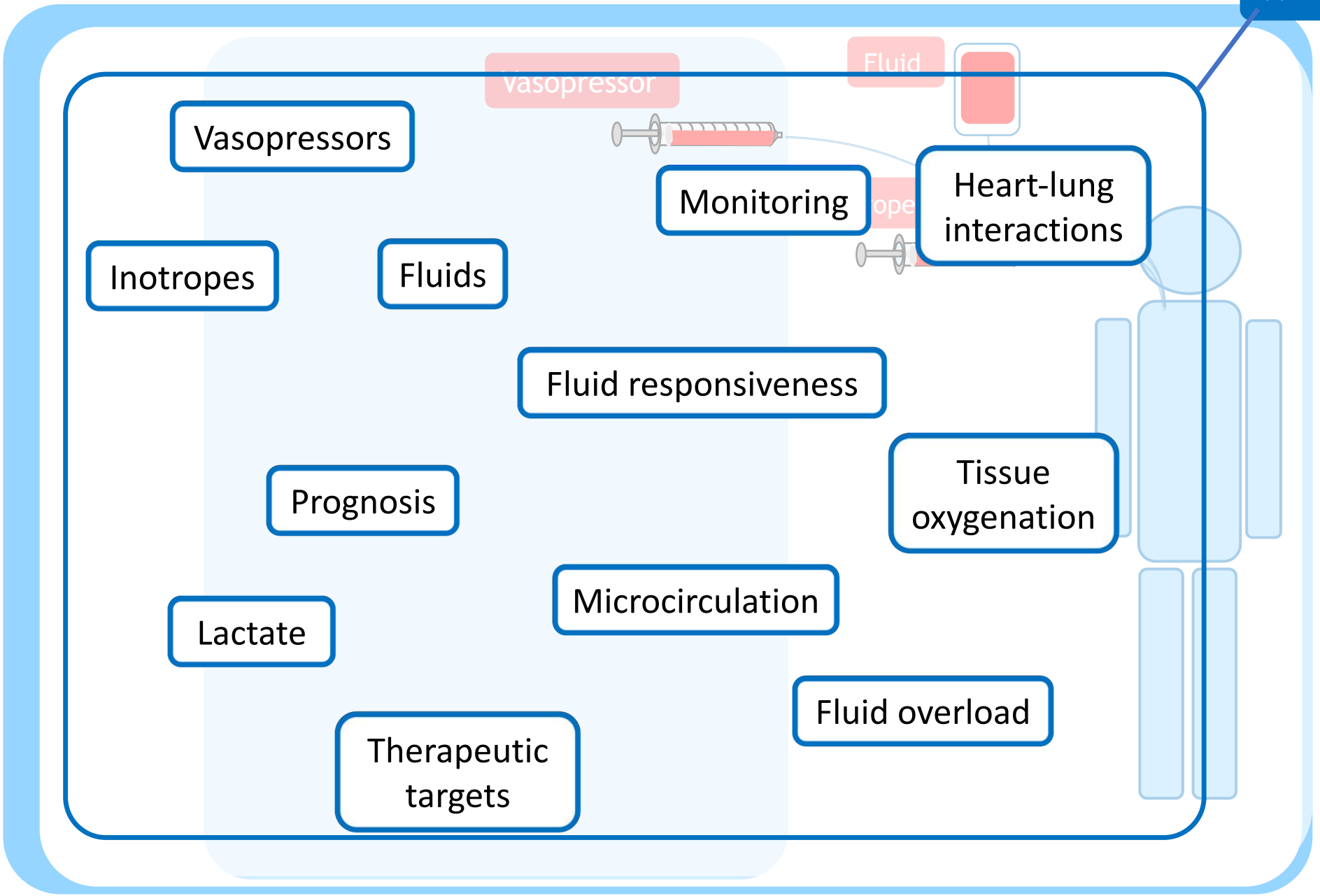
Glenn Hernández, MD, PhD; Gustavo A. Ospina-Tascón, MD, PhD; Lucas Petri Damiani, MSc; Elisa Estenssoro, MD; Arnaldo Dubin, MD, PhD; Javier Hurtado, MD; Gilberto Friedman, MD, PhD; Ricardo Castro, MD, MPH; Leyla Alegría, RN, MSc; Jean-Louis Teboul, MD, PhD; Maurizio Cecconi, MD, FFICM; Giorgio Ferri, MD; Manuel Jibaja, MD; Ronald Pairumani, MD; Paula Fernández, MD; Diego Barahona, MD; Vladimir Granda-Luna, MD, PhD; Alexandre Biasi Cavalcanti, MD, PhD; Jan Bakker, MD, PhD; for the ANDROMEDA-SHOCK Investigators and the Latin America Intensive Care Network (LIVEN)

424 patients with septic shock
Peripheral perfusion vs. lactate level-targeted resuscitation

Subgroup	No. of Events/Total (%)	
	Peripheral Perfusion-Targeted Resuscitation	Lactate Level-Targeted Resuscitation
Baseline lactate, mmol/L		
>4	37/85 (43.5)	41/88 (46.6)
≤4	37/127 (29.1)	51/124 (41.1)
APACHE II		
<25	32/130 (24.6)	49/135 (36.3)
≥25	42/82 (51.2)	43/77 (55.8)
SOFA		
<10	21/103 (20.4)	42/107 (39.3)
≥10	53/109 (48.6)	50/105 (47.6)
Confirmed source of infection		
No	25/61 (41)	26/59 (44.1)
Yes	49/151 (32.5)	66/153 (43.1)
Lactate decrease from admission to baseline measurement, %		
≤10	64/181 (35.4)	80/171 (46.8)
>10	10/31 (32.3)	12/41 (29.3)



What's new in 2019 ?



What's new in 2019 ?

Therapeutic targets

Skin mottling

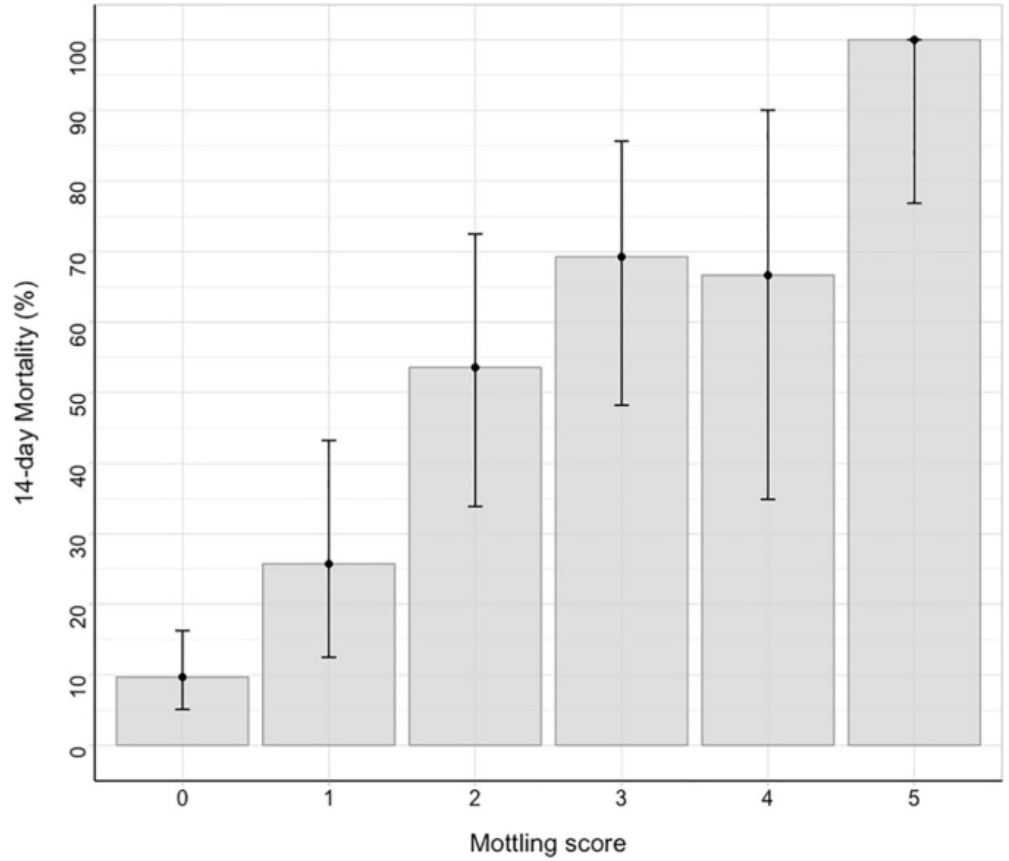
RESEARCH Open Access

Mottling score is a strong predictor of 14-day mortality in septic patients whatever vasopressor doses and other tissue perfusion parameters

Guillaume Dumas[1,2,3*], Jean-Rémi Lavillegrand[1,2], Jérémie Joffre[1], Naïke Bigé[1], Edmilson Bastos de-Moura[4], Jean-Luc Baudel[1], Sylvie Chevret[3], Bertrand Guidet[1,2,5], Eric Maury[1,2,5], Fabio Amorim[4] and Hafid Ait-Oufella[1,2,6]

259 patients with sepsis/septic shock

Mortality increases with the mottling score



What's new in 2019 ? | Therapeutic targets | Skin mottling

RESEARCH Open Access

Mottling score is a strong predictor of 14-day mortality in septic patients whatever vasopressor doses and other tissue perfusion parameters

Guillaume Dumas[1,2,3*], Jean-Rémi Lavillegrand[1,2], Jérémie Joffre[1], Naïke Bigé[1], Edmilson Bastos de-Moura[4], Jean-Luc Baudel[1], Sylvie Chevret[3], Bertrand Guidet[1,2,5], Eric Maury[1,2,5], Fabio Amorim[4] and Hafid Ait-Oufella[1,2,6]

259 patients with sepsis/septic shock

Table 2 Factors associated with mortality at day 14 (multivariate analysis)

	Model 1	
Variables	OR [95% CI]	*P* value
Mottling score at H6, by point	2.26 [1.72–2.97]	< 0.001
Arterial lactate at H6, by 1 mmol/l	1.29 [1.11–1.50]	< 0.001
Urine output at H6 < 0.5 ml/kg/h	3.03 [1.37–6.69]	0.01
	Model 2	
Variables	OR [95% CI]*	*P* value
Mottling score at H6, by point	2.1 [1.60–2.75]	< 0.001
Arterial lactate at H6, by 1 mmol/l	1.26 [1.09–1.47]	0.002
Urine output at H6 (ml/kg/h)	–	0.005

What's new in 2019 ?

Therapeutic targets

Skin mottling

RESEARCH Open Access

Mottling score is a strong predictor of 14-day mortality in septic patients whatever vasopressor doses and other tissue perfusion parameters

Guillaume Dumas[1,2,3*], Jean-Rémi Lavillegrand[1,2], Jérémie Joffre[1], Naïke Bigé[1], Edmilson Bastos de-Moura[4], Jean-Luc Baudel[1], Sylvie Chevret[3], Bertrand Guidet[1,2,5], Eric Maury[1,2,5], Fabio Amorim[4] and Hafid Ait-Oufella[1,2,6]

259 patients with sepsis/septic shock

Mottling in 50% of patients only

Table 1 Characteristics of 259 critically ill patients with sepsis or septic shock

Drugs	Mottling score		
Norepin			
Doses	0	109 (42)	125 (49)
Epineph			
Doses	1	22 (8)	36 (14)
Dobutar			
Doses	2	51 (20)	29 (11)
Mechanica			
Mortality a	3	41 (16)	29 (11)
Mottlir			
0	4	16 (6)	14 (5)
1			
2	5	20 (8)	24 (9)
3			
4			
5			

2	51 (20)	29 (11)
3	41 (16)	29 (11)
4	16 (6)	14 (5)
5	20 (8)	24 (9)

What's new in 2019 ?

Therapeutic targets

Skin mottling

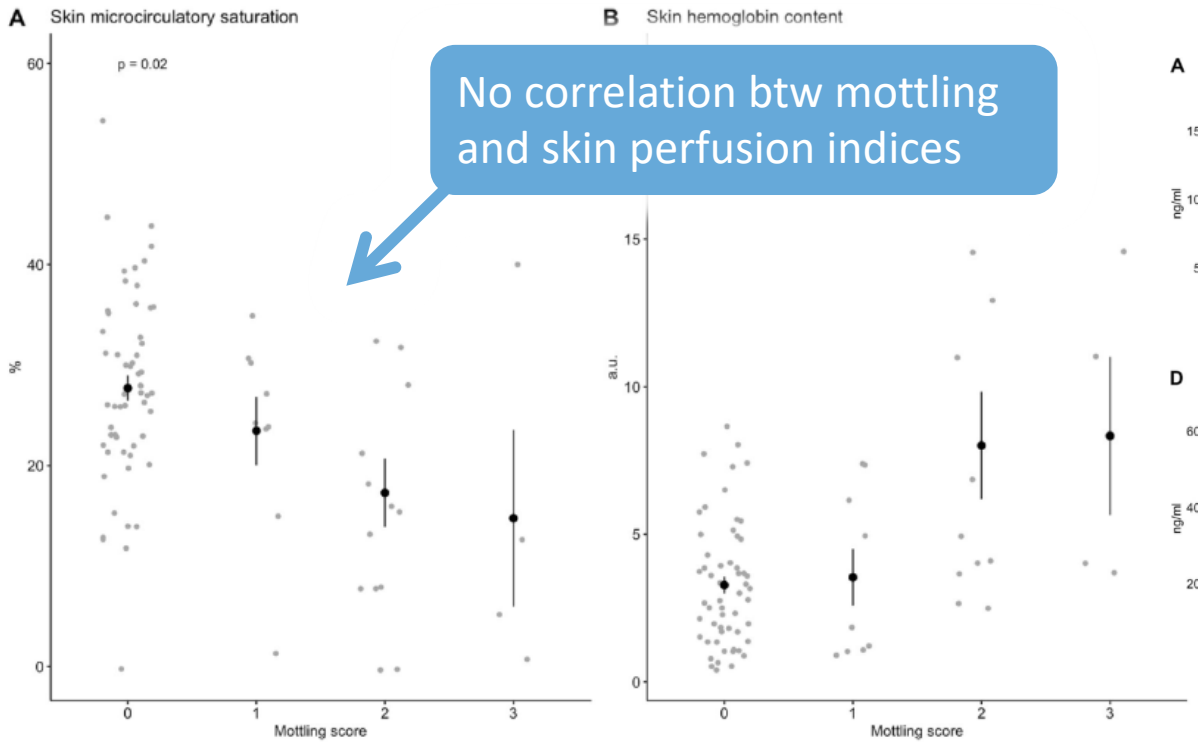
RESEARCH Open Access

Relationship of mottling score, skin microcirculatory perfusion indices and biomarkers of endothelial dysfunction in patients with septic shock: an observational study

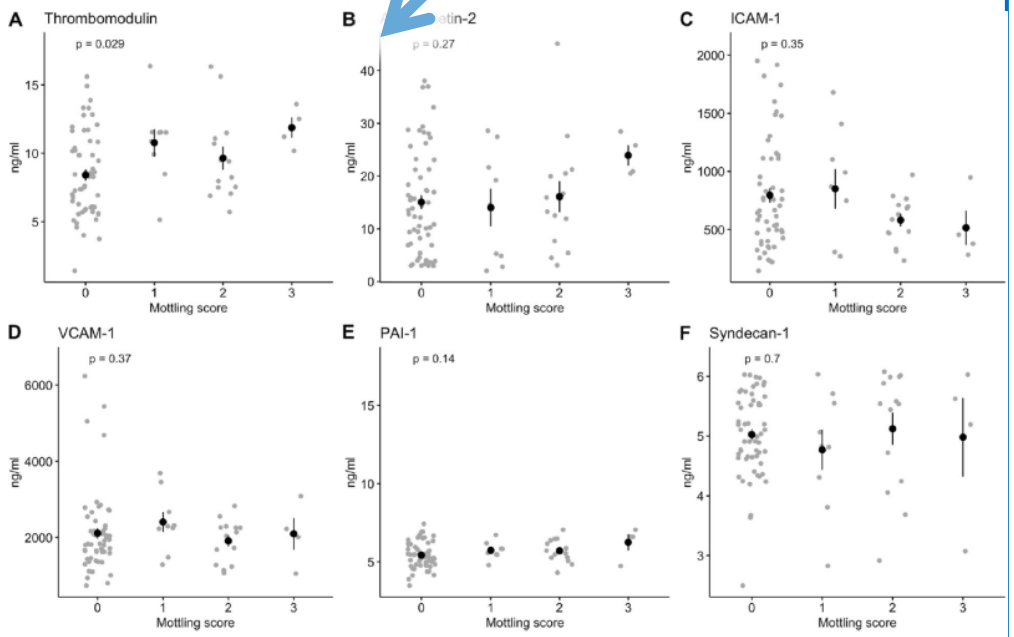
Sigita Kazune[1,2*], Anastasija Caica[2,3], Karina Volceka[2,3], Olegs Suba[4], Uldis Rubins[2] and Andris Grabovskis[2]

91 patients with septic shock

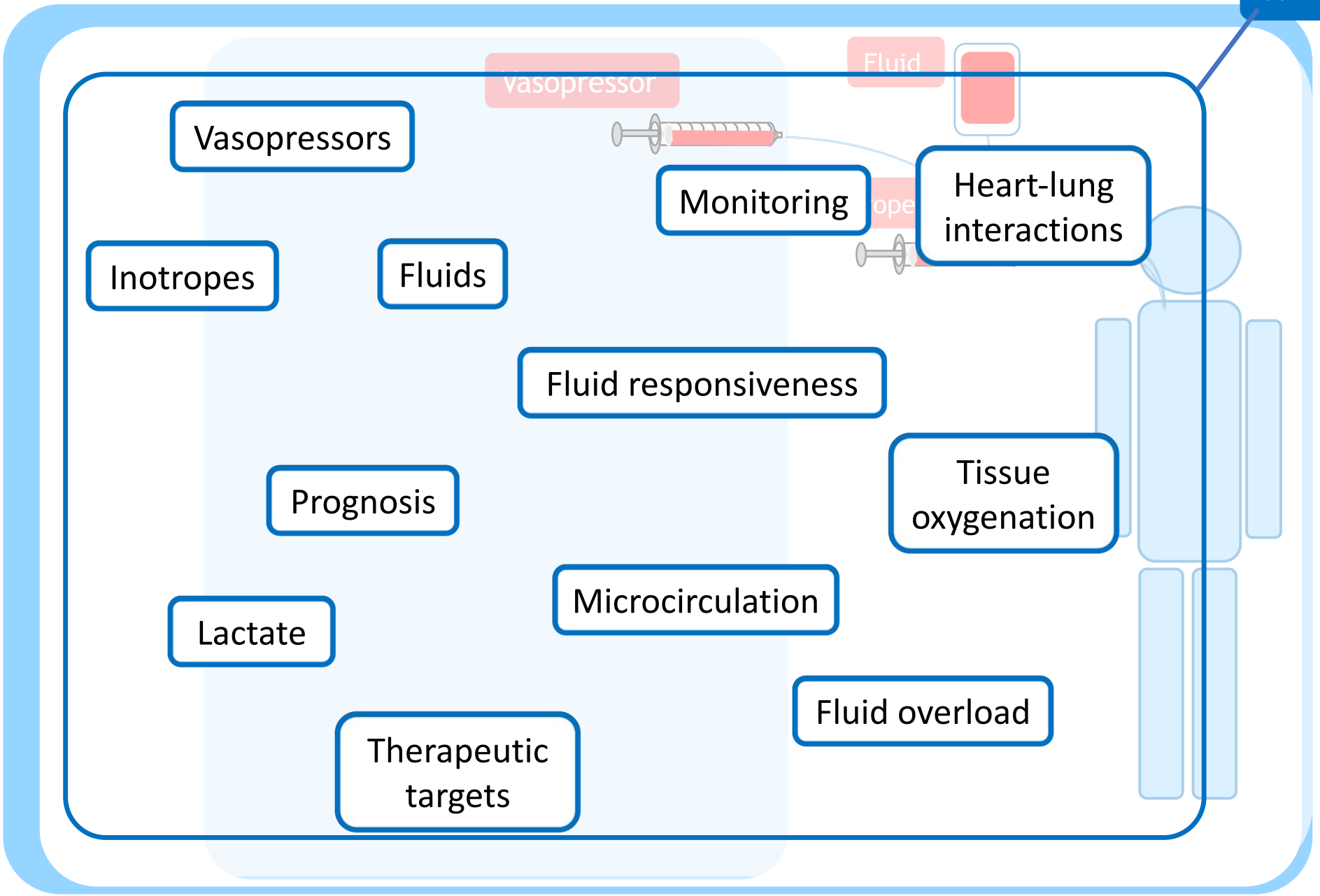
No correlation btw mottling and skin perfusion indices



No correlation btw mottling and markers of endothelial activation

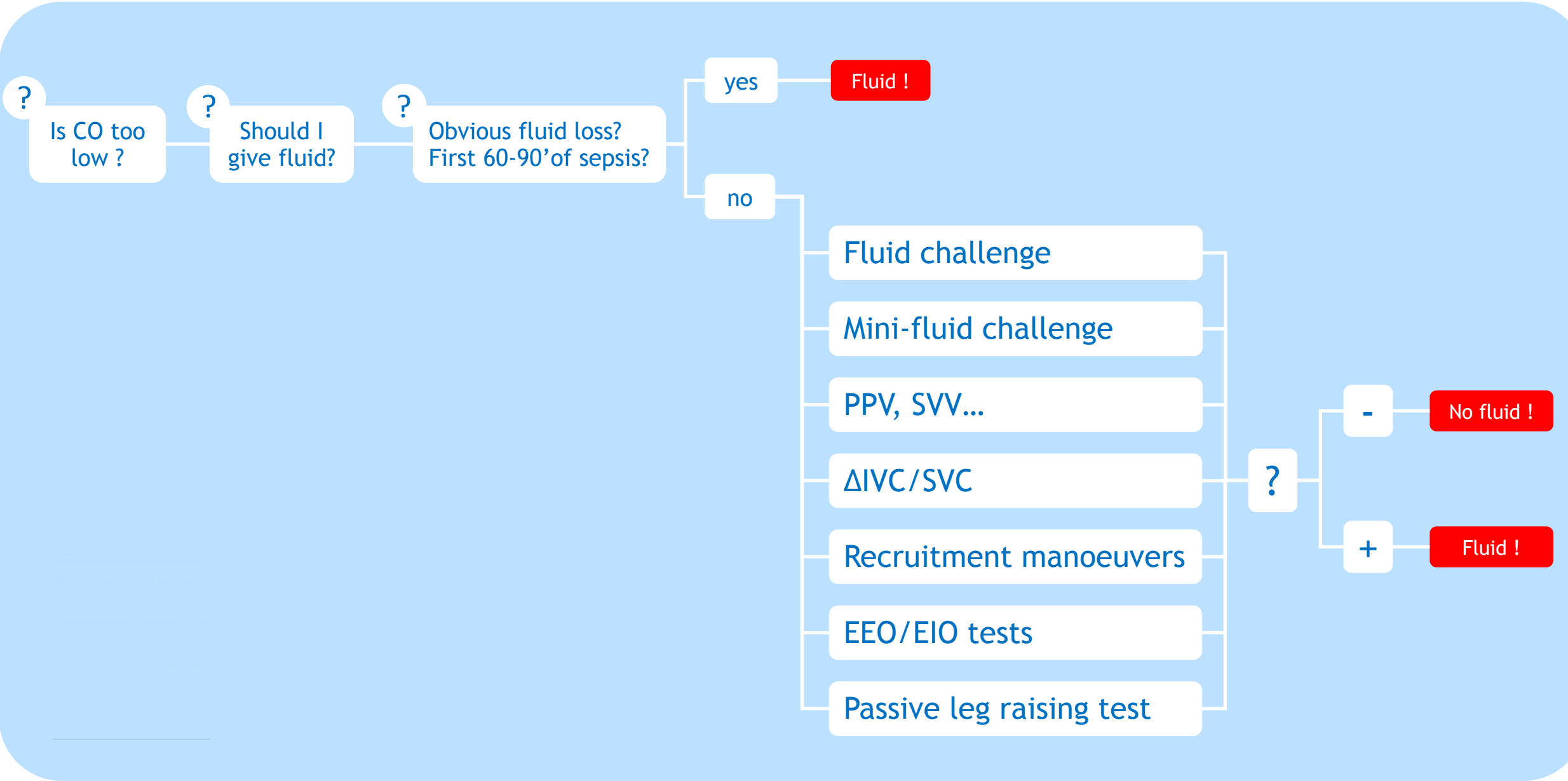


What's new in 2019 ?



What's new in 2019 ?

Fluid responsiveness



What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Monnet and Teboul *Critical Care*
DOI 10.1186/s13054-014-0708-5

CRITICAL CARE

EDITORIAL

Passive leg raising: five rules, not a drop of fluid!

Xavier Monnet[1,2*] and Jean-Louis Teboul[1,2]

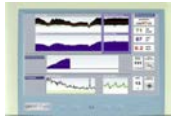
Changes in pulse contour-derived CO

PiCCO

EV 1000

Vigileo

LidCO rapid



Pulsioflex

Oeso Doppler

Changes in aortic blood flow

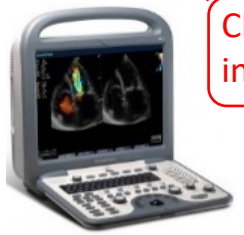
Plethysmography

Changes in perfusion index

Vascular Doppler

Changes in flow

Echo



Changes in VTI

Capnography

Changes in $EtCO_2$

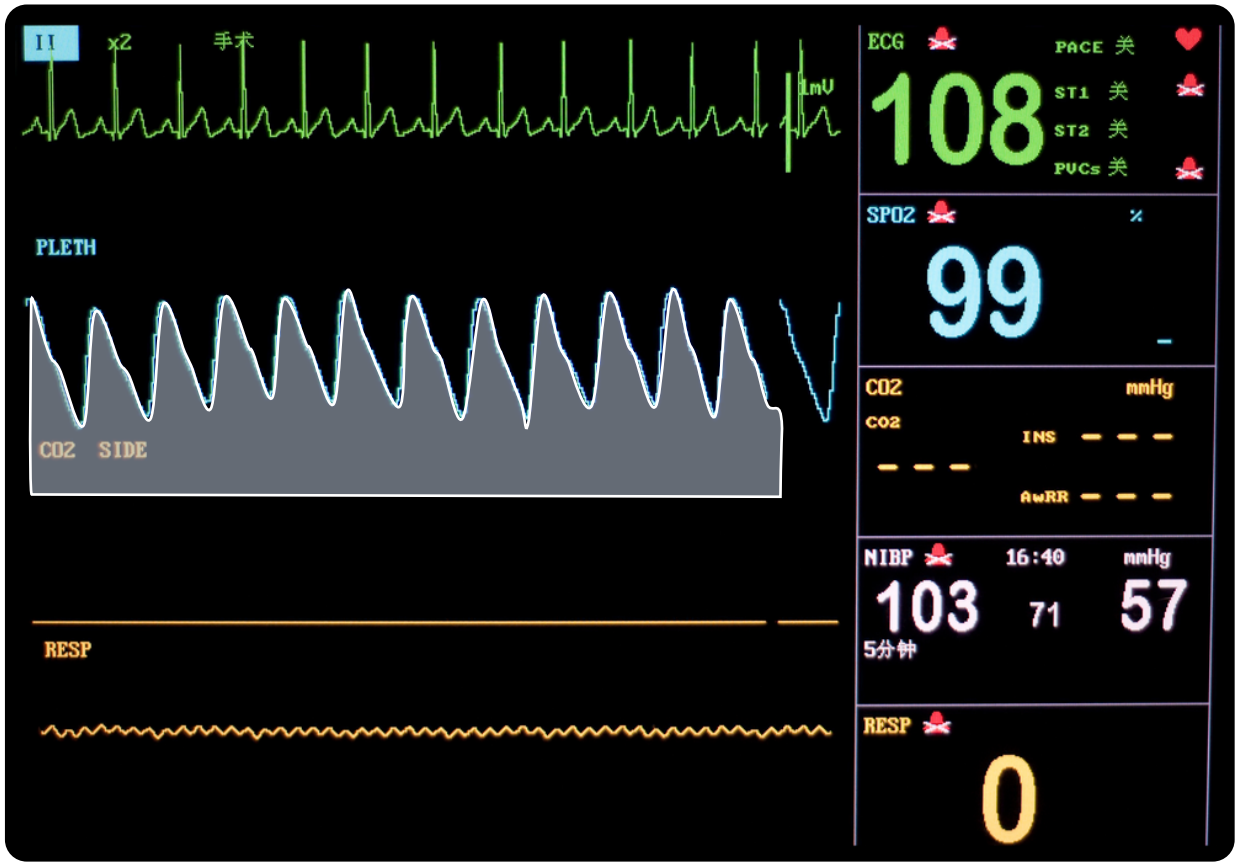
Starling SV

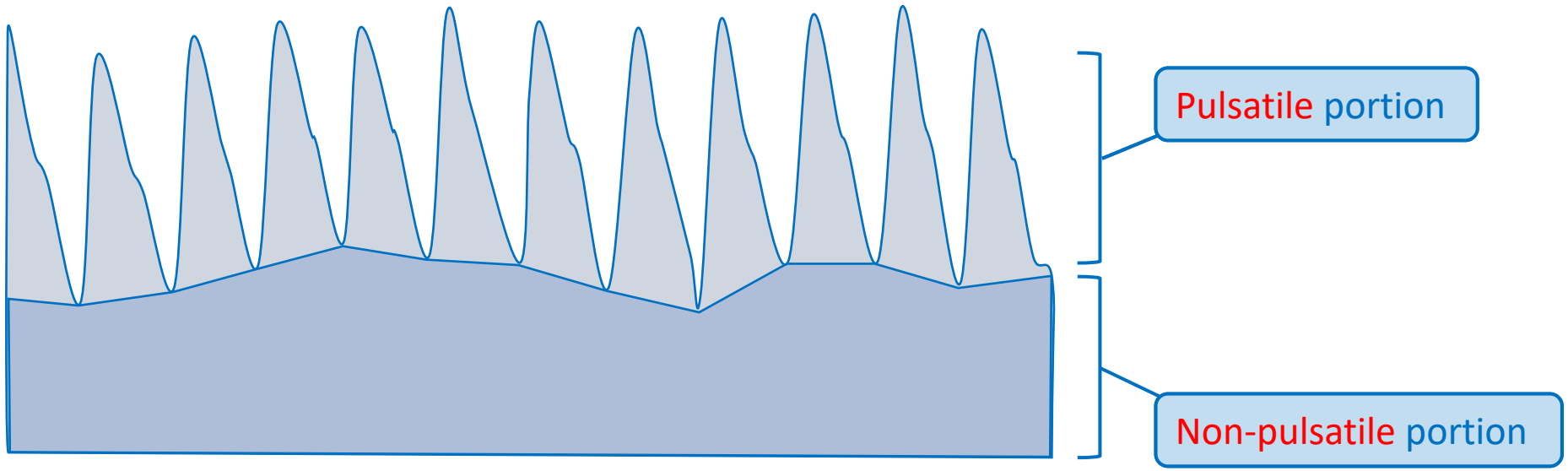
Changes in CO

What’s new in 2019 ?

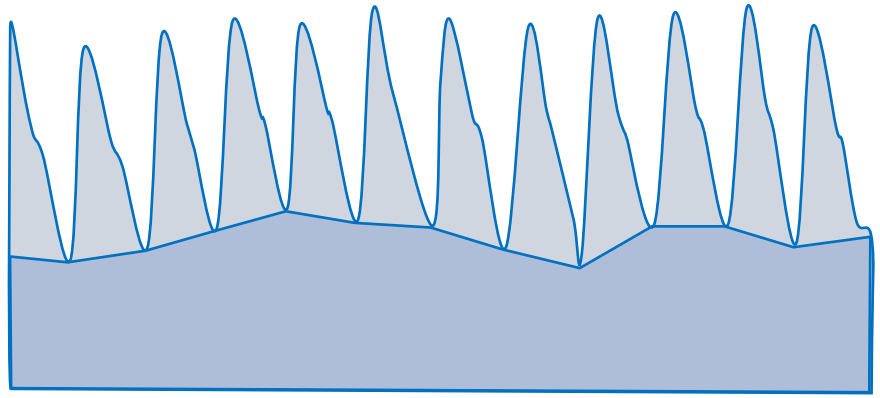
Fluid responsiveness

Passive leg raising test




Pulsatile portion
Non-pulsatile portion

What's new in 2019 ? Fluid responsiveness Passive leg raising test



Pulsatile portion

Non-pulsatile portion

Automatically measured by

Radical 7® (Masimo®)

$$\text{Perfusion index (PI)} = \frac{\text{Pulsatile portion}}{\text{Non-pulsatile portion}}$$

2 determinants

- Vasomotor tone
- Stroke volume

What's new in 2019 ? Fluid responsiveness Passive leg raising test

Beurton *et al. Critical Care* (2019) 23:19
https://doi.org/10.1186/s13054-019-2306-z

Critical Care

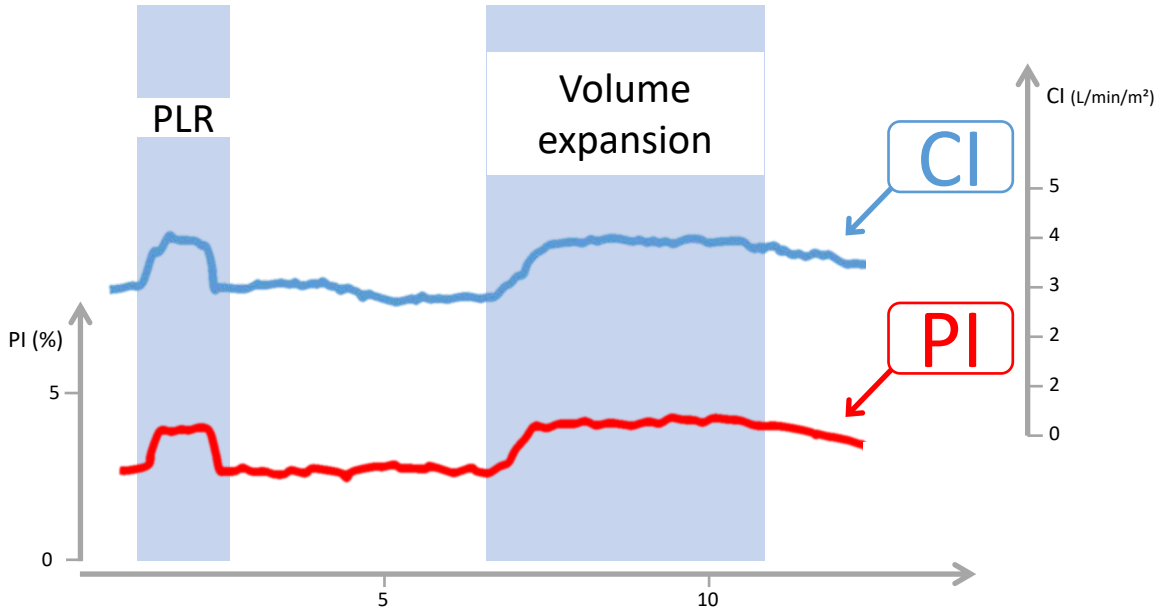
RESEARCH Open Access

The effects of passive leg raising may be detected by the plethysmographic oxygen saturation signal in critically ill patients

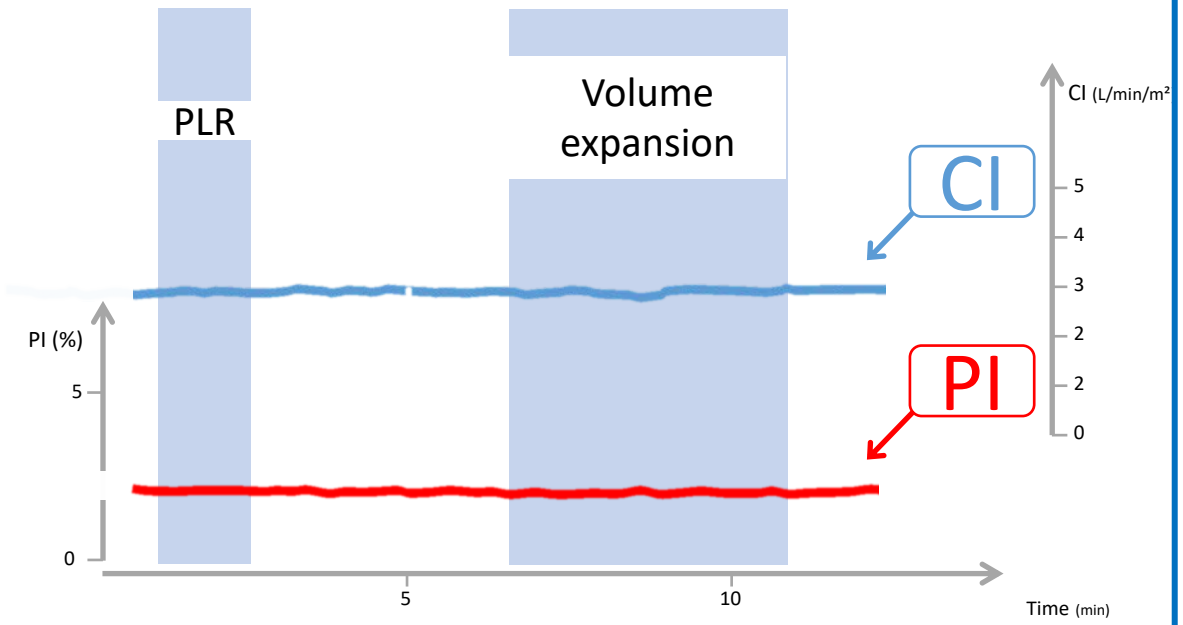
Alexandra Beurton[1,2*], Jean-Louis Teboul[1,2], Francesco Gavelli[1], Filipe Andre Gonzalez[1], Valentina Girotto[1], Laura Galarza[1], Nadia Anguel[1], Christian Richard[1] and Xavier Monnet[1,2]

72 ICU patients
Monitoring of PI (Radical7, Masimo®)

Responder



Non-responder



What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Beurton *et al. Critical Care* (2019) 23:19
https://doi.org/10.1186/s13054-019-2306-z

Critical Care

RESEARCH Open Access

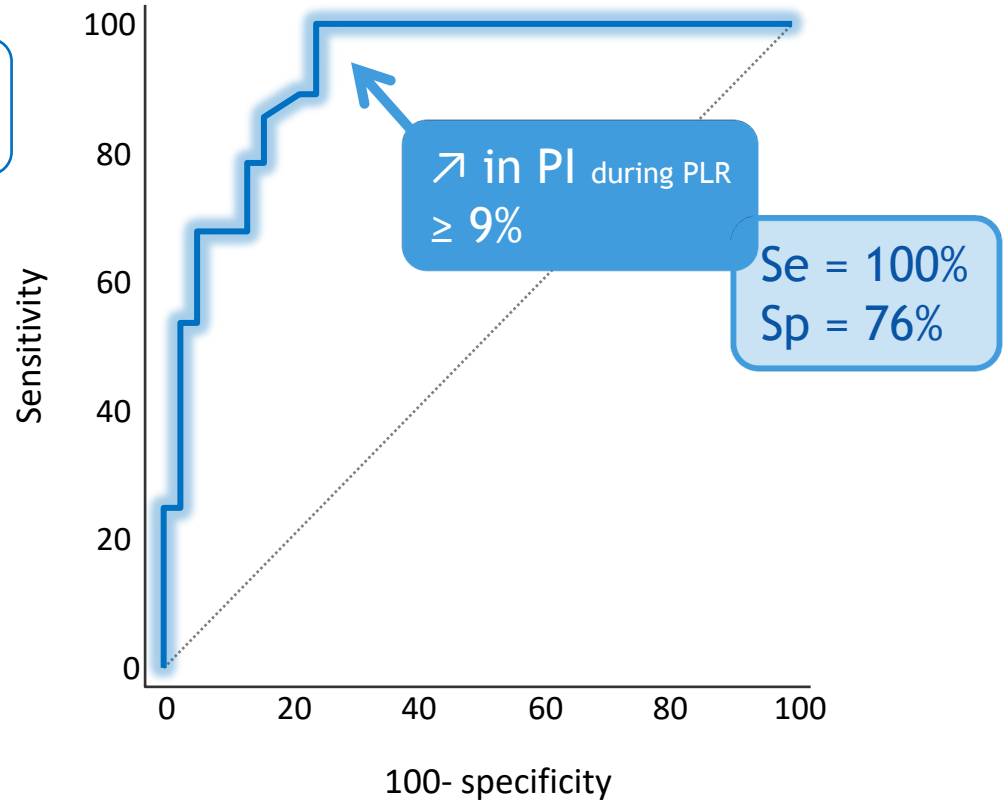
The effects of passive leg raising may be detected by the plethysmographic oxygen saturation signal in critically ill patients

Alexandra Beurton[1,2*], Jean-Louis Teboul[1,2], Francesco Gavelli[1], Filipe Andre Gonzalez[1], Valentina Girotto[1], Laura Galarza[1], Nadia Anguel[1], Christian Richard[1] and Xavier Monnet[1,2]

72 ICU patients
Monitoring of PI (Radical7, Masimo®)

3 excluded because no signal
3 excluded because unstable signal

Ability of PI changes to detect a positive PLR test



What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Monnet and Teboul *Critical Care*
DOI 10.1186/s13054-014-0708-5

CRITICAL CARE

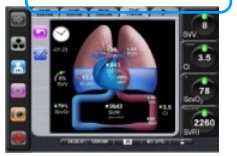
EDITORIAL

Passive leg raising: five rules, not a drop of fluid!

Xavier Monnet[1,2*] and Jean-Louis Teboul[1,2]

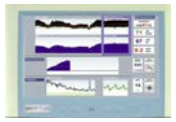
PiCCO

EV 1000



Vigileo

LidCO rapid



Pulsioflex

Changes in pulse contour-derived CO

Clinical examination

Changes in capillary refill time

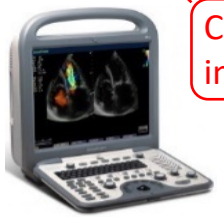
Oeso Doppler

Changes in aortic blood flow

Plethysmography

Changes in perfusion index

Echo



Changes in VTI

Vascular Doppler

Changes in flow

Capnography

Changes in $EtCO_2$

Starling SV

Changes in CO

What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Jacquet-Lagrèze et al. Critical Care (2019) 23:281
https://doi.org/10.1186/s13054-019-2560-0

Critical Care

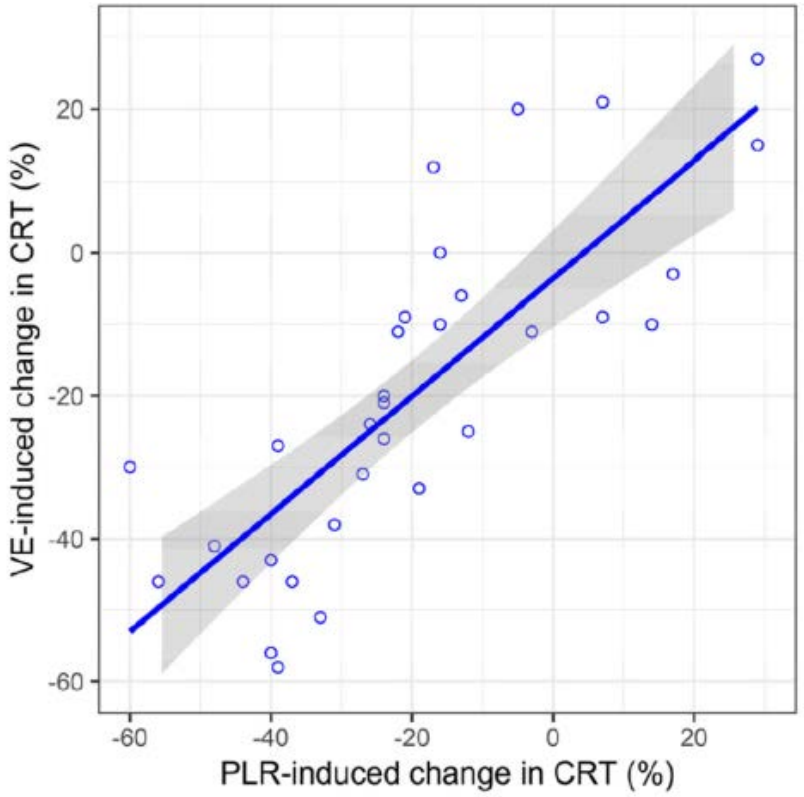
RESEARCH Open Access

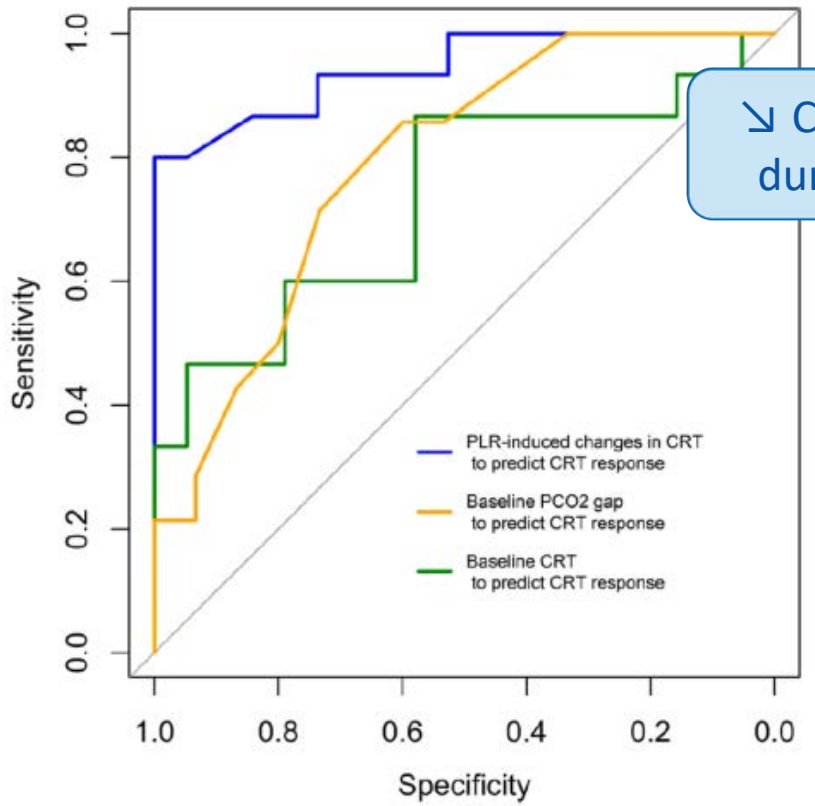
Capillary refill time variation induced by passive leg raising predicts capillary refill time response to volume expansion

Matthias Jacquet-Lagrèze[1,2*], Nourredine Bouhamri[1], Philippe Portran[1,2], Rémi Schweizer[1,2], Florent Baudin[3,2], Marc Lilot[4,5,6,7], William Fornier[1,2] and Jean-Luc Fellahi[1,2]

34 patients with circulatory failure
CRT, PLR and volume expansion

LSC of 4 CRT assessments = 25%





↘ CRT ≥27% during PLR

Se = 87%
Sp = 100%

What's new in 2019 ?

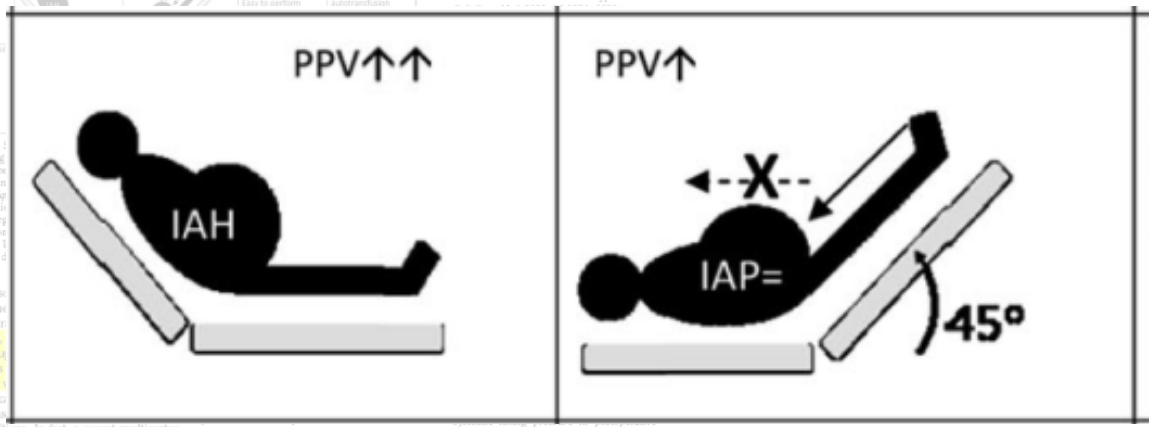
Fluid responsiveness

Passive leg raising test

Assessing fluid responsiveness with the passive leg raising maneuver in patients with increased intra-abdominal pressure: Be aware that not all blood returns!*

Malbrain Reuter

Crit Care Med 2010 Vol. 38, No. 9



Hamburg-Eppendorf University Hospital
Hamburg, Germany

REFERENCES

1. Mahjoub Y, Touzeau J, Airapetian N, et al: The passive leg-raising maneuver cannot accurately predict fluid responsiveness in patients with intra-abdominal hypertension.
cardiac surgery patients. *Crit Care Med* 2009; 37:912–918
9. Cannesson M, Delannoy B, Morand A, et al: Does the Pleth variability index indicate the respiratory-induced variation in the plethysmogram and arterial pressure waveforms? *Anesth Analg* 2008; 106:1189–1194
10. Wilcox S, Vandam LD: Alas, poor Trendelenburg and his position! A critique of its uses and effectiveness. *Anesth Analg* 1988; 67:574–578
11. Reuter DA, Felbinger TW, Schmidt C, et al: Trendelenburg positioning after cardiac surgery: Effects on intrathoracic blood volume and cardiac performance. *Eur J Anaesth* 2003; 20:17–20
12. Murphy CV, Schramm GE, Doherty JA, et al: The importance of fluid management in acute lung injury secondary to septic shock. *Chest* 2009; 136:102–109
13. Cheatham ML, Malbrain ML: Cardiovascular implications of abdominal compartment syndrome. *Acta Clin Belg Suppl* 2007; 62: 98–112
14. Mahjoub Y, Pila C, Friggeri A, et al: Assessing fluid responsiveness in critically ill patients: False-positive pulse pressure variation is detected by Doppler echocardiographic evalua-

What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Intra-Abdominal Hypertension Is Responsible for False Negatives to the Passive Leg Raising Test

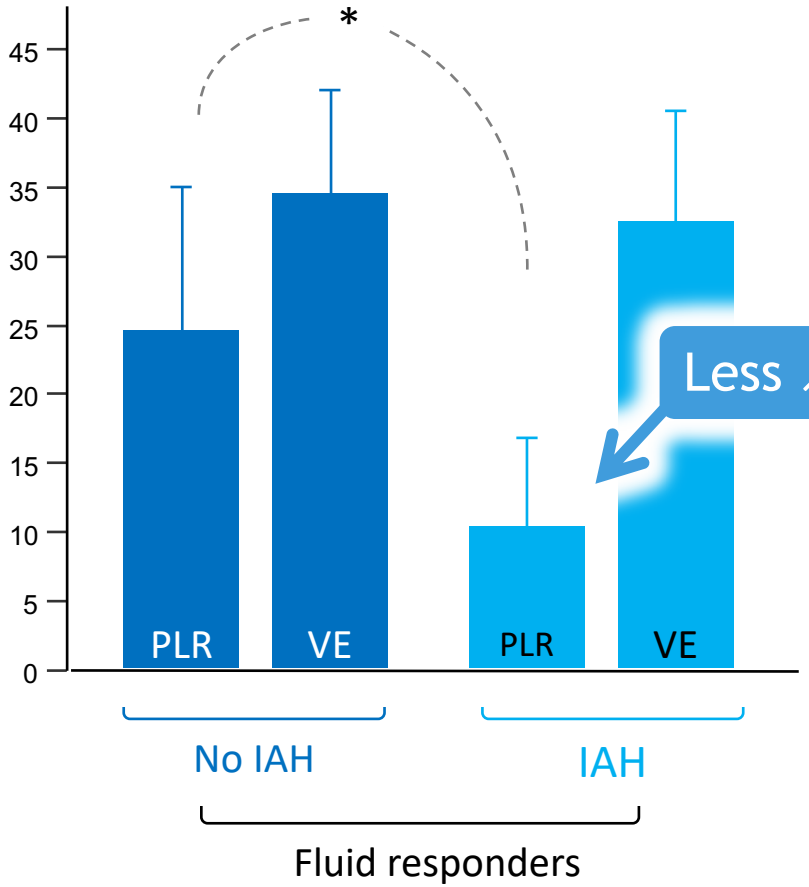
Alexandra Beurton, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]; Valentina Girotto, MD[1]; Laura Galarza, MD[1]; Nadia Anguel, MD[1]; Christian Richard, MD[1]; Xavier Monnet, MD, PhD[1,2]

Crit Care Med 2019

30 patients with IAP > 12 mmHg

30 patients without IAH

Changes in cardiac index (%)



Less ↗ in CI in case of IAH

What's new in 2019 ?

Fluid responsiveness

Passive leg raising test

Intra-Abdominal Hypertension Is Responsible for False Negatives to the Passive Leg Raising Test

Alexandra Beurton, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]; Valentina Girotto, MD[1]; Laura Galarza, MD[1]; Nadia Anguel, MD[1]; Christian Richard, MD[1]; Xavier Monnet, MD, PhD[1,2]

Crit Care Med 2019

30 patients with IAP > 12 mmHg
30 patients without IAH

IAH+

N=30

N=21 — Fluid responders

- PLR+ : N=6 — TRUE +
- PLR- : N=15 — FALSE-

N=9 — Fluid non-responders

- PLR+ : N=1 — FALSE+
- PLR- : N=8 — TRUE -

Some false negatives

IAH-

N=30

N=15 — Fluid responders

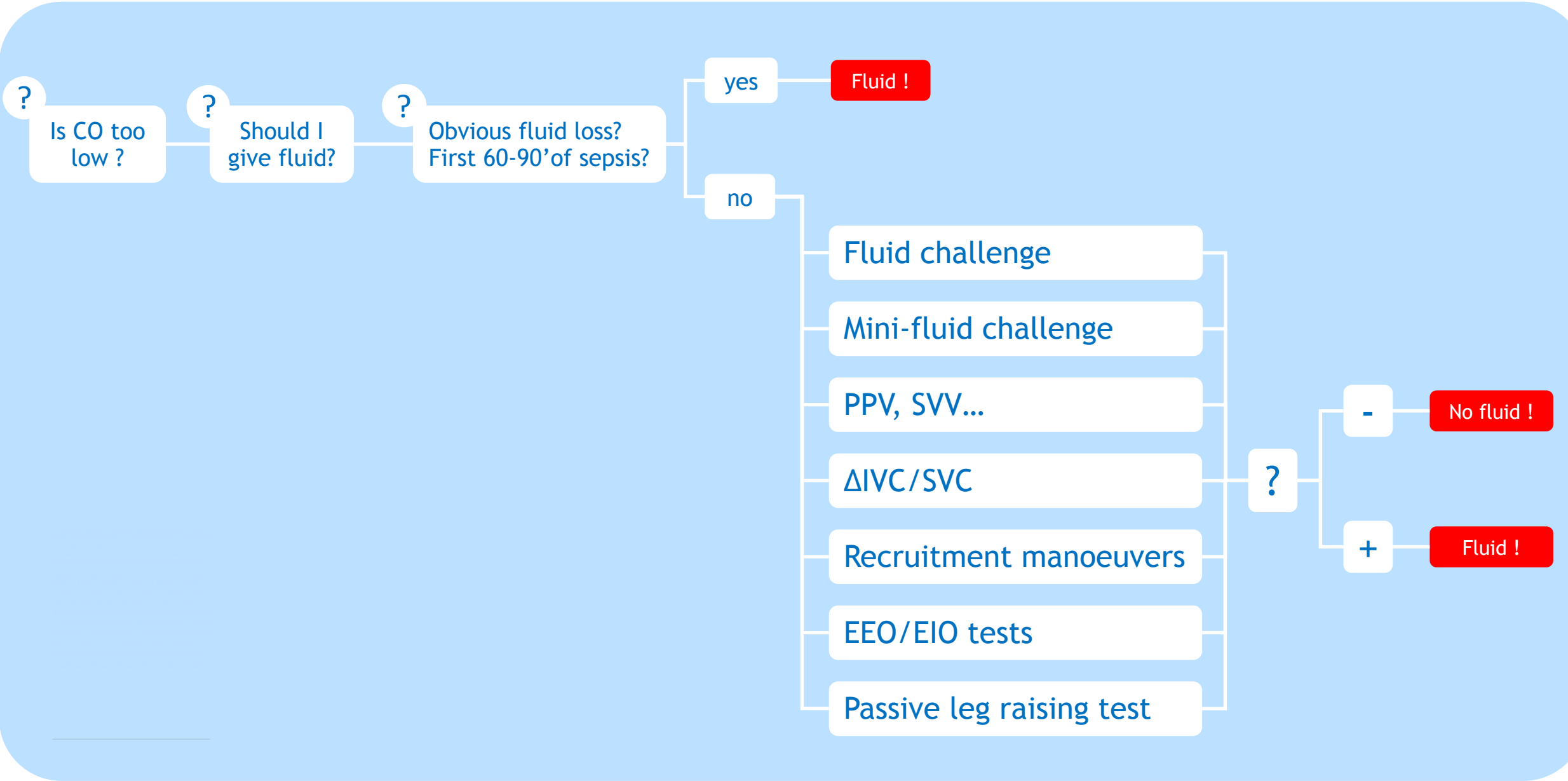
- PLR+ : N=14 — TRUE +
- PLR- : N=1 — FALSE-

N=15 — Fluid non-responders

- PLR+ : N=0 — FALSE+
- PLR- : N=15 — TRUE -

What's new in 2019 ?

Fluid responsiveness



What's new in 2019 ?

Fluid responsiveness

Recruitment manoeuvers

Messina et al. Critical Care (2019) 23:31
https://doi.org/10.1186/s13054-018-2294-4

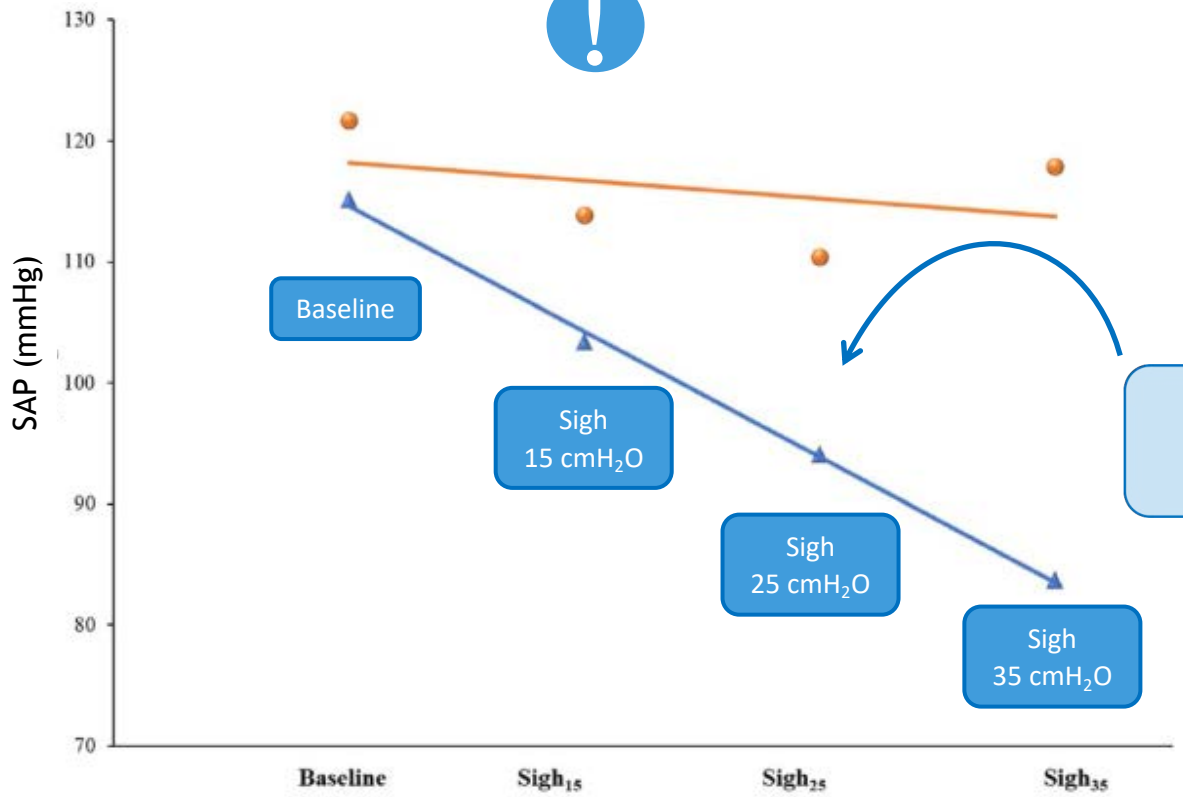
Critical Care

RESEARCH Open Access

Sigh maneuver to enhance assessment of fluid responsiveness during pressure support ventilation

Antonio Messina[1*†], Davide Colombo[2†], Federico Lorenzo Barra[1], Gianmaria Cammarota[2], Giacomo De Mattei[3], Federico Longhini[4], Stefano Romagnoli[5], Francesco DellaCorte[2], Daniel De Backer[6], Maurizio Cecconi[1] and Paolo Navalesi[4]

40 ICU patients
4 successive sigh maneuvers



Opportunities for automatisation

Slope of SAP decrease <4.4° from baseline

Se=100 (79-100)%
Sp=86 (79-100)%

What's new in 2019 ?

Fluid responsiveness

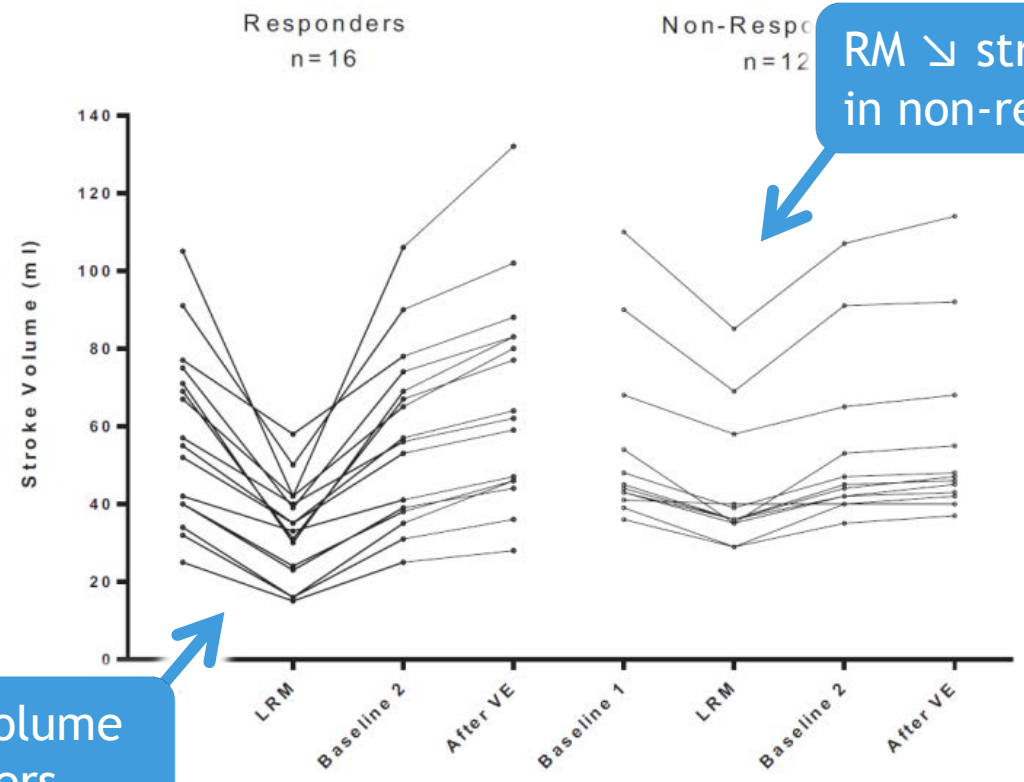
Recruitment manoeuvers

Changes in Stroke Volume Induced by Lung Recruitment Maneuver Predict Fluid Responsiveness in Mechanically Ventilated Patients in the Operating Room

Matthieu Biais, M.D., Ph.D., Romain Lanchon, M.D., Musa Sesay, M.D., Lisa Le Gall, M.D., Bruno Pereira, Ph.D., Emmanuel Futier, M.D., Ph.D., Karine Nouette-Gaulain, M.D., Ph.D.

ANESTHESIOLOGY 2017

28 patients during anaesthesia
RM with 30 cmH_2O for 30s
ProAQT to detect changes in SV



RM ↘ stroke volume less in non-responders

RM ↘↘ stroke volume more in responders

What's new in 2019 ?

Fluid responsiveness

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

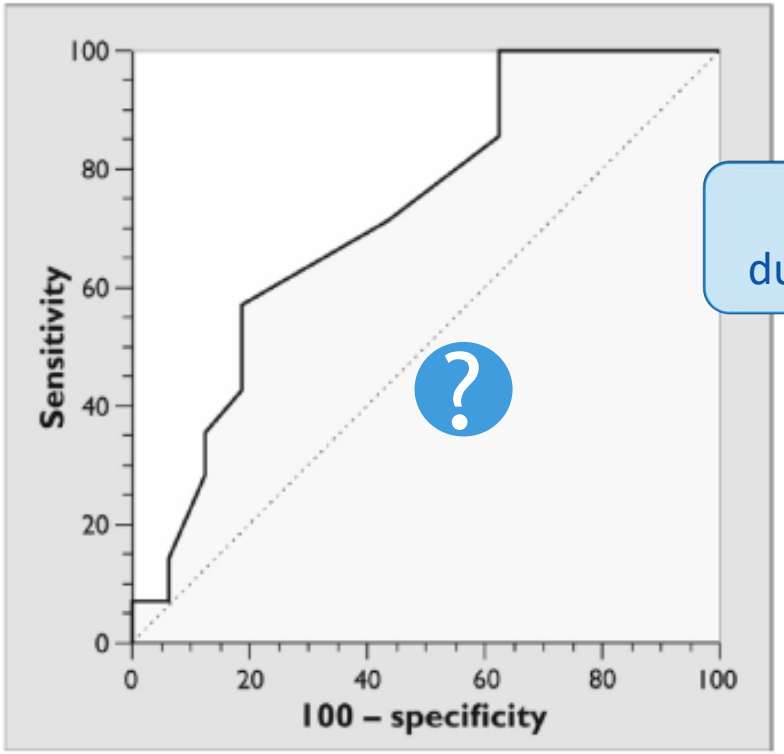
journal homepage: www.jcvaonline.com

Original Article

Dynamic Tests to Predict Fluid Responsiveness After Off-Pump Coronary Artery Bypass Grafting

Evgenia V. Fot, MD, Natalia N. Izotova, Aleksei A. Smetkin, Vsevolod V. Kuzkov, PhD, Mikhail Y. Kirov, PhD

32 patients after cardiac surgery
↗ PEEP from 5 to 20 cmH2O for 2 min



↘ MAP ≥5%
during PEEP test

Better with changes in cardiac output ?

What's new in 2019 ?

Fluid responsiveness

Pharamcodynamics of fluids ?

RESEARCH Open Access

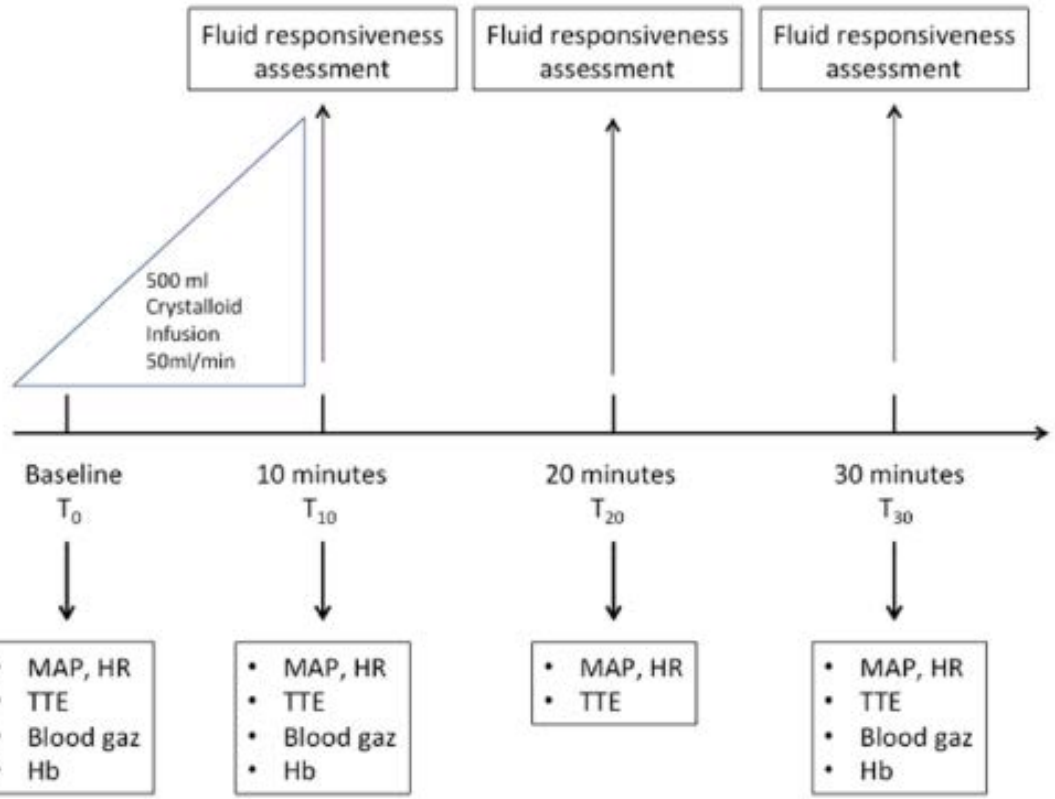
Time course of fluid responsiveness in sepsis: the fluid challenge revisiting (FCREV) study

Critical Care (2019)

Claire Roger[1,2], Laurent Zieleskiewicz[3,11], Christophe Demattei[4], Karim Lakhal[5], Gael Piton[6], Benjamin Louart[1,2], Jean-Michel Constantin[7], Russell Chabanne[7], Jean-Sébastien Faure[7], Yazine Mahjoub[8], Isabelle Desmeulles[9], Hervé Quintard[10], Jean-Yves Lefrant[1,2], Laurent Muller[1,2*] and AzuRea Group

143 patients with septic shock

FR = ↗VTI ≥15% with fluid



What's new in 2019 ?

Fluid responsiveness

Pharamcodynamics of fluids ?

RESEARCH Open Access

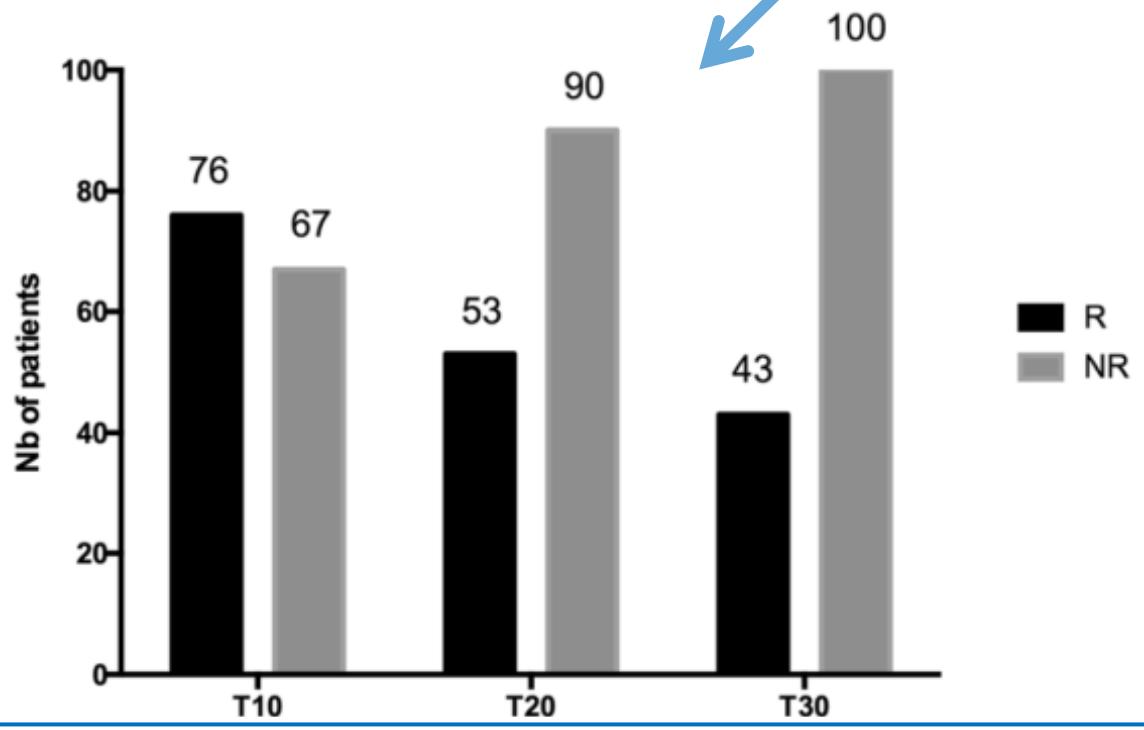
Time course of fluid responsiveness in sepsis: the fluid challenge revisiting (FCREV) study

Claire Roger[1,2], Laurent Zieleskiewicz[3,11], Christophe Dematteï[4], Karim Lakhal[5], Gael Piton[6], Benjamin Louart[1,2], Jean-Michel Constantin[7], Russell Chabanne[7], Jean-Sébastien Faure[7], Yazine Mahjoub[8], Isabelle Desmeulles[9], Hervé Quintard[10], Jean-Yves Lefrant[1,2], Laurent Muller[1,2*] and AzuRea Group

143 patients with septic shock

FR = ↗VTI ≥15% with fluid

50% of responders are no longer responders 20min later



What's new in 2019 ?

Fluid responsiveness

Pharamcodynamics of fluids ?

Nunes et al. Annals of Intensive Care 2014, 4:25
http://www.annalsofintensivecare.com/content/4/1/25

Annals of Intensive Care
a SpringerOpen Journal

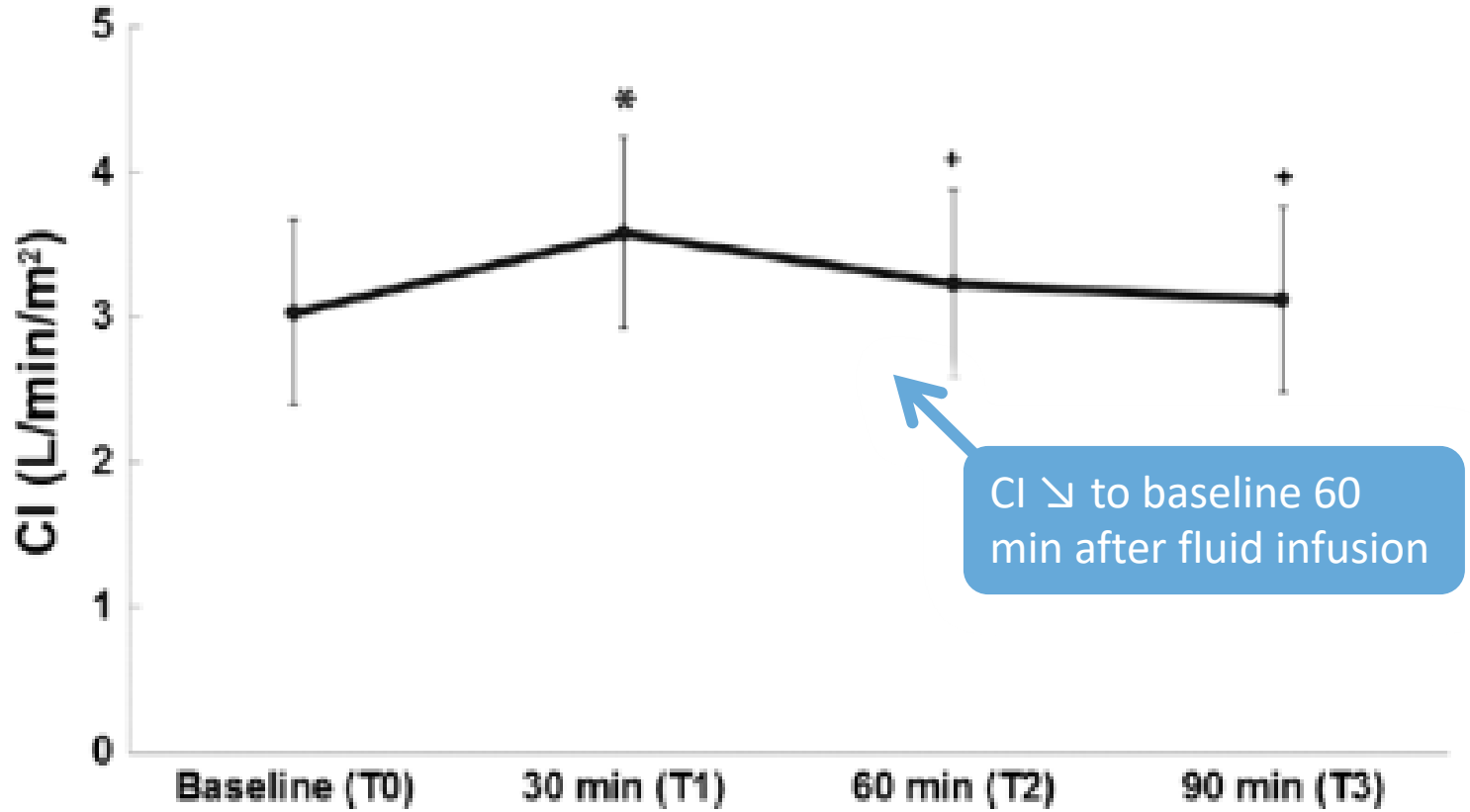
RESEARCH Open Access

Duration of hemodynamic effects of crystalloids in patients with circulatory shock after initial resuscitation

Thieme Souza Oliveira Nunes, Renata Teixeira Ladeira, Antônio Tonete Bafi, Luciano Cesar Pontes de Azevedo, Flavia Ribeiro Machado and Flávio Geraldo Rezende Freitas*

21 patients with shock (14 = septic)

FR = ↗CI ≥15% with fluid (PA catheter)



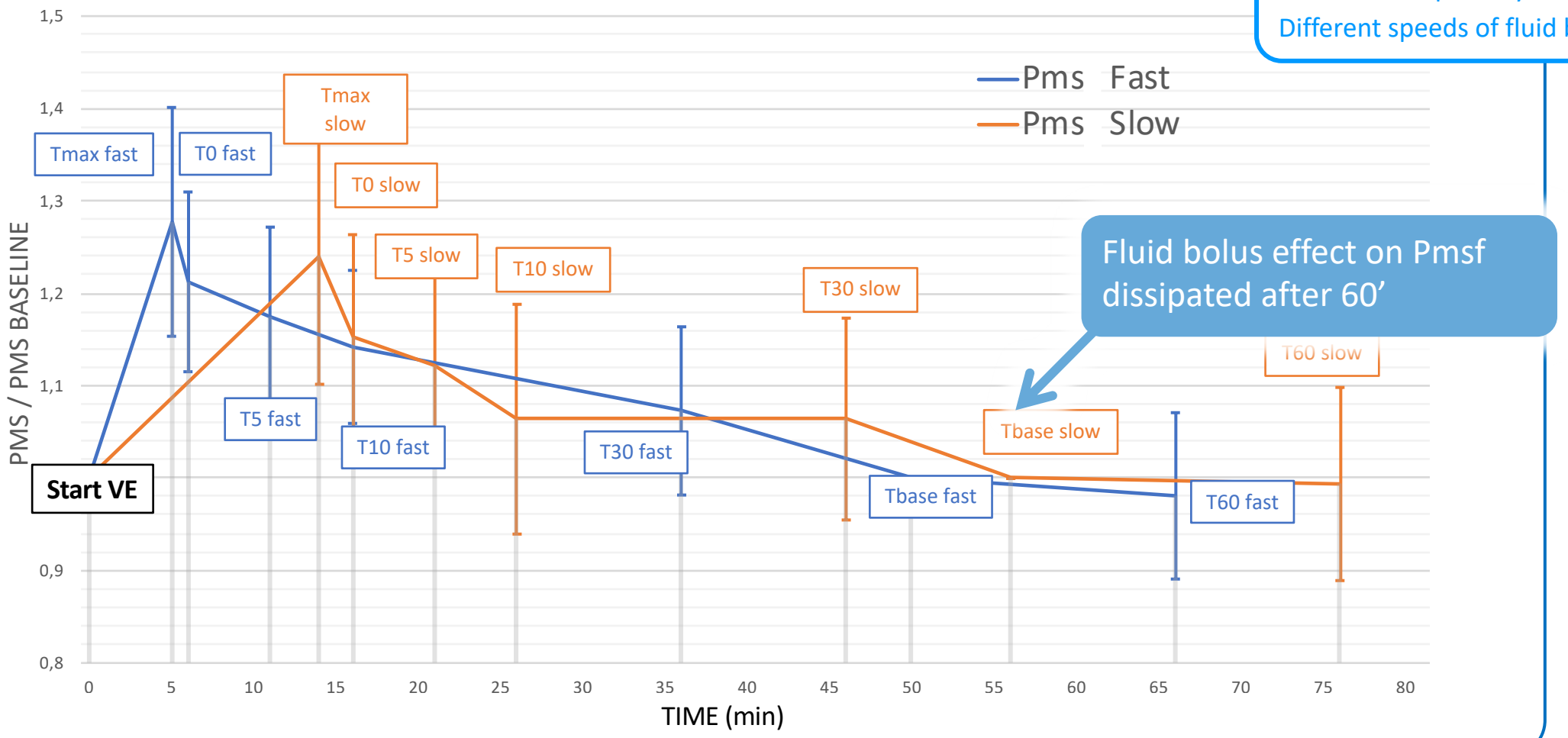
CI ↘ to baseline 60 min after fluid infusion

Does the infusion rate affect the haemodynamic effect of a fluid bolus in patients with septic shock? A pharmacodynamic study

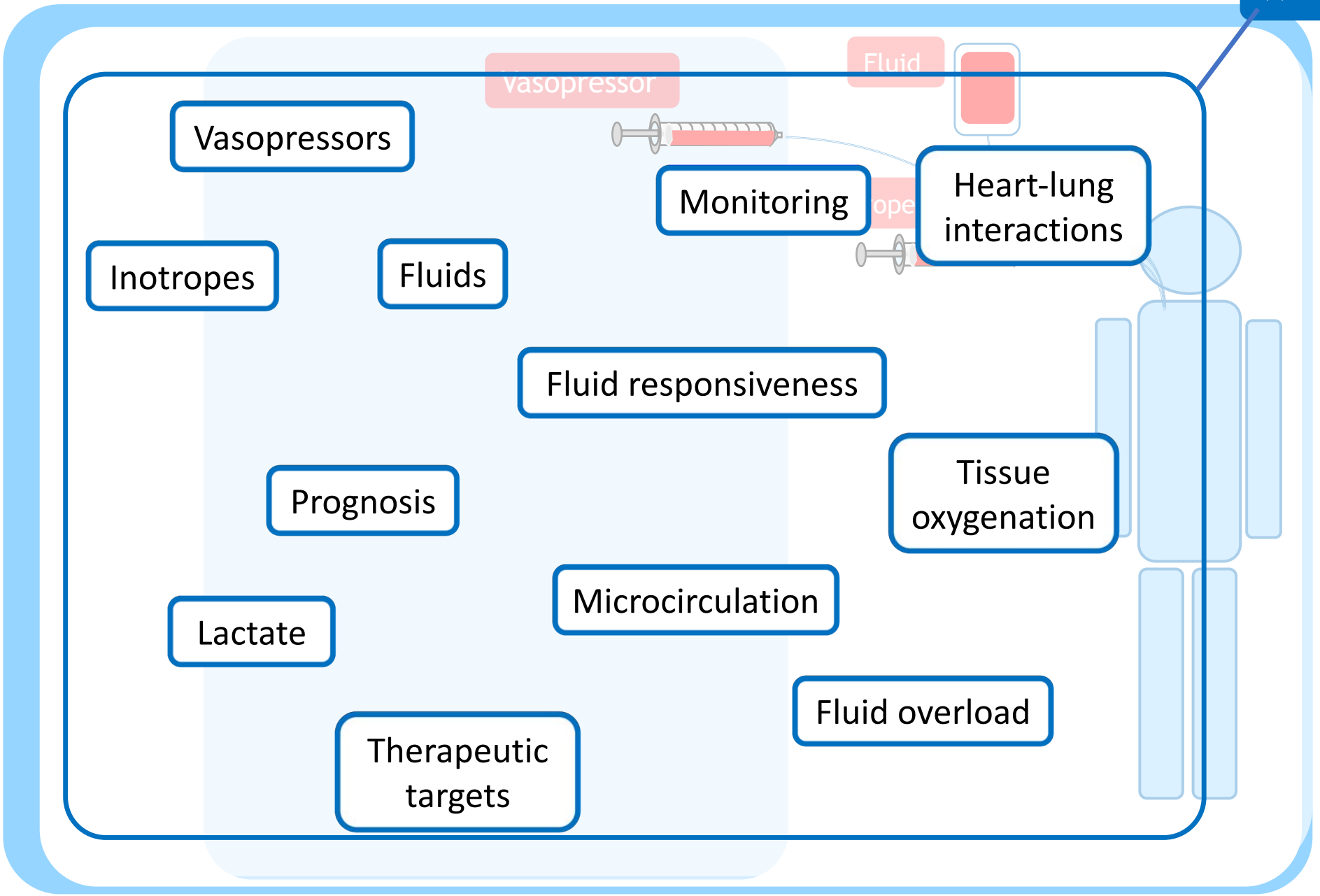
Arthur PAVOT, Francesco GAVELLI, Jean-Louis TEBOUL, Christopher LAI, Imane ADDA, Xavier MONNET

In preparation

20 patients with shock
Pmsf with respiratory manoeuvers
Different speeds of fluid bolus



What's new in 2019 ?



What's new in 2019 ? Monitoring Precision of CO monitoring techniques

de Courson *et al. Ann. Intensive Care* (2019) 9:116
https://doi.org/10.1186/s13613-019-0590-z

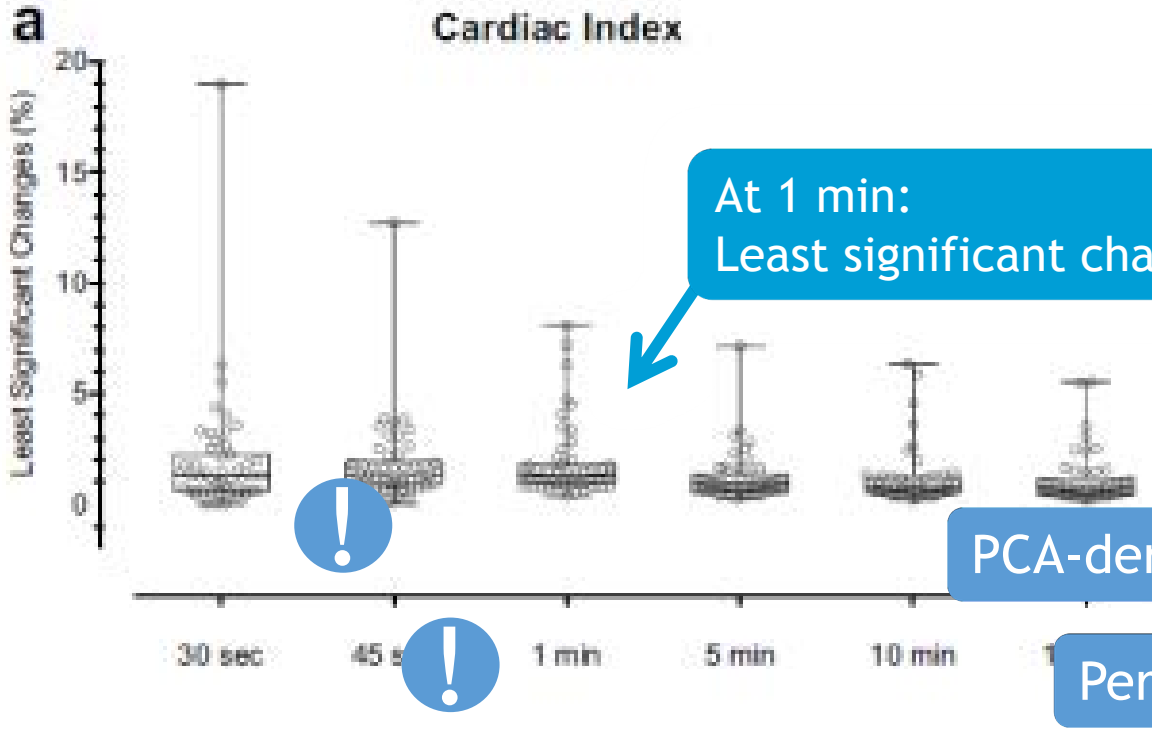
Annals of Intensive Care

RESEARCH Open Access

Evaluation of least significant changes of pulse contour analysis-derived parameters

Hugues de Courson[1], Loic Ferrer[2], Grégoire Cane[1], Eric Verchère[1], Musa Sesay[1], Karine Nouette-Gaulain[1,3] and Matthieu Biais[1,4,5*]

20 volume expansions
20 ↗and 20 ↘ in norepinephrine
Flotrac/Vigileo3 vs. TPTD



At 1 min:
Least significant change = 0.7%

PCA-derived CI is very precise !

Perfect for tests of fluid responsiveness

What's new in 2019 ? | Monitoring | Precision of CO monitoring techniques

Jozwiak et al. Critical Care (2019) 23:116
https://doi.org/10.1186/s13054-019-2413-x

Critical Care

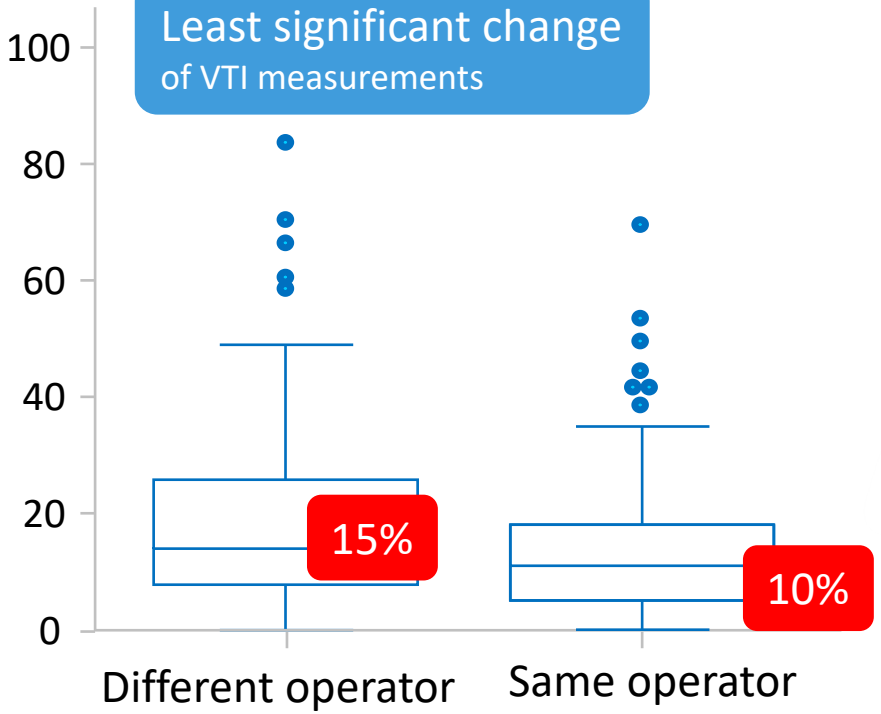
RESEARCH Open Access

What is the lowest change in cardiac output that transthoracic echocardiography can detect?

Mathieu Jozwiak[1,2*], Pablo Mercado[1,2], Jean-Louis Teboul[1,2], Anouar Benmalek[3], Julia Gimenez[1,2], François Dépret[1,2], Christian Richard[1,2] and Xavier Monnet[1,2]

100 stable patients
16% in 1F, 54% under MV

Least significant change
of VTI measurements



Echo hardly detects changes in VTI ≤10%

What's new in 2019 ? | Monitoring | Precision of CO monitoring techniques

Jozwiak et al. Critical Care (2019) 23:116
https://doi.org/10.1186/s13054-019-2413-x

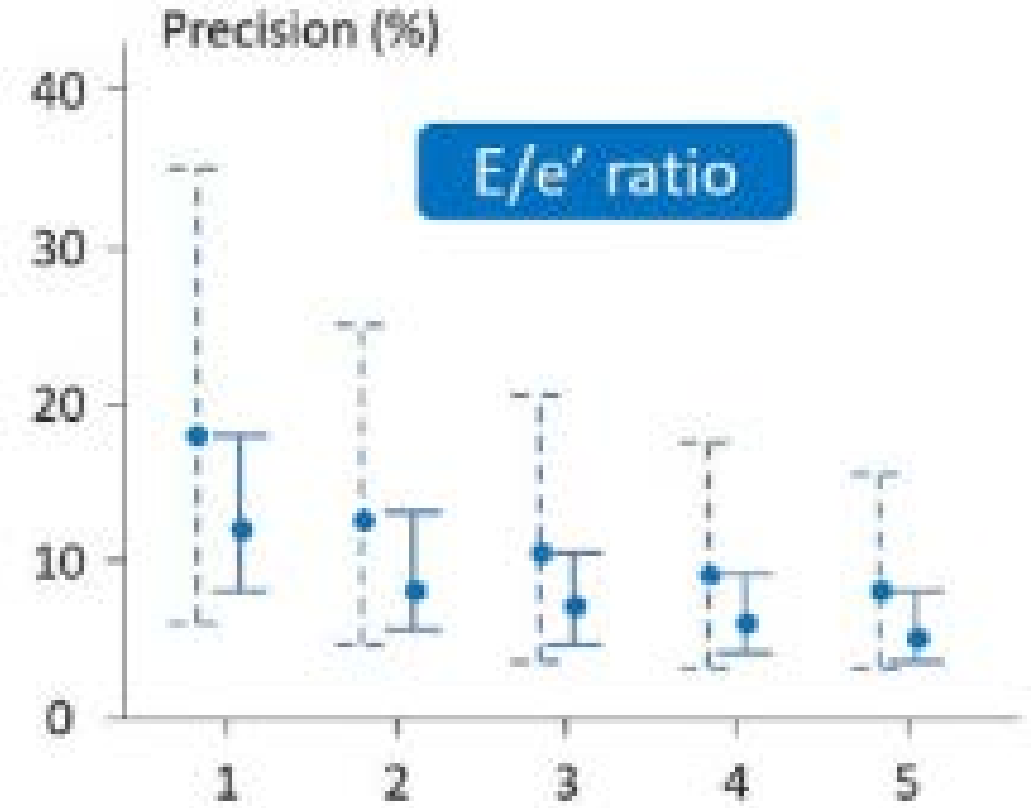
Critical Care

RESEARCH Open Access

What is the lowest change in cardiac output that transthoracic echocardiography can detect?

Mathieu Jozwiak[1,2*], Pablo Mercado[1,2], Jean-Louis Teboul[1,2], Anouar Benmalek[3], Julia Gimenez[1,2], François Dépret[1,2], Christian Richard[1,2] and Xavier Monnet[1,2]

100 stable patients
16% in 1F, 54% under MV



Que retenir de 2019…
… en hémodynamique ?

Pr Xavier MONNET

Service de médecine intensive-réanimation

Hôpital de Bicêtre

xavier.monnet@aphp.fr