



Hafid Ait-Oufella, MD.PhD.

Médecine Intensive-Réanimation  
Hôpital Saint-Antoine  
Sorbonne Université

Inserm U970  
Université Paris-Cité



## La microcirculation en pratique

Conflit d'intérêt : aucun

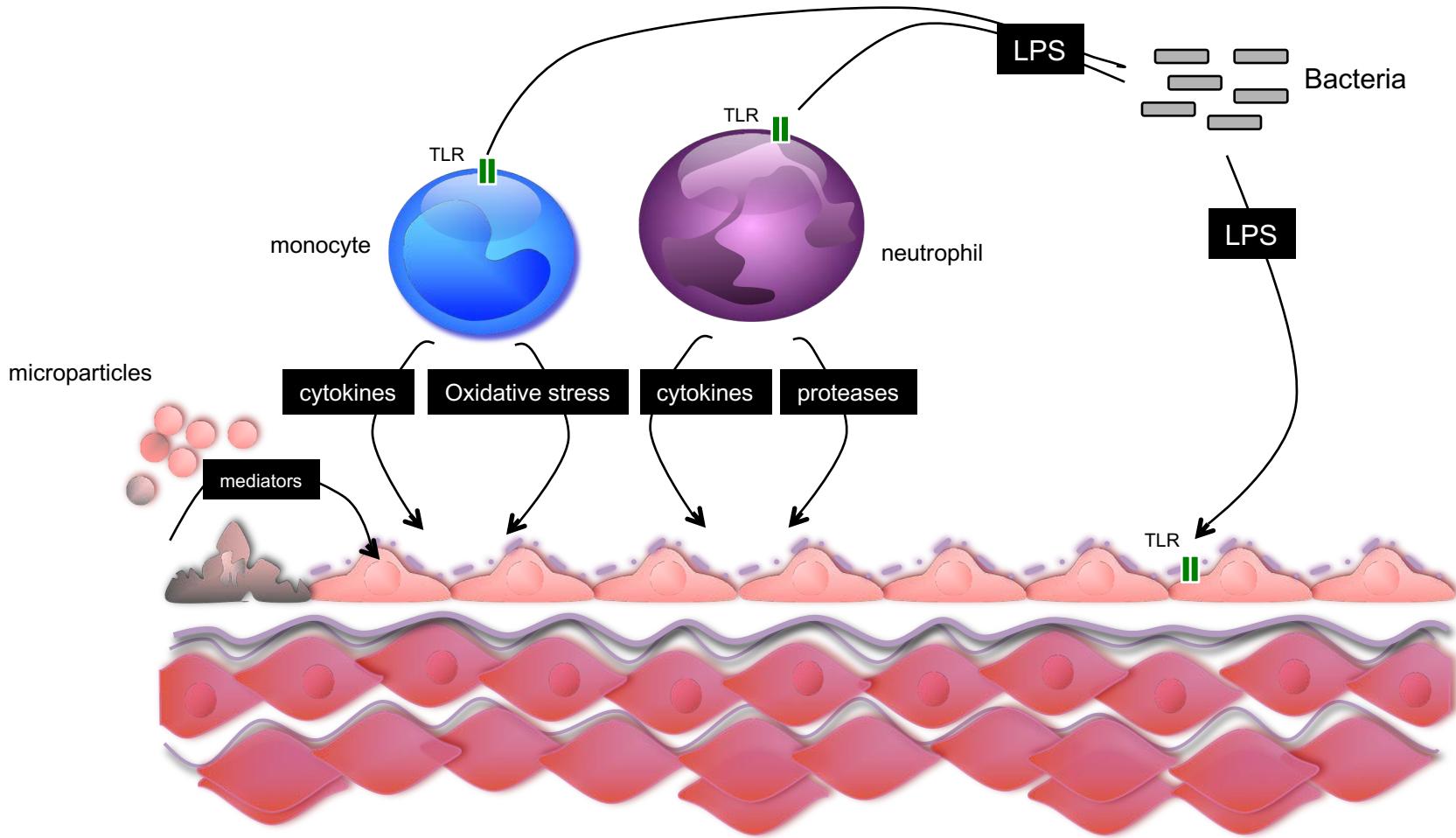
# **La microcirculation en pratique**

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*Au cours du choc septique*

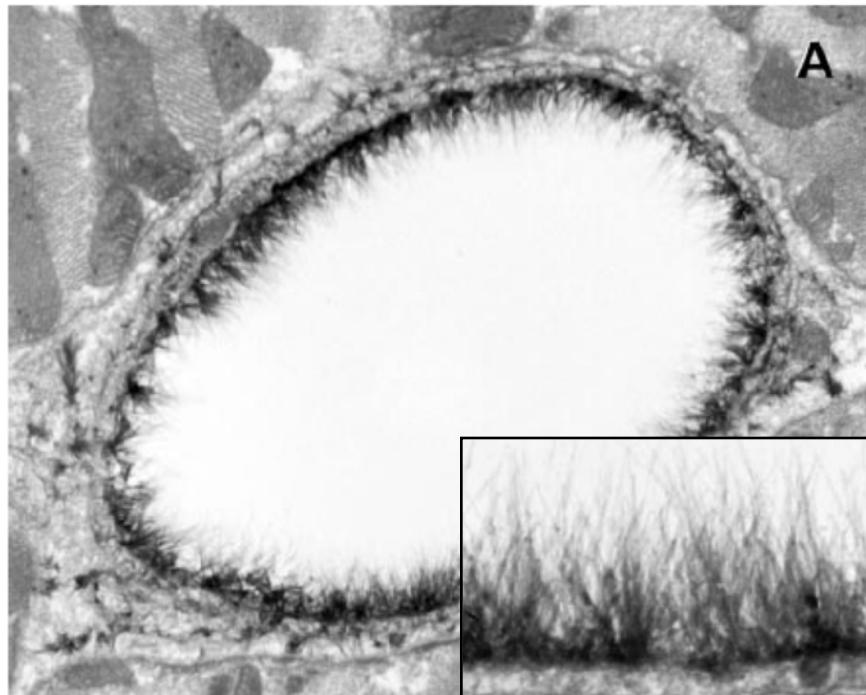
1. Physiopathologie : EVALUATION
2. Outils d'évaluation de la perfusion : TRI
3. Utilisation des outils pour la prise en charge : DYNAMIQUE
4. Questions

# Dommages endothéliaux au cours du sepsis

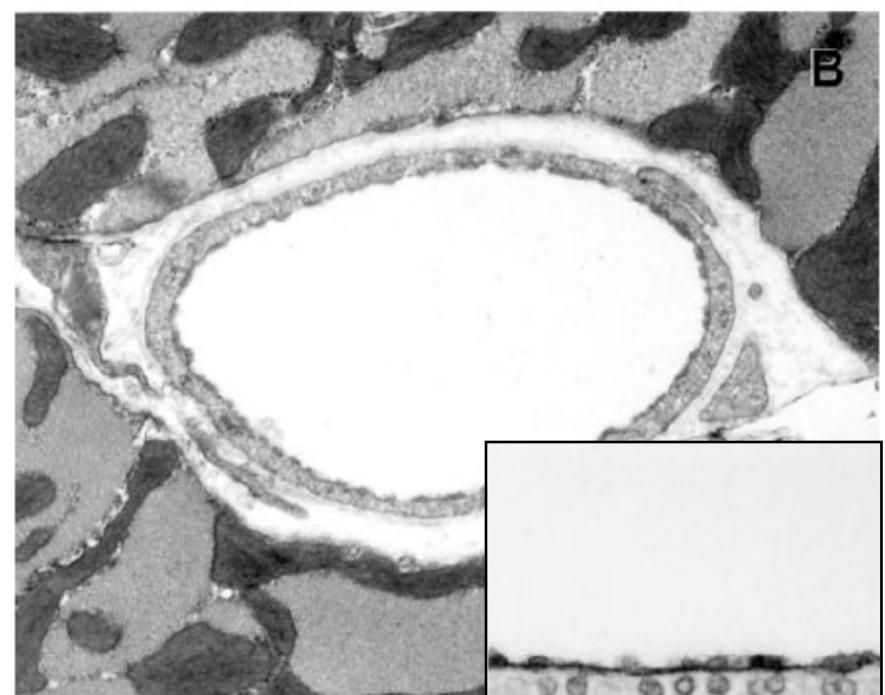


# Glycocalyx

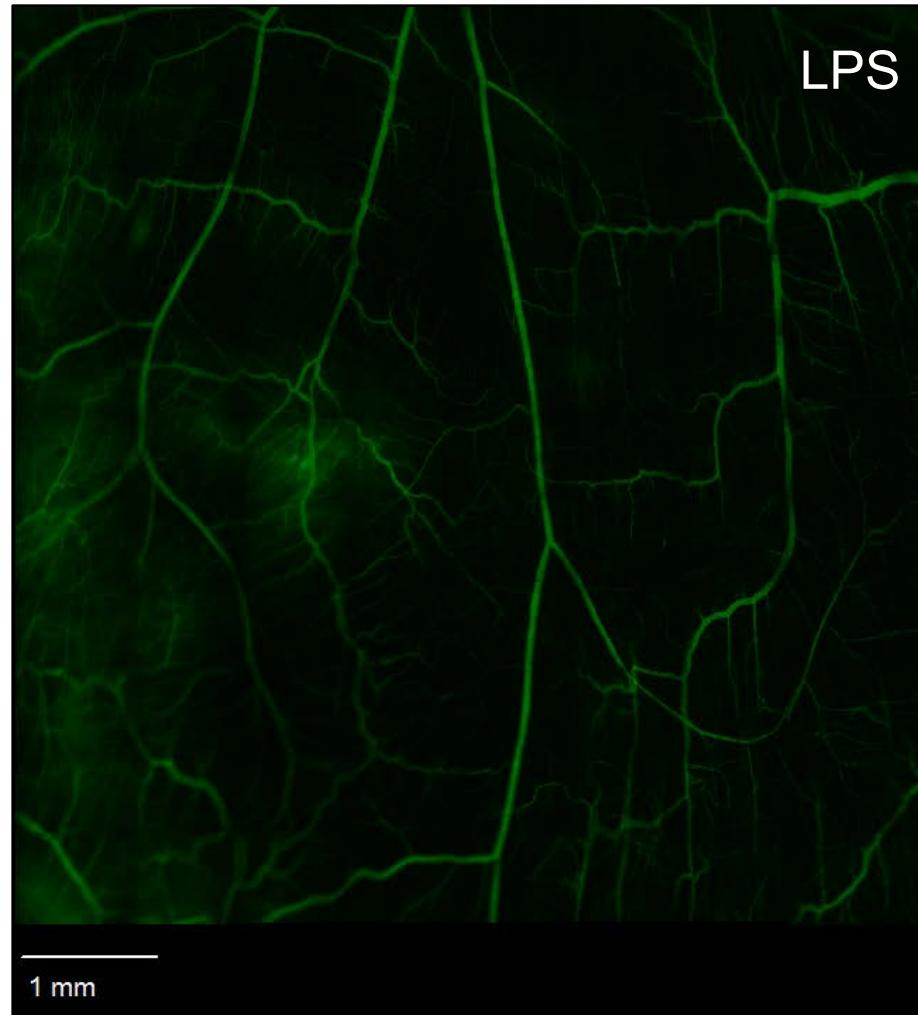
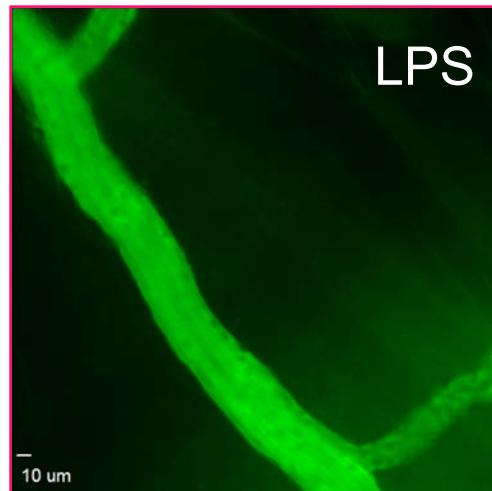
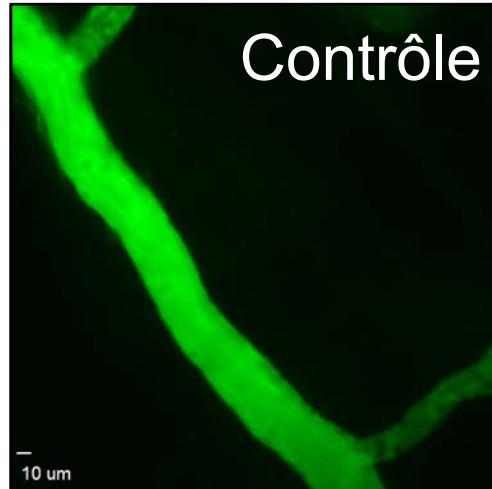
De base



Sepsis



# Syndrome de fuite capillaire



Personal data

# Syndrome de fuite capillaire en pratique

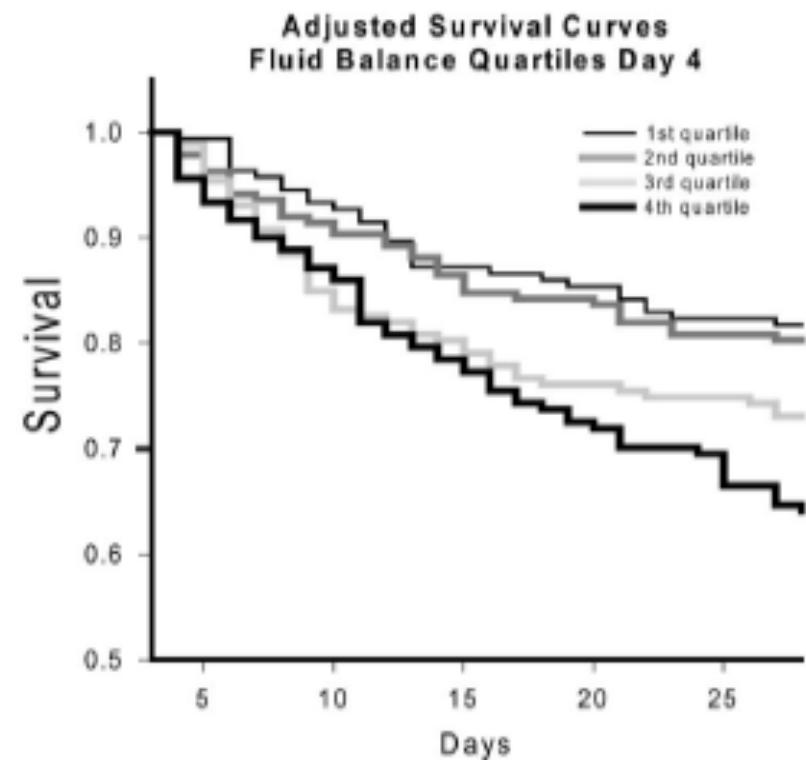
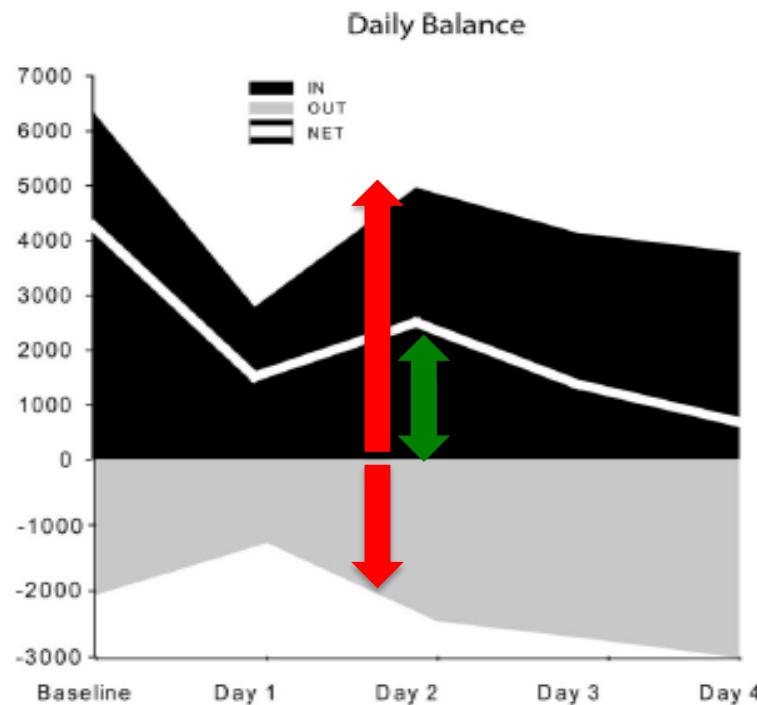
*Surcharge pulmonaire  
Oedème des parties molles  
Prise de poids*



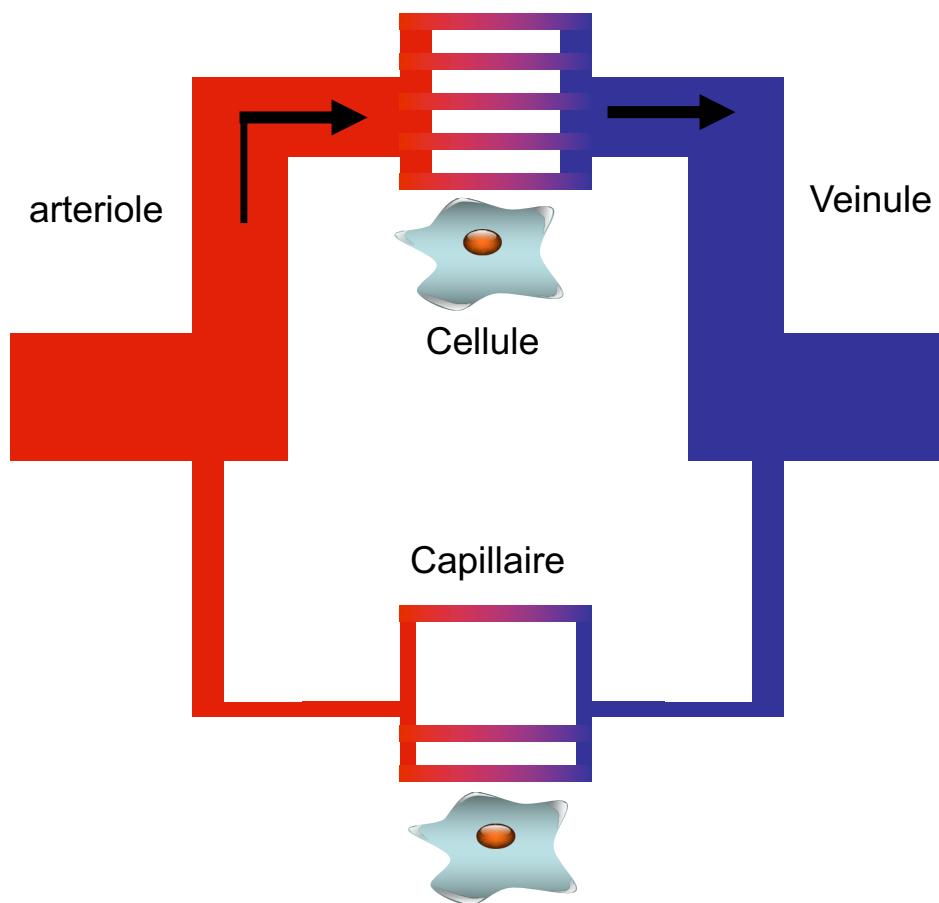
# BH positif est associé à un pronostic péjoratif

Analyse post-hoc de VASST

Choc septique n=778

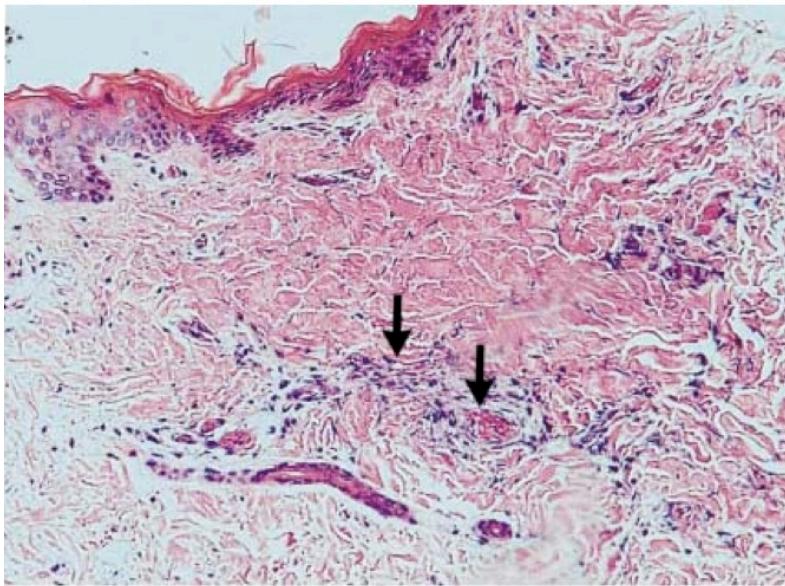


# Altérations du flux microcirculatoire lié au sepsis



1. Altération du tonus vasculaire
2. Activation plaquetttaire
3. Activation de la coagulation

# Etat pro-thrombotique lié au sepsis



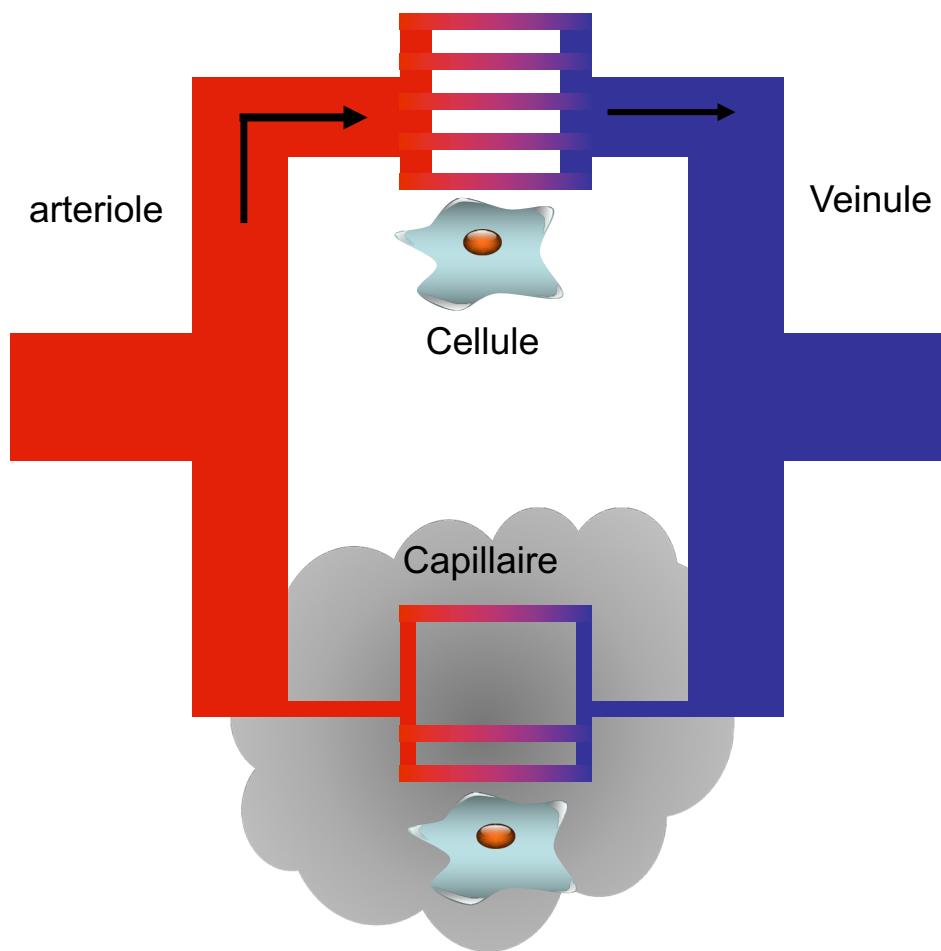
Thromboses microvasculaires

Faust et al., N Engl J Med 2001

*Fulminans purpura à pneumocoque*



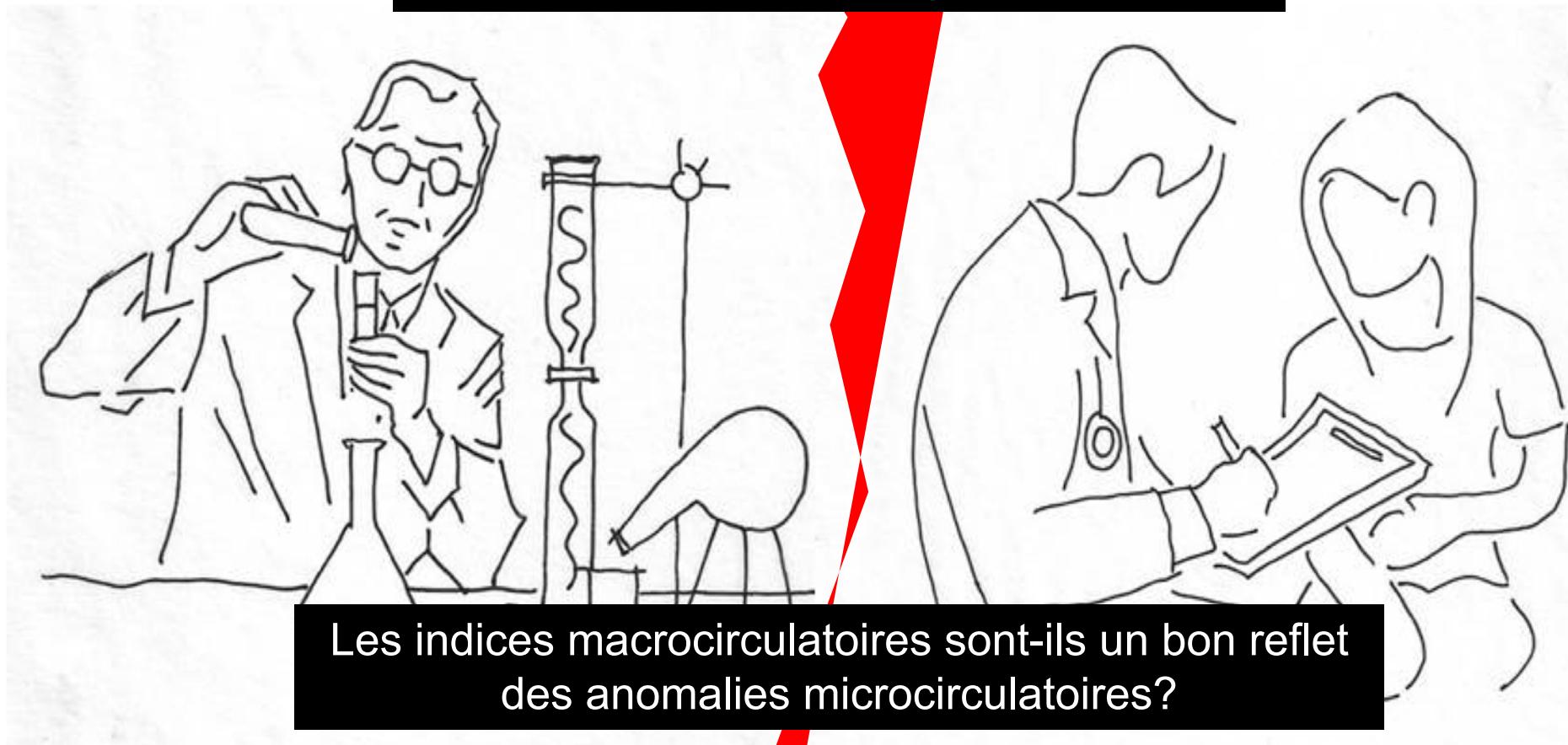
# Altérations du flux microcirculatoire lié au sepsis



1. Altération du tonus vasculaire
2. Activation plaquetttaire
3. Activation de la coagulation
4. Adhésion leucocytaire

# Altérations hétérogènes du flux microcirculatoire au cours du sepsis

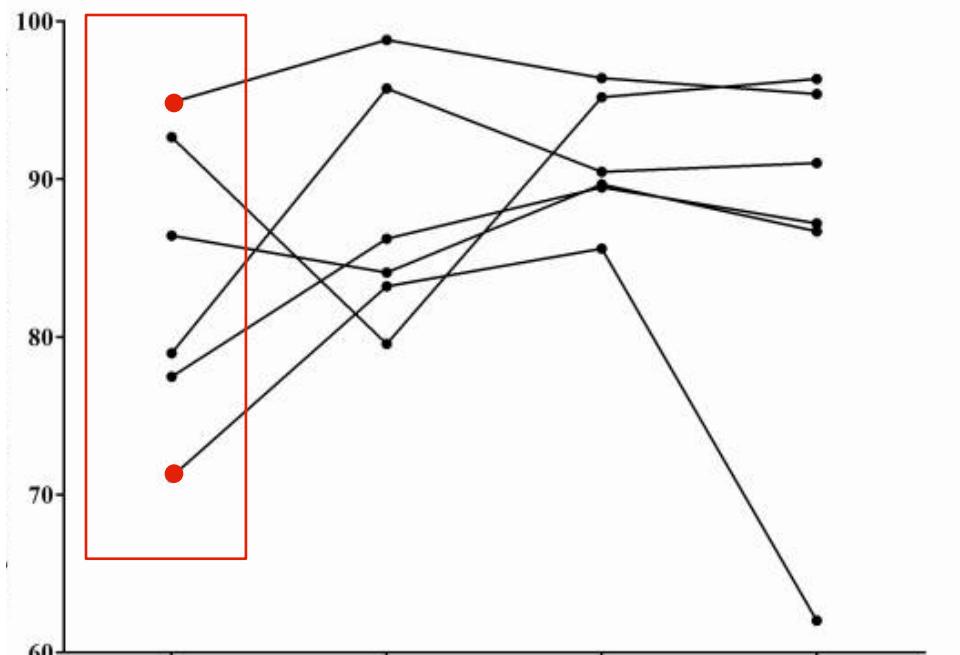
Comment évaluer le flux microcirculatoire au cours du sepsis ?



Les indices macrocirculatoires sont-ils un bon reflet des anomalies microcirculatoires?

# Pas de relation entre le niveau de PAM et le flux microcirculatoire

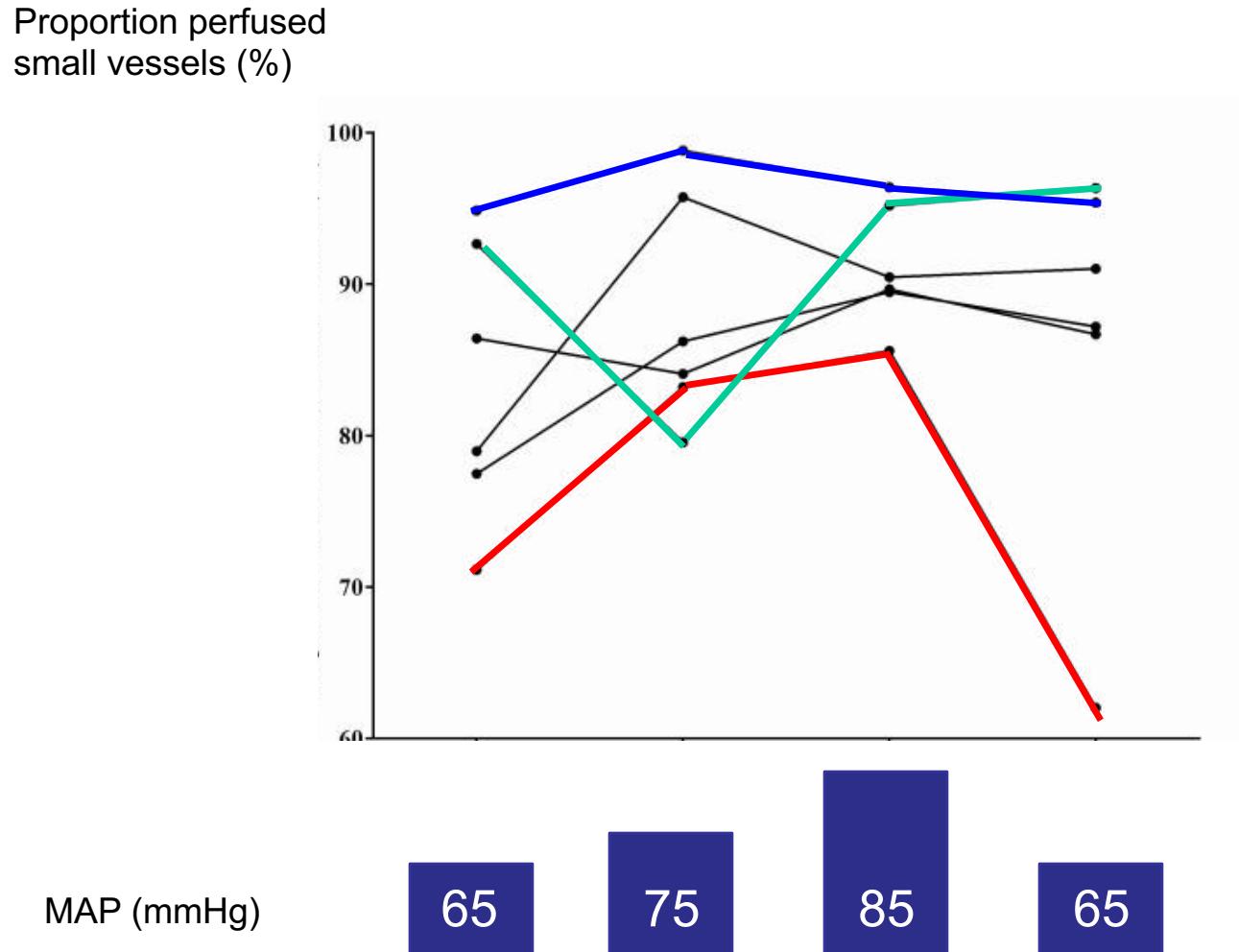
Proportion perfused  
small vessels (%)



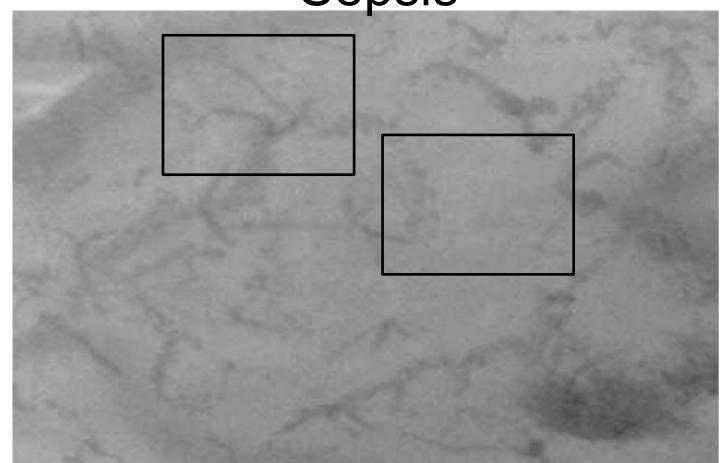
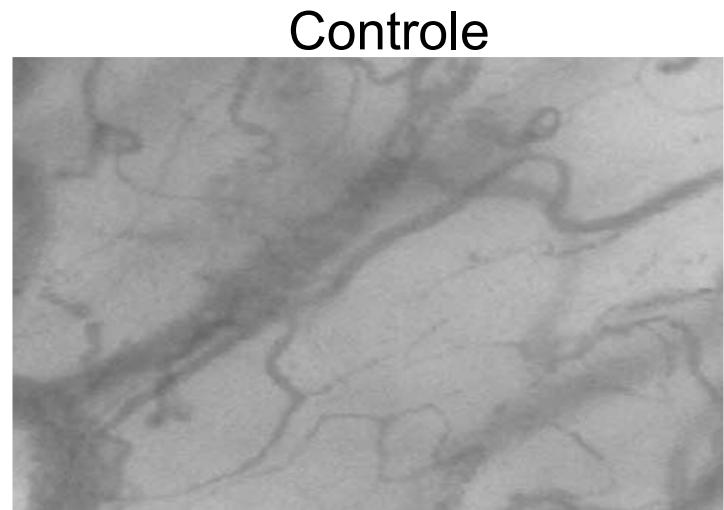
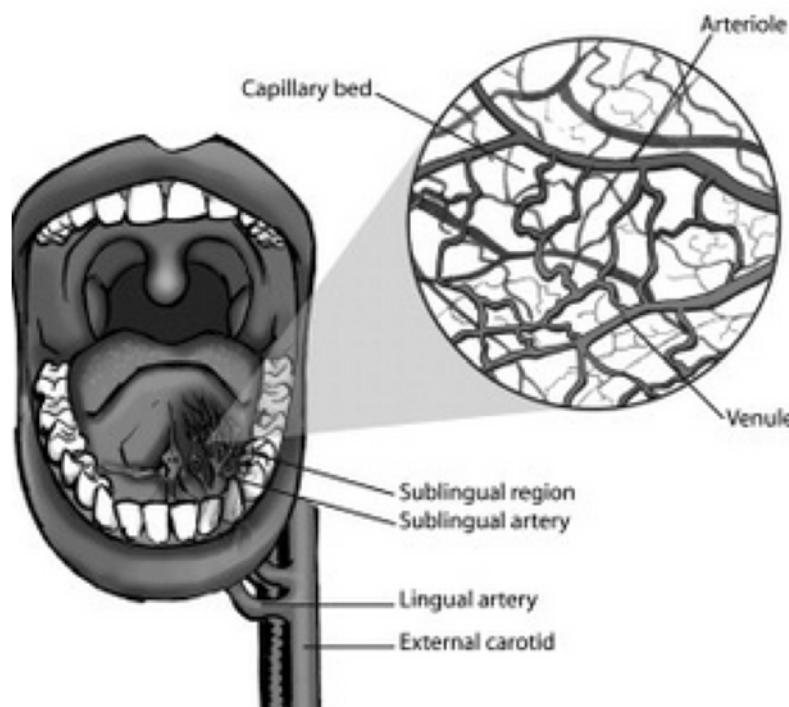
MAP (mmHg)

65

# Pas de relation entre les variations de PAM et les variations de flux microcirculatoire

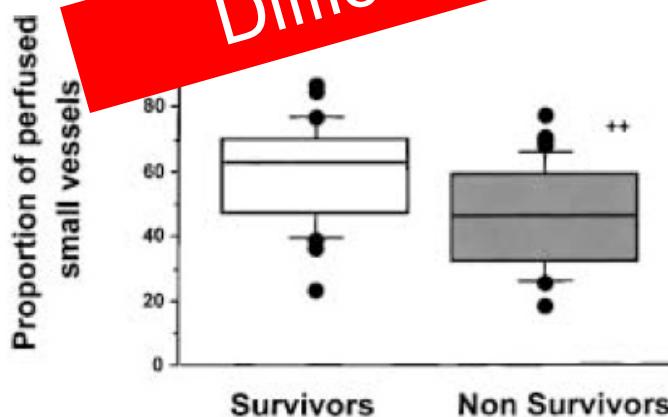


# Capillaroscopie sublinguale (OPS/SDF)

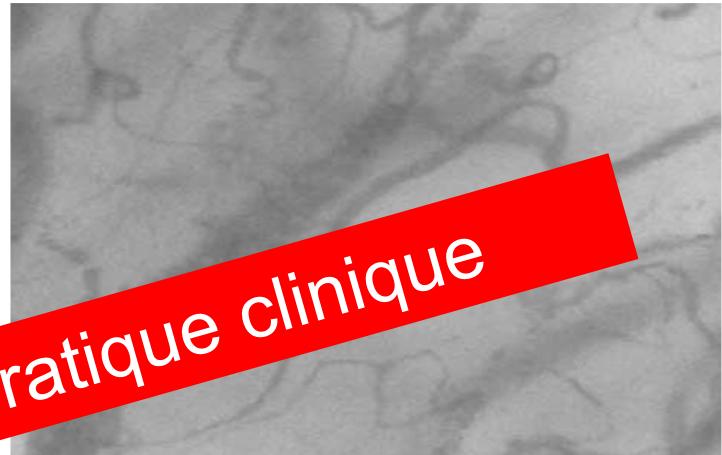


# Capillaroscopie sublinguale (OPS/SDF)

50 sepsis, 41 choc septique  
 $61 \pm 10$  ans  
APACHE II  $21 \pm 4$   
SOFA  $13 \pm 2$   
Mortalité 56%

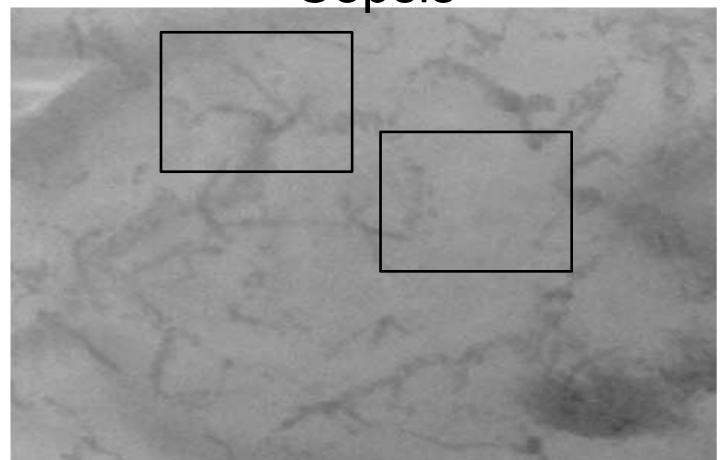


Controle



Difficile à utiliser en pratique clinique

Sepsis



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

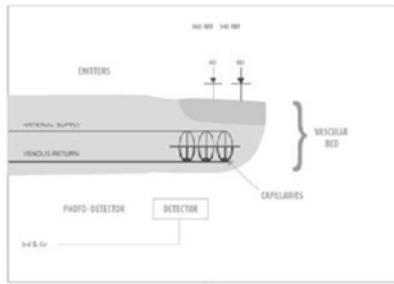
## **Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine**

Shock is typically associated with evidence of inadequate tissue perfusion on physical examination. The three organs readily accessible to clinical assessment of tissue perfusion are the:

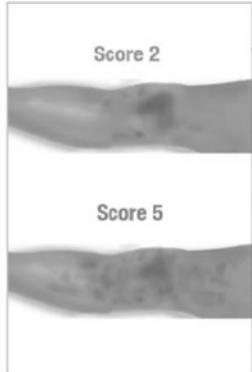
- skin (degree of cutaneous perfusion);
- kidneys (urine output);
- brain (mental status).

# Outils d'évaluation de la perfusion tissulaire

## Peripheral Perfusion Index



## Mottle Score



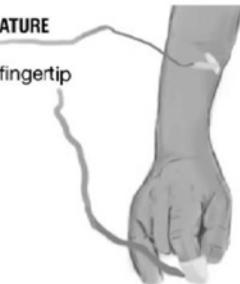
## Body temperature gradient

Delta TEMPERATURE

$T_{\text{forearm}} - T_{\text{fingertip}}$

=

$T_{\text{skindiff}}$



## Capillary refill time

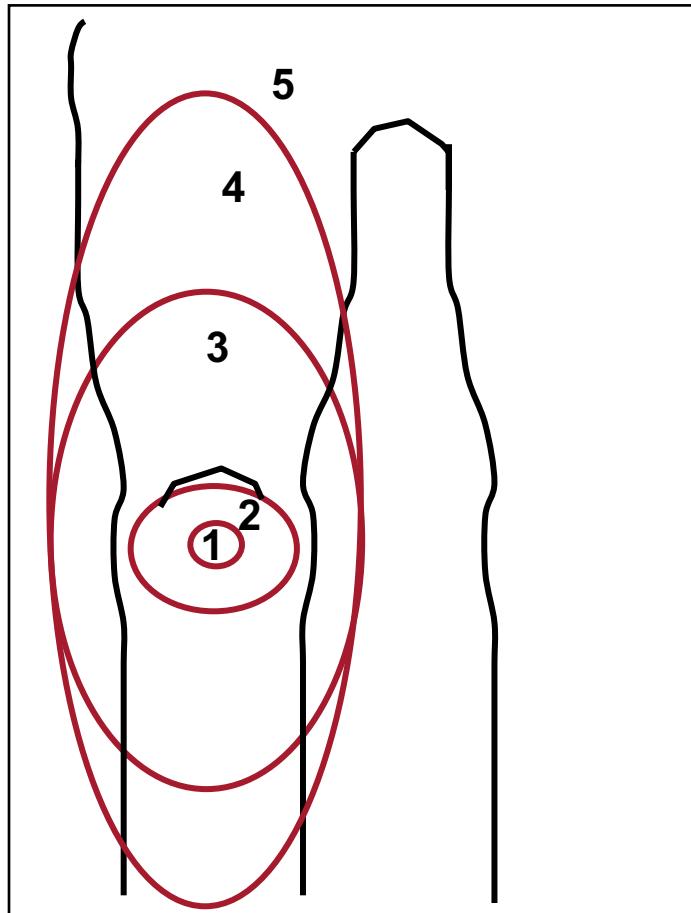
Pressure is applied to nailbed until it turns white

Blood returned to tissue

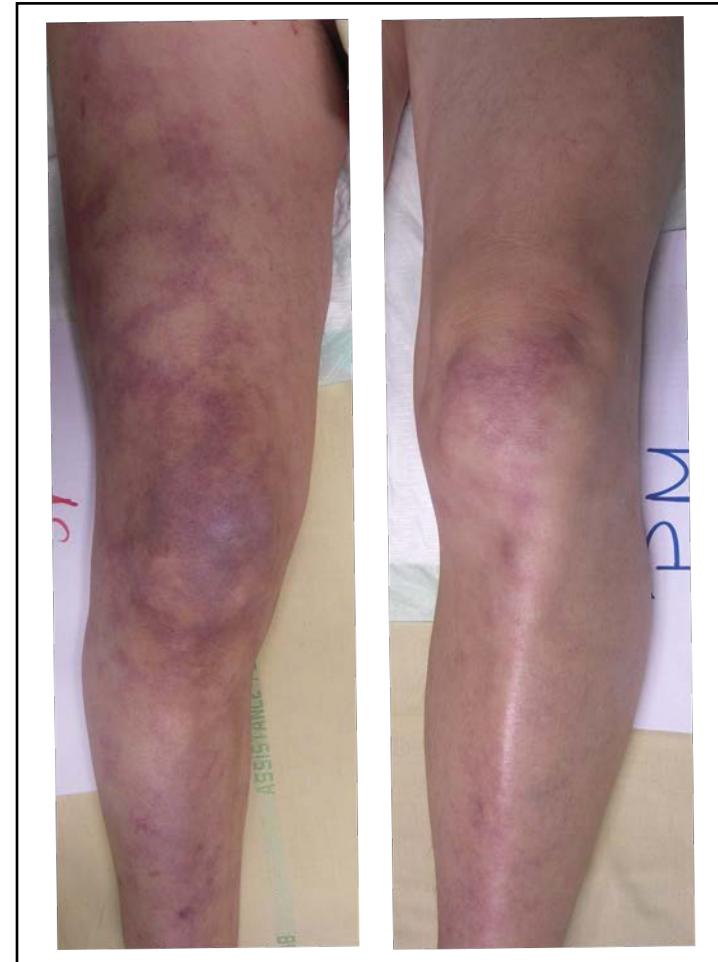


# Marbrures

## Mottling score



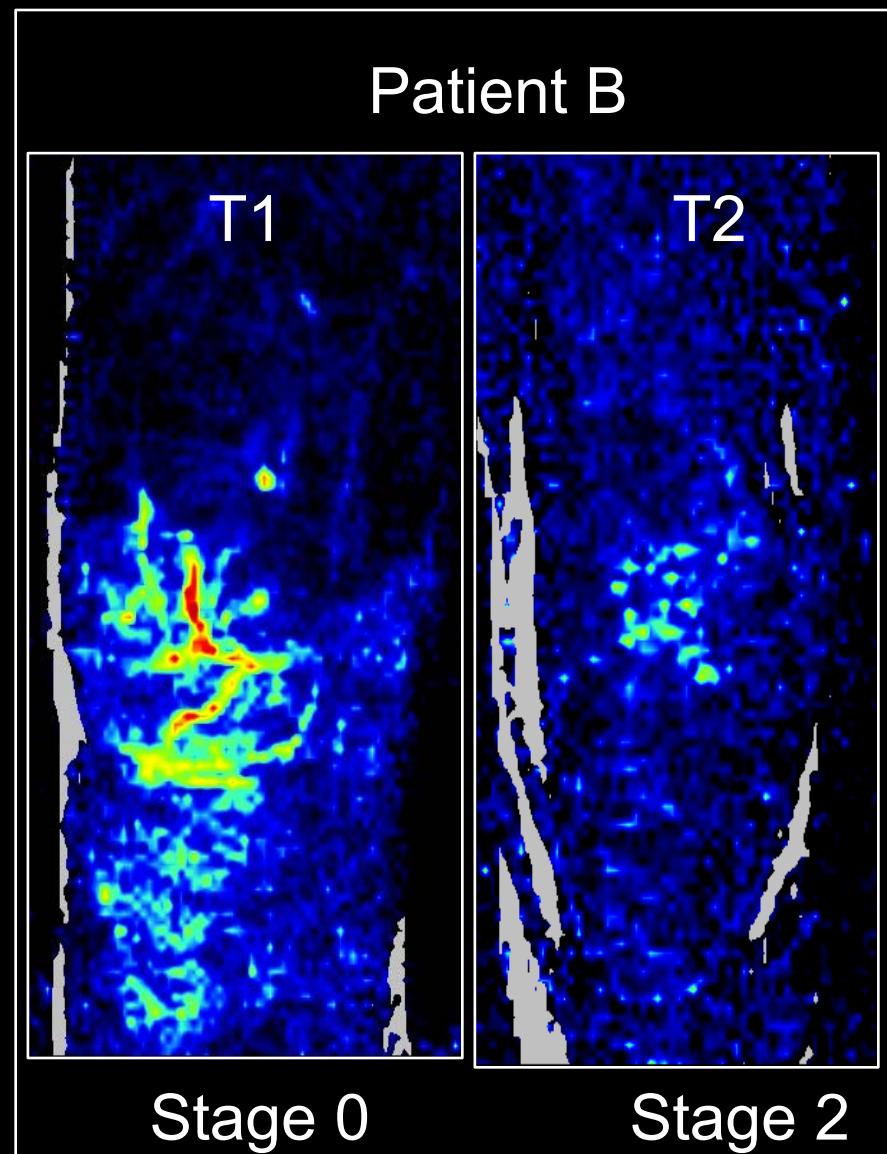
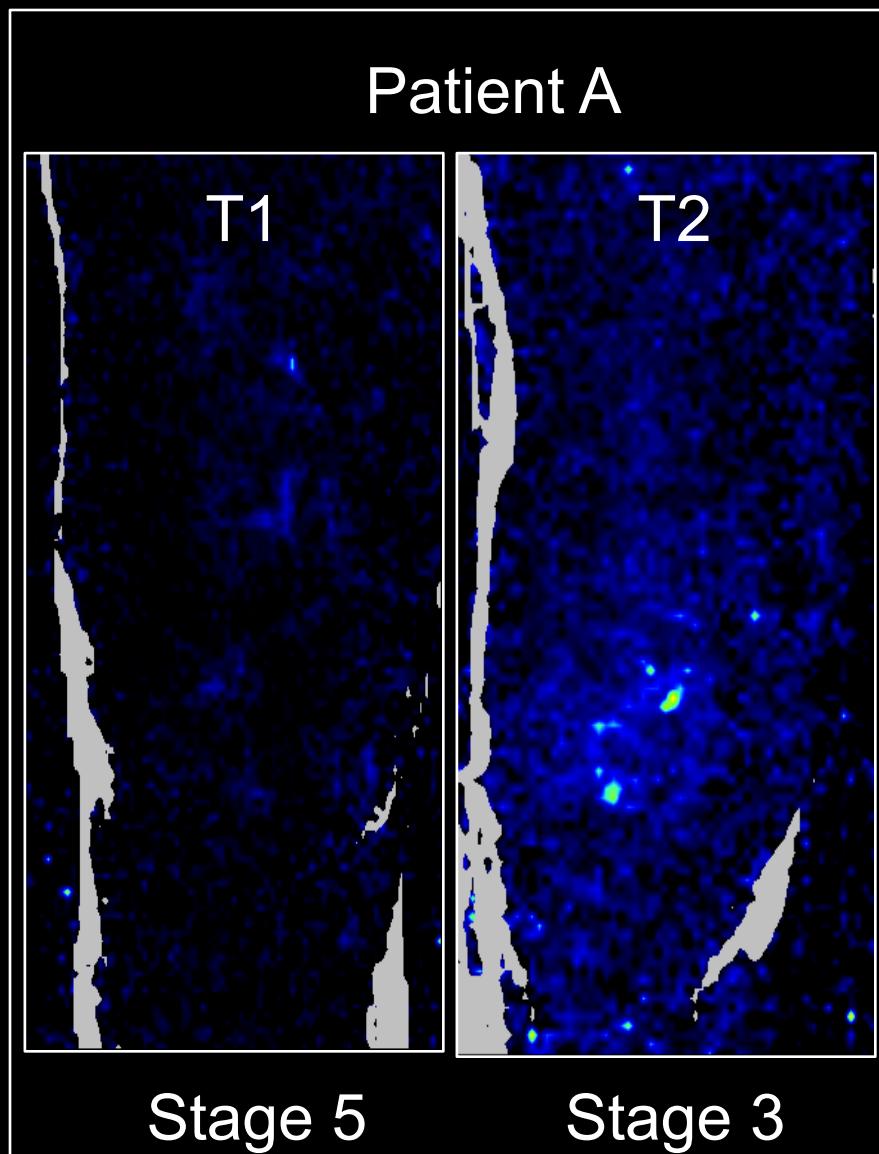
Bonne reproductibilité  
kappa 0.87, 95% CI (0.72-0.97))



STADE 4

STADE 2

# Hypoperfusion dans les zones de marbrures



# Score de marbrures et pronostic

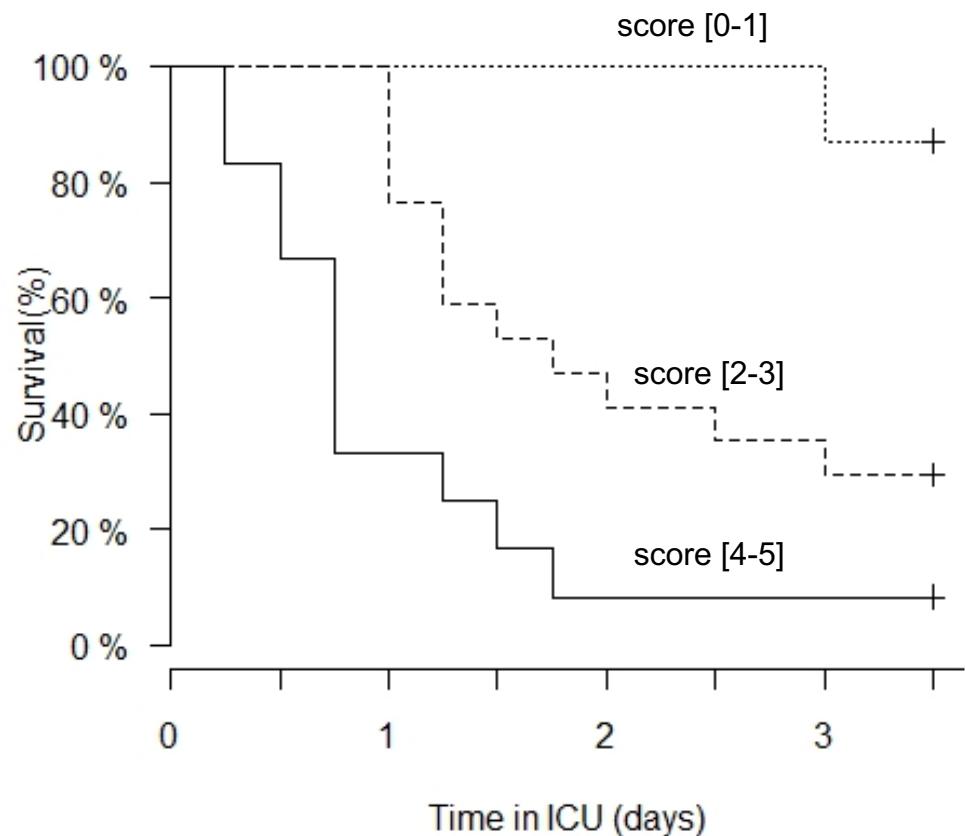
Prospective monocentrique

Choc septique (n=60)

SAPS II 59 (5–71)

SOFA 11.5 (8.5–14.5)

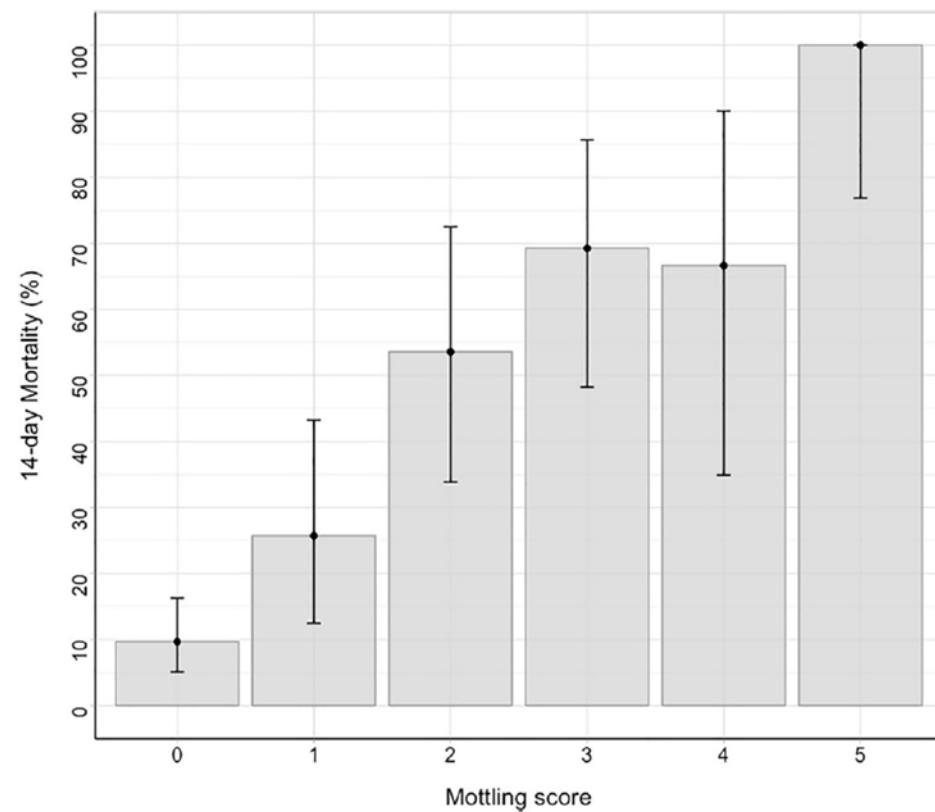
Evaluation à H6



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

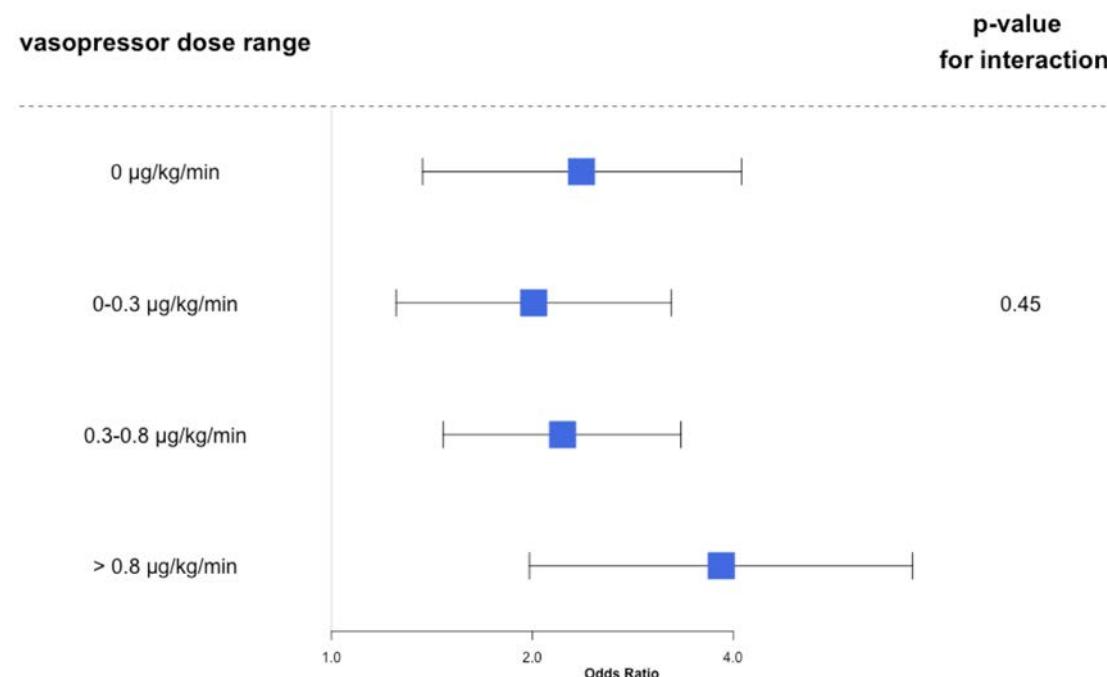
Guillaume Dumas<sup>1,2,3\*</sup>, Jean-Rémi Lavillegrand<sup>1,2</sup>, Jérémie Joffre<sup>1</sup>, Naïke Bigé<sup>1</sup>, Edmilson Bastos de-Moura<sup>4</sup>, Jean-Luc Baudel<sup>1</sup>, Sylvie Chevret<sup>3</sup>, Bertrand Guidet<sup>1,2,5</sup>, Eric Maury<sup>1,2,5</sup>, Fabio Amorim<sup>4</sup>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

Méta-analyse (5 études)  
n= 259  
SAPS II 54 (41–70)  
SOFA 10 (5–14)  
Mortalité at J14: 37%  
Evaluation à H6



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

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Rémi Coudroy  
Angéline Jamet  
Jean-Pierre Frat  
Anne Veinstein  
Delphine Chatellier  
Véronique Goudet  
Severin Cabasson  
Arnaud W. Thille  
René Robert

## **Incidence and impact of skin mottling over the knee and its duration on outcome in critically ill patients**

Monocentrique prospective

Observationnelle

1 an

Tous les patients admis en Réa

Données recueillies par les infirmier(e)s

Marbrures OUI/NON & durée

Rémi Coudroy  
Angéline Jamet  
Jean-Pierre Frat  
Anne Veinstein  
Delphine Chatellier  
Véronique Goudet  
Severin Cabasson  
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René Robert

## Incidence and impact of skin mottling over the knee and its duration on outcome in critically ill patients

Variables	No mottling (n = 561)	Mottling (n = 230)	p value
Age (years), median (IQR)	58 (42–70)	64 (53–74)	<0.0001
Gender, female, n (%)	243 (43)	80 (35)	0.03
History of peripheral arterial occlusive disease, n (%)	34 (6.1)	16 (7.0)	0.63
Diagnosis on admission			<0.0001
Cardiac arrest, n (%)	20 (3.6)	25 (11)	<0.0001
Shock, n (%)	79 (14)	62 (27)	<0.0001
Acute respiratory failure, n (%)	211 (37)	72 (31)	0.10
Coma, n (%)	135 (24)	36 (16)	0.01
Other, n (%)	116 (21)	35 (15)	0.09
At admission			
Sequential organ failure assessment score, median (IQR)	4 (1–7)	7 (4–11)	<0.0001
Simplified acute physiology score II, median (IQR)	32 (21–45)	46 (34–59)	<0.0001
During ICU stay			
Mechanical ventilation, n (%)	207 (37)	165 (72)	<0.0001
Duration of mechanical ventilation, days, median (IQR)	4 (2–9)	7 (3–14)	<0.0001
Vasopressors, n (%)	115 (21)	125 (54)	<0.0001
Renal replacement therapy, n (%)	46 (8.2)	61 (27)	<0.0001
Outcomes			
ICU length of stay, days, median (IQR)	4 (3–7)	7 (4–14)	<0.0001
In-ICU mortality, n (%)	46 (8)	70 (30)	<0.0001

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



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

5 études prospectives  
259 patients, choc septique  
Mortalité J14 : 37%

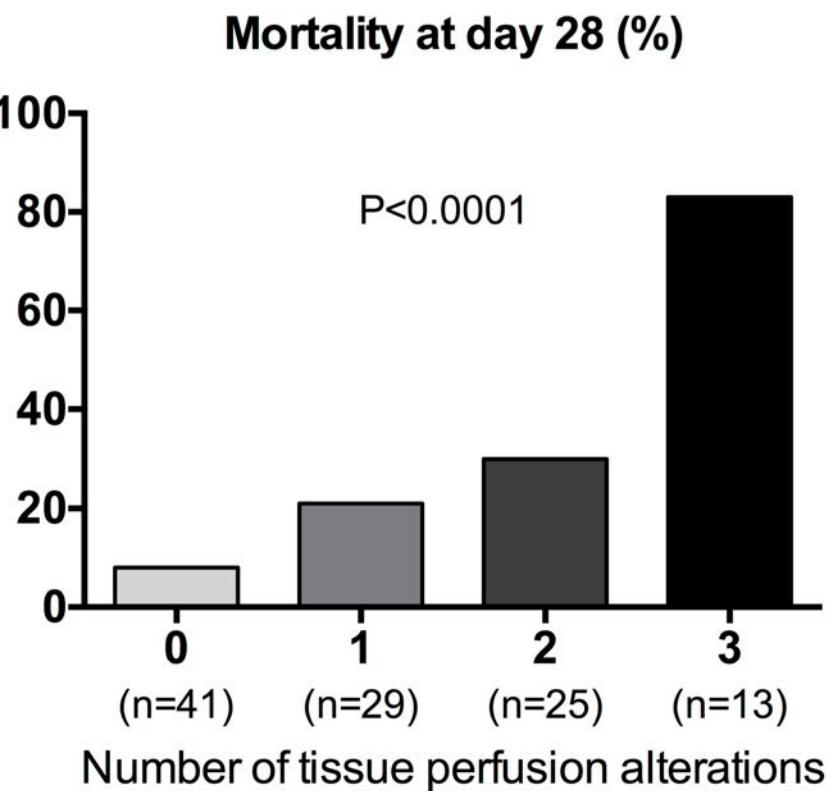
## Analyse multivariée

	OR [95% CI]*	P value
<b>Mottling score at H6, by point</b>	<b>2.07 [1.51-2.84]</b>	<b>&lt;0.0001</b>
<b>Arterial lactate at H6, by 1 mmol/l</b>	<b>1.42 [1.17-1.73]</b>	<b>0.0005</b>
<b>Urine output at H6 (ml/kg/h)</b>	<b>2.68 [1.04-6.91]</b>	<b>0.04</b>

## Tissue perfusion alterations correlate with mortality in patients admitted to the intensive care unit for acute pulmonary embolism

Etude Rétrospective  
22 ans  
317 EP  
Mortalité at J28: 25%

3 paramètres :  
-Marbrures OUI/NON  
-Lactate >2mmol/l  
-Oligurie <0.5mL/kg/h



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



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# Hyperlactatémie $\neq$ hypoperfusion tissulaire

1/ Défaut d'élimination

Liée au sepsis

Maladie hépatique

2/ Effet de Wash Out

3/ Modification métabolique

4/ Activation adrénergique

5/ Médicaments (Metformine..)

6/ Autres

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



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5 études prospectives  
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# Association Between Urine Output and Mortality in Critically Ill Patients: A Machine Learning Approach

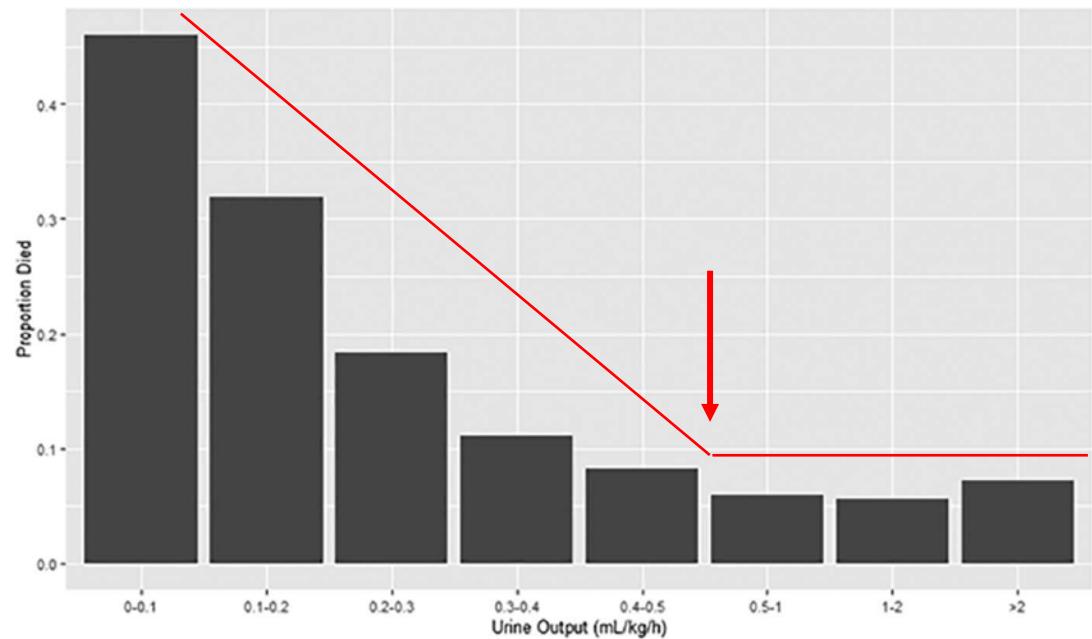
Etude Rétrospective  
Australie-N Zelande  
10 ans  
183 centres  
161 940 patients

Patients admis en USI/Réa

Exclusion: dialysé chronique

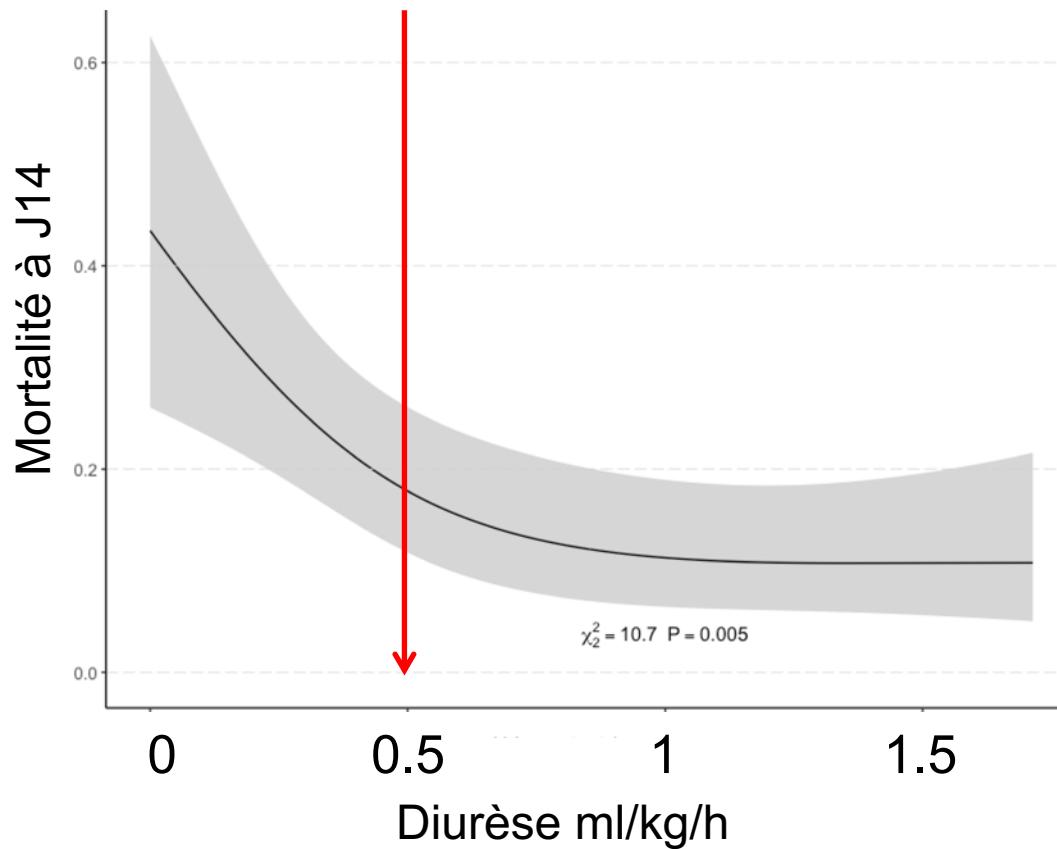
Mortalité 8%

Mortalité ajustée en fonction de la diurèse



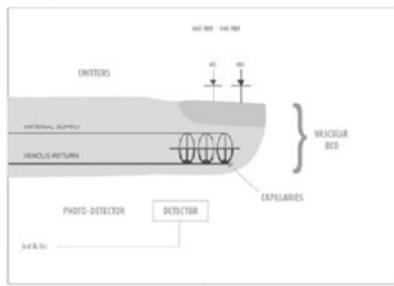
# Diurèse au cours de la prise en charge

5 études prospectives  
259 patients en choc septique  
Mortalité J14 : 37%

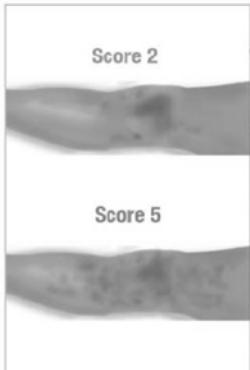


# Outils d'évaluation de la perfusion tissulaire

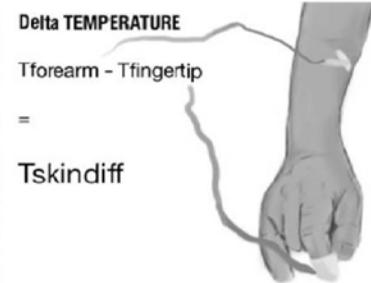
Peripheral Perfusion Index



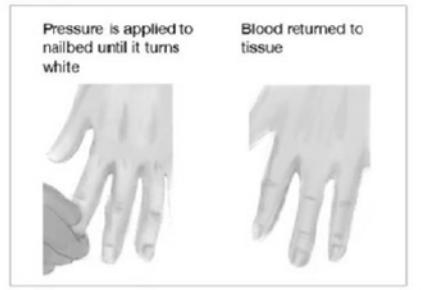
Mottle Score



Body temperature gradient



Capillary refill time



# The Power of Flash Mob Research



Conducting a Nationwide Observational Clinical Study on Capillary Refill Time in a Single Day

Etude un jour donné (Pays-Bas)  
458 participants (internes, étudiants, infirmières)  
38 centres  
TRC sur sternum ou index (5s ou 15s)

TABLE 3 ] Agreement Between Two Investigators Assessed by Using the Intraclass Correlation Coefficient

Variable	Intraclass Correlation Coefficient	95% CI (Lower and Upper Bound)	Interpretation
CRT <sub>p5</sub>	0.52	0.49-0.56	Moderate correlation
CRT <sub>p15</sub>	0.54	0.50-0.57	Moderate correlation
CRT <sub>s5</sub>	0.43	0.39-0.47	Low correlation
CRT <sub>s15</sub>	0.46	0.42-0.49	Low correlation

# TRC reproductibilité inter-observateur

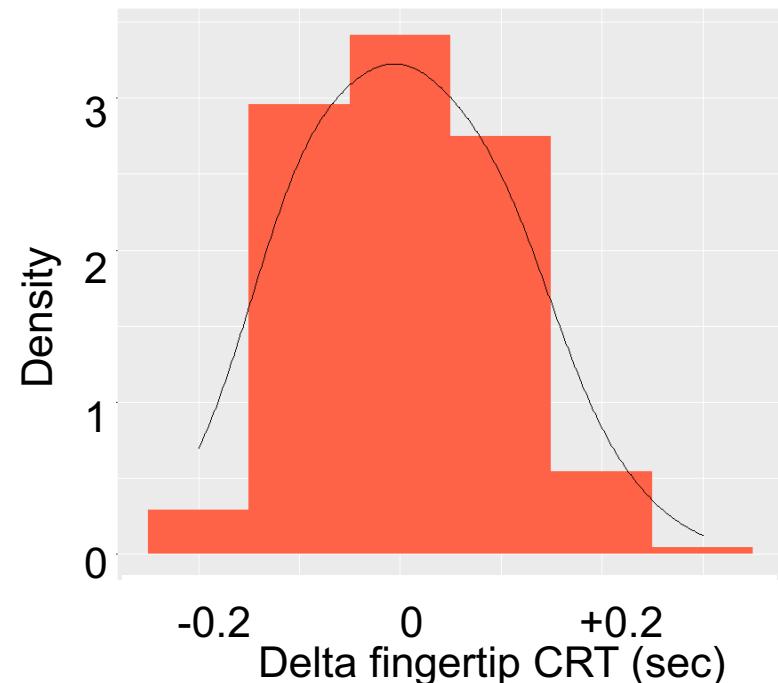
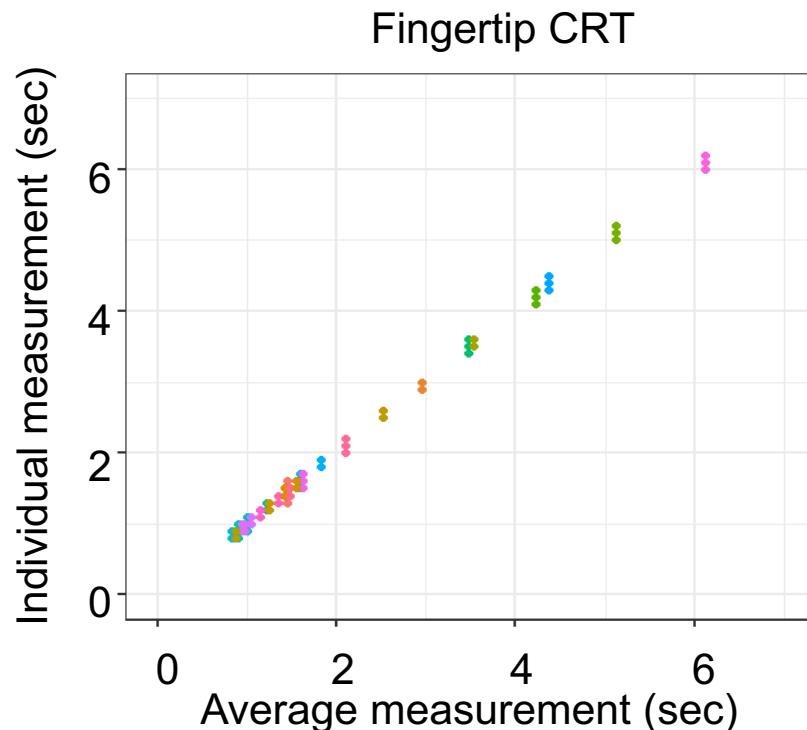


Concordance inter-observateur

- Index : 80% [73-86]
- Genou : 95% [93-98]

# TRC reproductibilité intra-observateur

2 médecins entraînés  
40 patients en réanimation  
3 mesures du TRC index

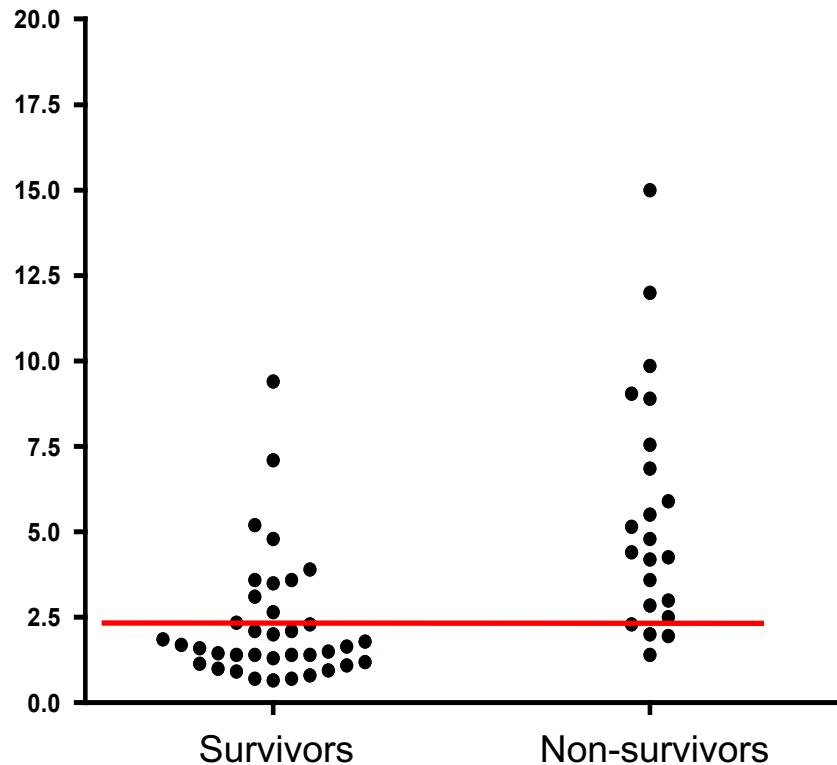


# TRC & sepsis: en réanimation

Patients (n)	59
Age, years, [mean (SD)]	69 (14)
Gender, female [n, (%)]	21 (35)
Primary site of infection [n, (%)]	
Lung	27 (46)
Abdomen	16 (27)
Urinary tract	4 (7)
Soft tissue	5 (8)
Primary bacteremia	7 (12)
SOFA at H6	10 [7-14]
SAPS II	61 [50-78]
Mechanical ventilation [n, (%)]	38 (65)
Norepinephrine n (%)	54 (91)
doses µg/kg/min [median, 25-75th percentile]	0.30 [0.1-0.6]
Epinephrine n (%)	5 (9)
doses µg/kg/min [median, 25-75th percentile]	0.2 [0.06-0.2]

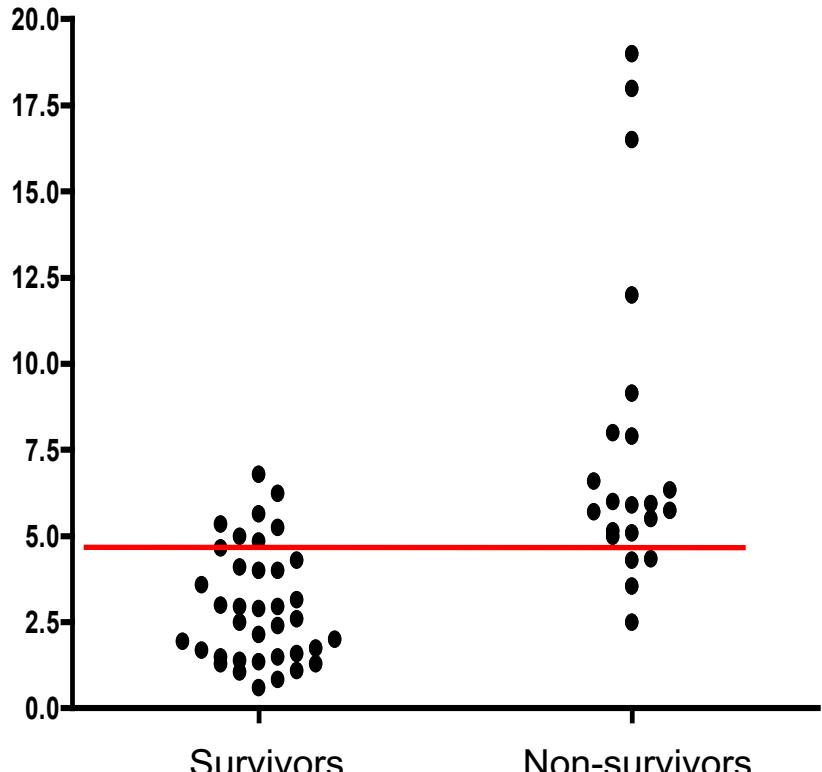
# TRC & sepsis: en réanimation

H6 Index CRT (s)



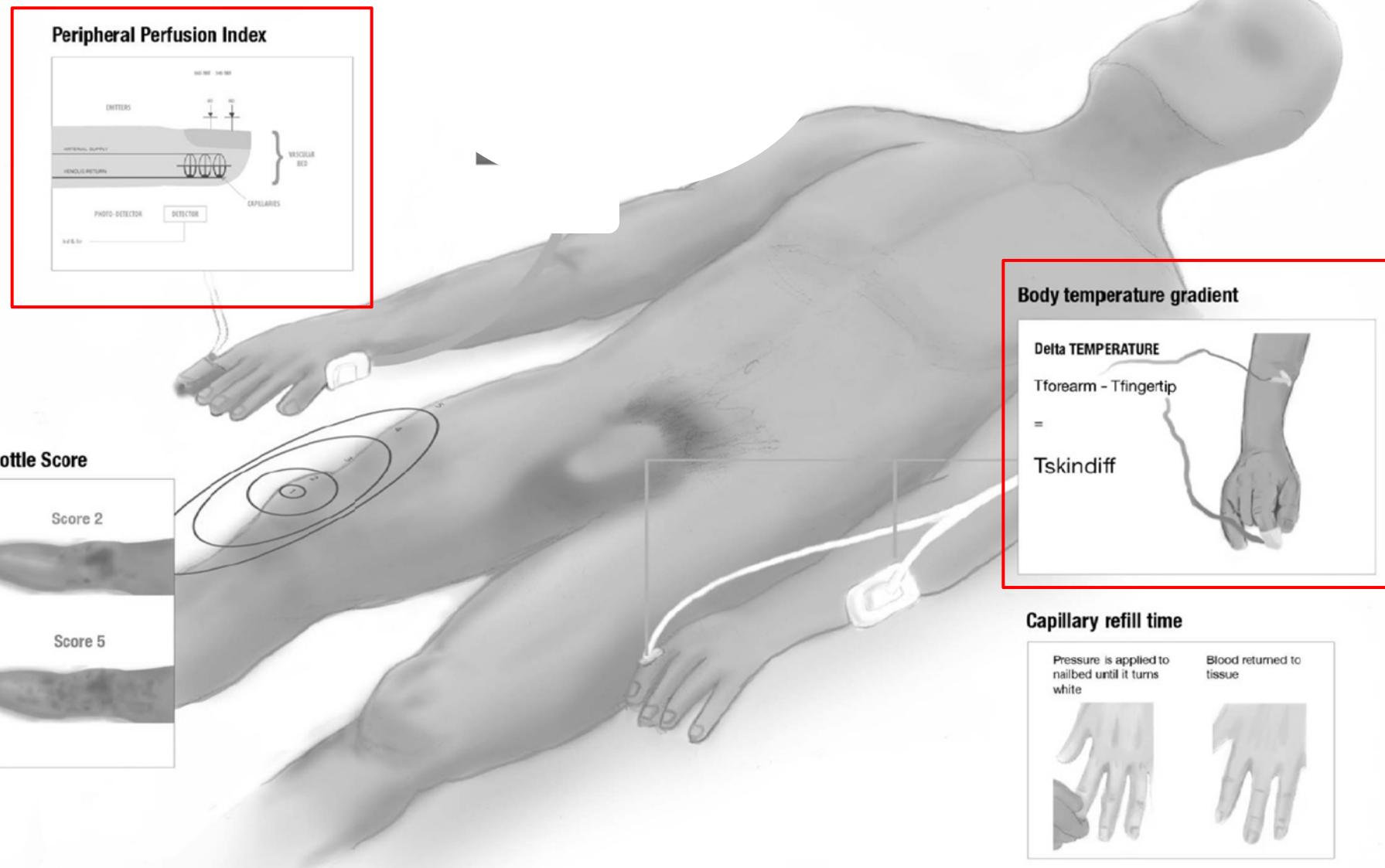
Sensitivity 82% (CI95% [60, 95])  
Specificity 73% (CI95% [56, 86])

H6 Knee CRT (s)



Sensitivity 82% (CI95% [60, 95])  
Specificity 84% (CI95% [68, 94])

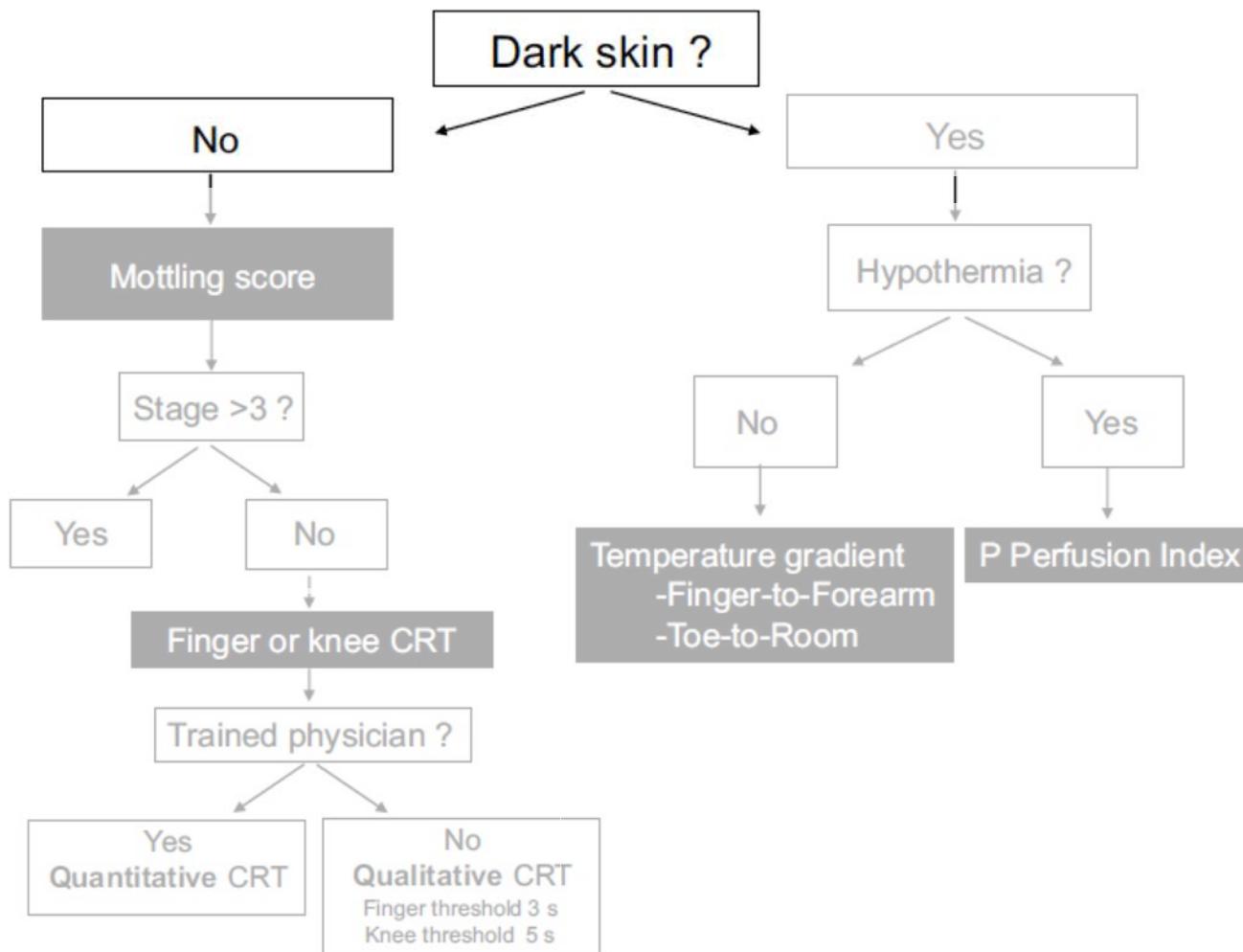
# Outils d'évaluation de la perfusion tissulaire



# Narrative review: clinical assessment of peripheral tissue perfusion in septic shock

Triage

Geoffroy Hariri<sup>1,2</sup>, Jérémie Joffre<sup>1,2</sup>, Guillaume Leblanc<sup>3,4</sup>, Michael Bonsey<sup>1</sup>, Jean-Remi Lavillegrand<sup>1,2</sup>, Tomas Urbina<sup>1</sup>, Bertrand Guidet<sup>1,2,5</sup>, Eric Maury<sup>1,2,5</sup>, Jan Bakker<sup>6,7,8,9</sup> and Hafid Ait-Oufella<sup>1,2,10\*</sup>



Gustavo A. Ospina-Tascón  
Mauricio Umaña  
William F. Bermúdez  
Diego F. Bautista-Rincón  
Juan D. Valencia  
Humberto J. Madriñán  
Glenn Hernandez  
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César Arango-Dávila  
Daniel De Backer

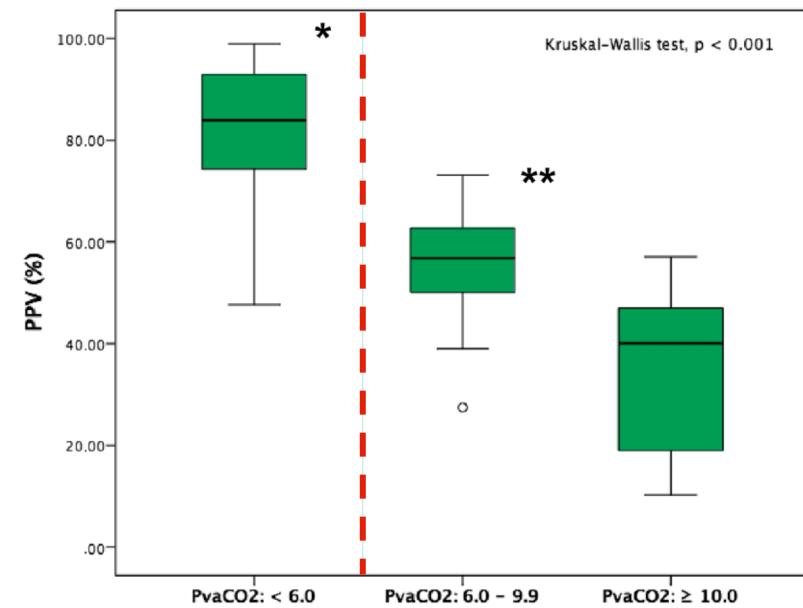
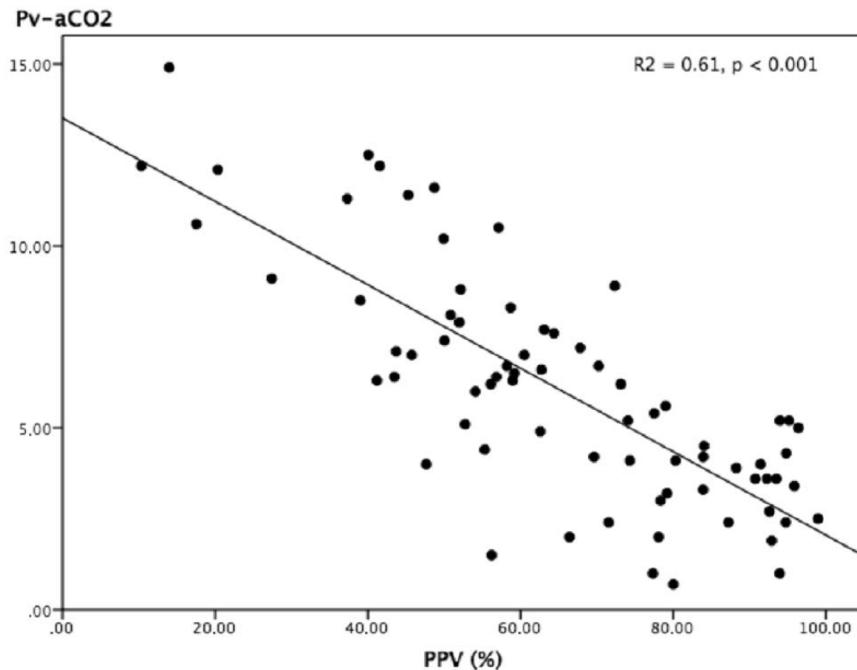
# Can venous-to-arterial carbon dioxide differences reflect microcirculatory alterations in patients with septic shock?

n= 75 choc septique

SOFA 11 (8–15)

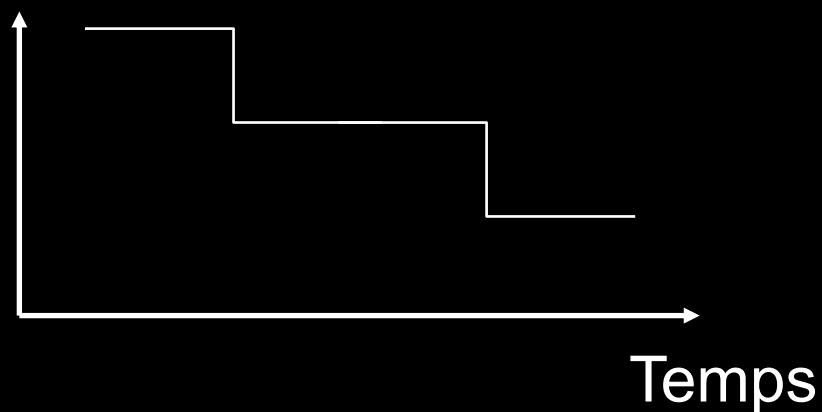
Vidéomicroscopie sublingual T0 et T6

Gradient artério-veineux en CO<sub>2</sub>



# Deuxième question

Cinétique des paramètres  
d'hypoperfusion tissulaire ?



# Evolution du score de marbrures

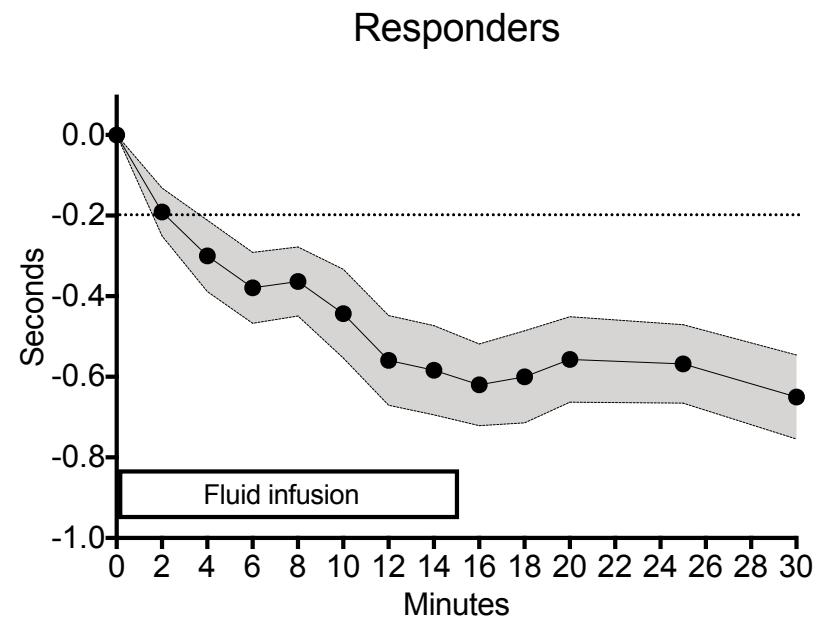
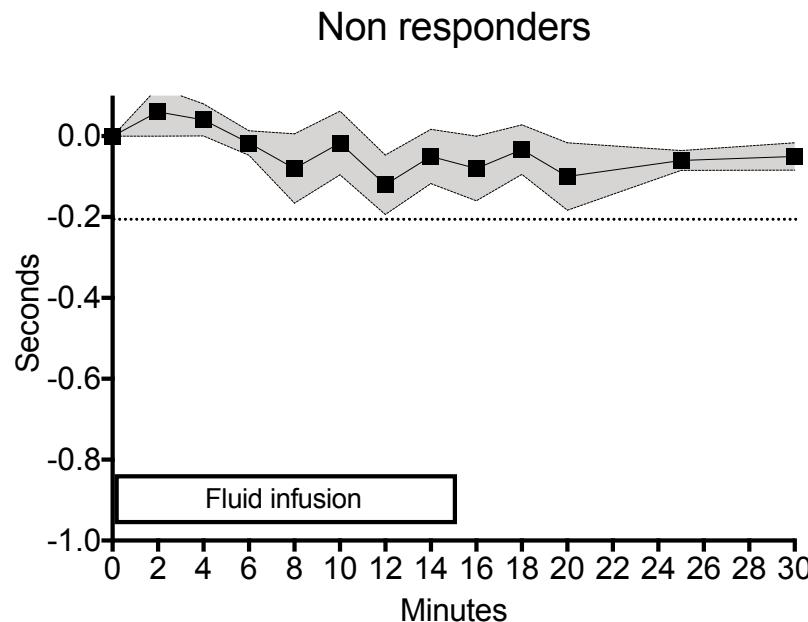
Au cours de la prise en charge  
Entre H0 et H6

	Survivants (n=13)	Non-survivant (n=25)
Diminution du score (n=13)	10	3*
Pas de diminution du score (n=25)	3	22*

\*P=0.0005

# Evolution du TRC au cours du remplissage ?

Médecins entraînés  
31 patients sepsis/choc septique  
500 cc S Salé en 15 minutes  
Mesures répétées du TRC



Gustavo A. Ospina-Tascón  
Mauricio Umaña  
William F. Bermúdez  
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# Can venous-to-arterial carbon dioxide differences reflect microcirculatory alterations in patients with septic shock?

n= 75 choc septique

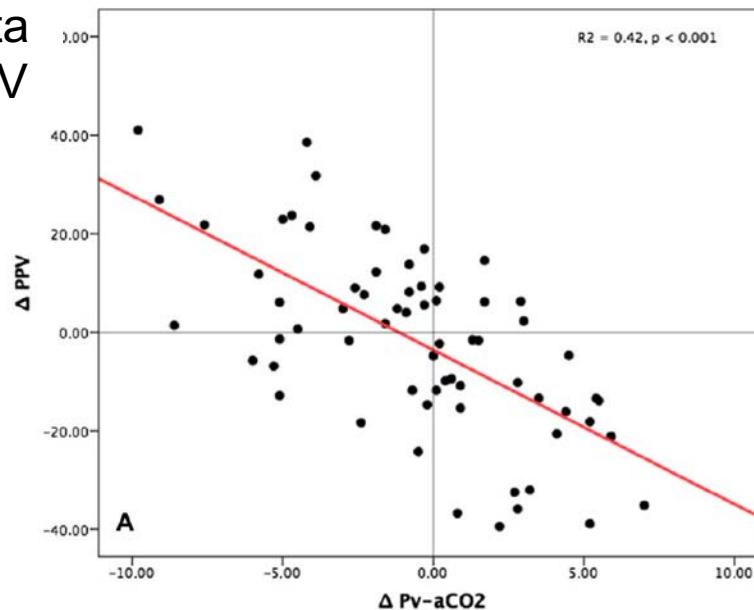
SOFA 11 (8–15)

Vidéomicroscopie sublingual T0 et T6

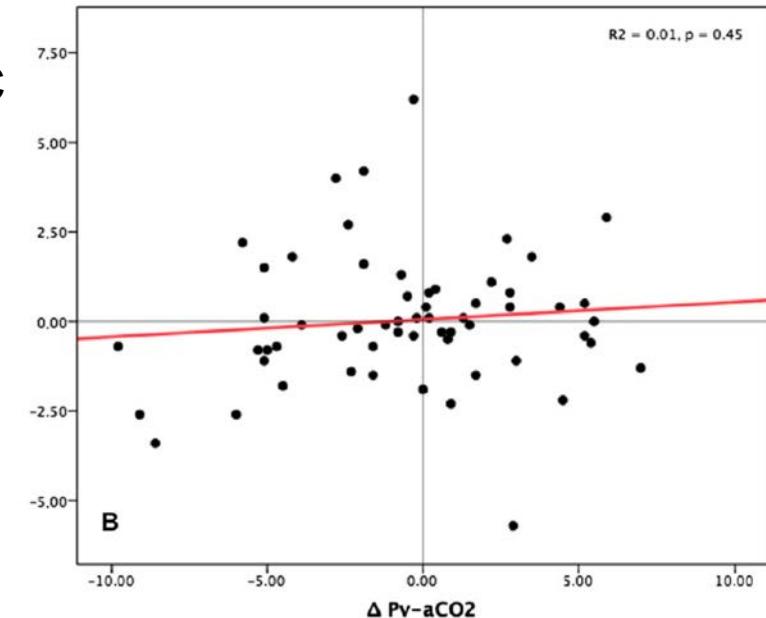
Gradient artério-veineux en CO<sub>2</sub>

*Variations de gradient entre H0 et H6*

Delta  
PPV

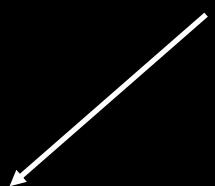


Delta  
Débit C

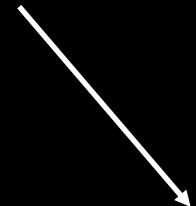


# Evaluer la perfusion tissulaire

Utile pour la prise en charge  
thérapeutique ?



Pour faire ?

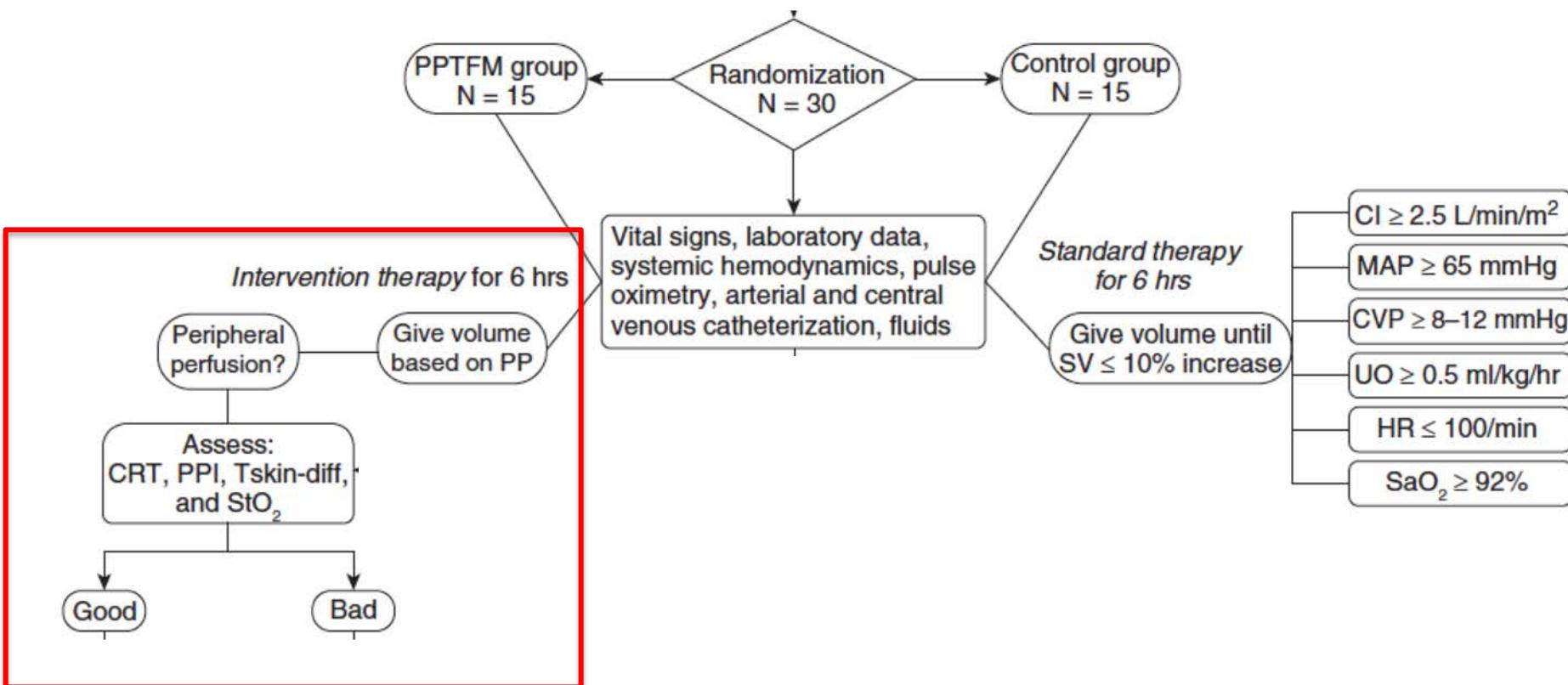


Pour ne pas faire ?



# Prise en charge basée sur l'évaluation de la perfusion tissulaire

Choc septique (N=30)



# Prise en charge basée sur l'évaluation de la perfusion tissulaire

Variables and Groups	Study Period	
	0–6 h	7–72 h
Cumulative fluids, ml		
Control	6,069 (1,715)	10,028 (941)
PPTFM	4,227 (1,081)	7,565 (982)
Urine output, ml		
Control	1.2ml/kg/h	520 (160)
PPTFM	0.8ml/kg/h	332 (84)
SOFA <sub>total</sub>		
Control	12.8 (10.0–16.8)	11.0 (5.3–15.3)
PPTFM	11.5* (8.0–13.0)	8.3 (5.5–13.1)

# 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

Multicentrique (n=) internationale (n=5)

Comparaison de 2 stratégies de réanimation pendant 8 heures

-Soit sur la mesure du TRC toutes 30 minutes

- Objectif < 3 secondes

-Soit sur la clairance du lactate toutes les 2 heures

- Objectif baisse > 20%

# Principaux résultats

424 patients inclus en 1 an

Age 63 (17) ans, SOFA 9,6 (3,5)

Sepsis abdominal (34%) pulmonaire (30%)

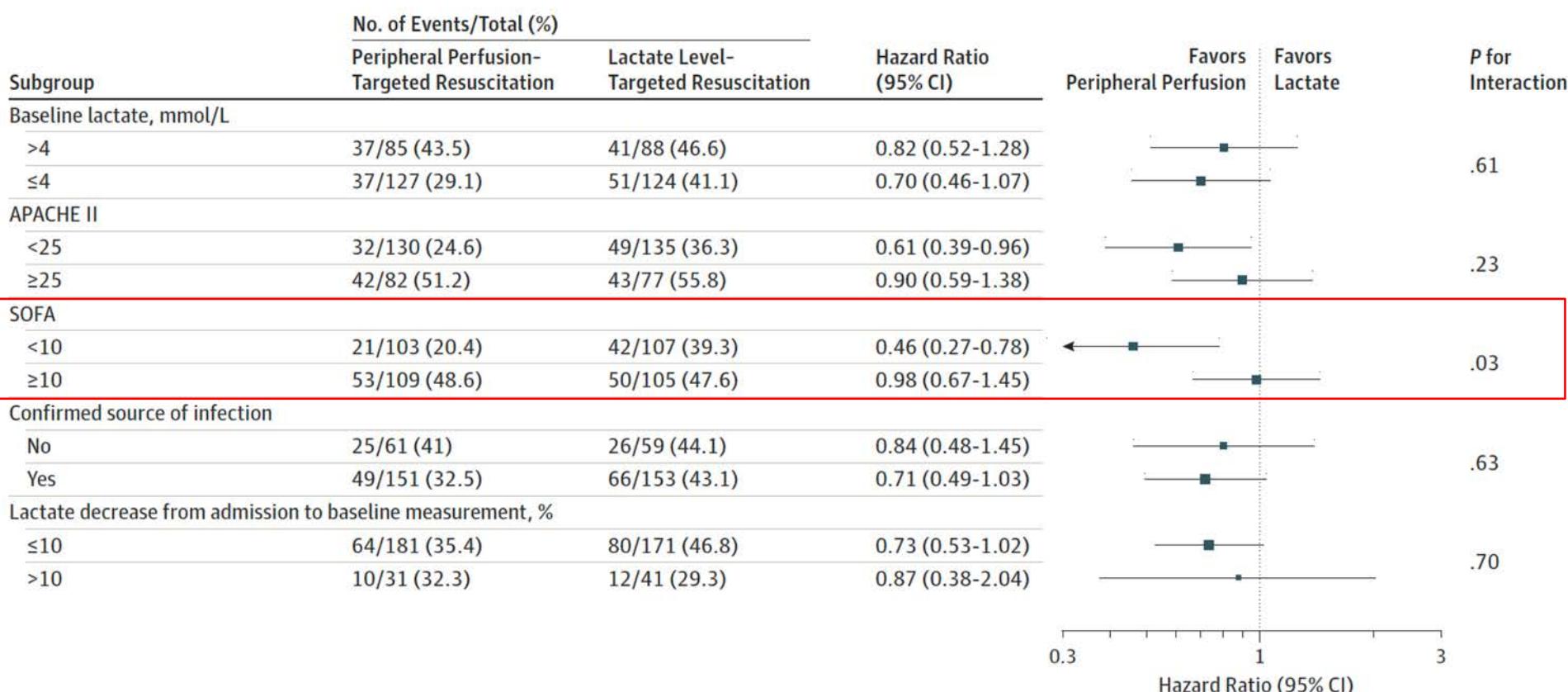
Outcome	Peripheral Perfusion-Targeted Resuscitation (n = 212)	Lactate Level-Targeted Resuscitation (n = 212)	Unadjusted Absolute Difference (95% CI)	Adjusted Relative Measure (95% CI)	P Value
<strong>Primary Outcome</strong>					
Death within 28 d, No. (%)	74 (34.9)	92 (43.4)	-8.5 (-18.2 to 1.2) <sup>b</sup>	HR, 0.75 (0.55 to 1.02) <sup>a</sup>	.06 <sup>a</sup>
<strong>Secondary Outcomes</strong>					
Death within 90 d, No. (%)	87 (41.0)	99 (46.7)	-5.7 (-15.6 to 4.2) <sup>b</sup>	HR, 0.82 (0.61 to 1.09) <sup>a</sup>	.17 <sup>a</sup>
Mechanical ventilation-free days within 28 d, mean (SD) <sup>c</sup>	14.6 (12.1)	12.7 (12.2)	1.9 (-0.6 to 4.3)		.14
Renal replacement therapy-free days within 28 d, mean (SD) <sup>c</sup>	18.5 (12.1)	16.9 (12.1)	1.7 (-1.5 to 4.8)		.31
Vasopressor-free days within 28 d, mean (SD) <sup>c</sup>	16.7 (12.0)	15.1 (12.3)	1.6 (-0.7 to 3.9)		.18
SOFA at 72 h, No. <sup>d</sup>	165	166			.045
Mean (SD)	5.6 (4.3)	6.6 (4.7)	-1.00 (-1.97 to -0.02)		

# Principaux résultats

424 patients inclus en 1 an

Age 63 (17) ans, SOFA 9,6 (3,5)

Sepsis abdominal (34%) pulmonaire (30%)

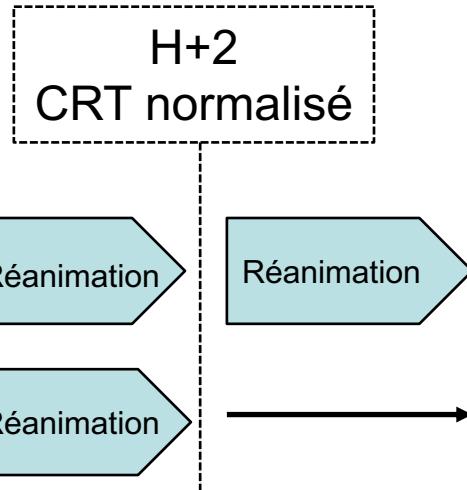




# A lactate-targeted resuscitation strategy may be associated with higher mortality in patients with septic shock and normal capillary refill time: a post hoc analysis of the ANDROMEDA-SHOCK study

Eduardo Kattan<sup>1</sup>, Glenn Hernández<sup>1</sup>, Gustavo Ospina-Tascón<sup>2</sup>, Emilio Daniel Valenzuela<sup>1</sup>, Jan Bakker<sup>1,3,4,5</sup>, Ricardo Castro<sup>1</sup> and The ANDROMEDA-SHOCK Study Investigators and the Latin America Intensive Care Network (LIVEN)

2022





# A lactate-targeted resuscitation strategy may be associated with higher mortality in patients with septic shock and normal capillary refill time: a post hoc analysis of the ANDROMEDA-SHOCK study

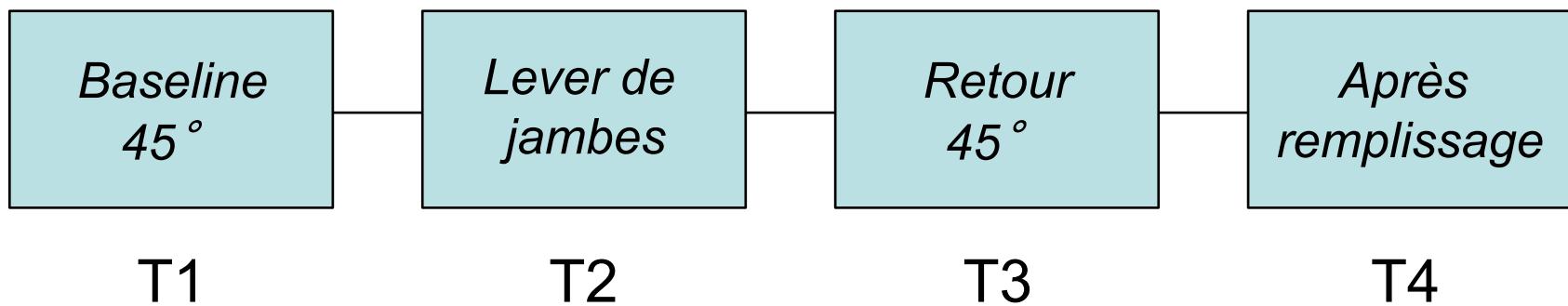
Eduardo Kattan<sup>1</sup>, Glenn Hernández<sup>1</sup>, Gustavo Ospina-Tascón<sup>2</sup>, Emilio Daniel Valenzuela<sup>1</sup>, Jan Bakker<sup>1,3,4,5</sup>, Ricardo Castro<sup>1</sup> and The ANDROMEDA-SHOCK Study Investigators and the Latin America Intensive Care Network (LIVEN)

Original study arm	CRT Normal at 2 h ( <i>n</i> = 184)		<i>P</i>
	CRT	Lactate	
Fluid bolus 0–8 h (ml)	500 [0–1500]	1000 [500–2000]	0.004
Fluid balance 8 h (ml) →	1090 [319–2000]	1360 [559–2401]	0.038
X2 → Vasopressor test	19 (19)	35 (43)	0.001
X5 → Inodilator test	3 (3)	13 (16)	0.003
Resuscitative interventions	1.25 [0.5–3]	3 [1.8–4.2]	0.001
SOFA 24 h	7 [4–10]	8 [5–11]	0.11
dSOFA 0–24 h	2 [0–4]	1 [−1–3]	0.004
X2 → RRT	11 (11)	16 (19)	0.1
MV	66 (65)	57 (70)	0.50
ICU length of stay (days)	6 [3–12]	6 [3–11]	0.60
28-day mortality	23 (23)	33 (40)	0.009

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

Matthias Jacquet-Lagrèze<sup>1,2\*</sup> , Nourredine Bouhamri<sup>1</sup>, Philippe Portran<sup>1,2</sup>, Rémi Schweizer<sup>1,2</sup>, Florent Baudin<sup>3,2</sup>, Marc Lilot<sup>4,5,6,7</sup>, William Fournier<sup>1,2</sup> and Jean-Luc Fellahi<sup>1,2</sup>

- Insuffisance circulatoire aigue
- Décision du remplissage vasculaire par le clinicien



- Paramètres hémodynamiques et de perfusion tissulaire
- Répondeurs : diminution de 25% du TRC



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

Matthias Jacquet-Lagrèze<sup>1,2\*</sup> , Nourredine Bouhamri<sup>1</sup>, Philippe Portran<sup>1,2</sup>, Rémi Schweizer<sup>1,2</sup>, Florent Baudin<sup>3,2</sup>, Marc Lilot<sup>4,5,6,7</sup>, William Fournier<sup>1,2</sup> and Jean-Luc Fellahi<sup>1,2</sup>

N= 34 dont 13 sepsis

SOFA 8 [6-11]

Lactate artériel : 2.0 [1.2-3.8]

Noradrénaline 0.22 [0.10-0.51]

	Baseline (T1)	During PLR (T2)	Baseline (T3)	After VE (T4)	Group R/ NR
Répondeurs	3.6 [2.8, 6.0]	2.3 [1.6, 3.6]	NA	2.1 [1.8, 2.9]*	< 0.001
NON-Répondeurs	2.6 [2.3, 3.3]	2.6 [2.0, 3.1]	NA	2.6 [2.0, 3.1]	

# La perfusion tissulaire

En pratique



Homme, 60 ans, choc septique sur pneumopathie  
Aux urgences remplissage 30mL/kg, antibiothérapie  
Intubation sédation, VAC 60% PEP 8

HÔPITAL SAINT-ANTOINE

Homme, 60 ans, choc septique sur pneumopathie  
Aux urgences remplissage 30mL/kg, antibiothérapie  
Intubation sédation, VAC 60% PEP 8

Aux urgences remplissage 30mL/kg, antibiothérapie													
Intubation sédation, VAC 60% PEP 8													
	12	13	14	15	16	17	18	19	20	21	22	23	24
NA: 2mg/h Lactate: 2,1					NA: 1,6mg/h Lactate: 2,7				NA: 1mg/h Lactate: 1,6				NA: 0,6mg/h Lactate: 1,2
DEXTRORÉSISTANCE													
TEMPÉRATURE / °C	37,7 (R)	37,8 (T)	38,2 (R)	37,8 (T)	37,5 (T)	37,6 (T)	37,8 (T)	37,6 (T)	37,6 (T)	37,6 (T)	37,6 (T)	37,6 (T)	37,6 (T)
PAS / PAD /	108/57	102/58	121/65	113/62	107/58	117/60	123/67						
PAM /	(71)	(71)	(78)	(79)	73	77	82						
FC /	95	91	87	85	81	76	75						
MARBRURES / TRC /	III	III	I		I	I							
MODE	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC	VAC
HUMIDIFICATEUR CHAUFFANT /	600x22	600x22	390x25	390x25	390x25	390x25	390x25	390x25	390x25	390x25	390x25	390x25	390x25
FR /	27	25	26	25	25	25	25	25	25	25	25	25	25
VT /	412	453	395	384	388	370	370						
FiO <sub>2</sub> / O <sub>2</sub>	40%	46%	45%	45%	50%	50%	50%						
PRESSION PLATEAU /	--	--	--	--	--	16	16	16	16	16	16	16	16
PIC / PEP	3115	3315	2818	2918	29/8	30/8	31/8						
SpO <sub>2</sub>	92%	96%	97%	98%	98%	98%	98%						
PRESSION DU BALLONNET /	30cmH <sub>2</sub> O			30cmH <sub>2</sub> O	30cmH <sub>2</sub> O	30cmH <sub>2</sub> O	30cmH <sub>2</sub> O						
ASPIRATIONS / SYSTEME-CLOS □			Aspiration abondante										
REPÈRE SONDE INTUBATION	24 (AD)												24 (AD)
CONSCIENCE / SOMMEIL / RAMSAY	R-6/5	R-6/5	R-5										R-5
AGITATION / CONTENTION □	-1+	-1+	-1+										-1+
DOULEUR (selon échelle)	-	-	-	-									-
DIGESTIVES													
ASPIRATION /													
TRANSIT / VOMISSEMENTS	Ø			Ø									
ASCITE /													
PÉRIMÈTRE ABDOMINAL /													
DEBIT / L/min	(120)	20	21	70	40	30	60	100	80	105	85	50	60
UF	(120)	20	21	70	40	30	60	100	80	105	85	50	60

# Autre situation

Femme 55 ans

Transférée d'hématologie

Aplasie fébrile post-chimiothérapie

VVP bras droit propre

Que faites-vous ?

T= 39° C

Consciente

FR: 22/minutes

PAM: 55 mmHg, malgré 2L de remplissage par sérum salé

*Should we treat mild hypotension in septic patients in the absence of peripheral tissue hypoperfusion?*

**Jean-Rémi Lavillegrand, Guillaume  
Dumas, Naïke Bigé, Daniel Zafimahazo,  
Bertrand Guidet, Eric Maury & Hafid  
Ait-Oufella**

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Critically ill patients admitted for sepsis and PAM<65mmHg

N=124



Fluid resuscitation

PAM>65 mmHg  
N=24



PAM<65mmHg  
N=100

Norepinephrine  
PAM >65mmHg  
N=89

Permissive  
hypotension  
N=11

# Hypotension permissive ?

Variables	H0	H6	H12	H18	H24
Glasgow	15 [15-15]	15 [15-15]	15 [15-15]	15 [15-15]	<b>15 [15-15]</b>
Heart rate (min <sup>-1</sup> )	104 [92-106]	90 [79-119]	93 [85-109]	89 [82-98]	<b>94 [75-110]</b>
MAP (mmHg)	62 [57-62]	60 [57-63]	62 [60-64]	67 [59-69]	<b>73 [69-76]</b>
Diuresis (mL/Kg/6h)	-	6.9 [5.4-8.5]	7 [5.1-8.5]	7.3 [4.7-8]	<b>6.9 [4.3-9.9]</b>
Mottling score	0 [0-1]	0 [0-0]	0 [0-0]	0 [0-0]	<b>0 [0-0]</b>
Lactate arterial level (mmol/L)	1.8 [1.2-3.1]	-	1.1 [0.9-1.2]	-	<b>1.1 [1.0-1.3]</b>
SOFA score	<b>4 [3-6]</b>	-	-	-	<b>2 [1-4]</b>

# Hypotension permissive ?

Variables	H0	H6	H12	H18	H24
Glasgow	15 [15-15]	15 [15-15]	15 [15-15]	15 [15-15]	<b>15 [15-15]</b>
Heart rate (min <sup>-1</sup> )	104 [92-106]	90 [79-119]	93 [85-109]	89 [82-98]	<b>94 [75-110]</b>
MAP (mmHg)	62 [57-62]	60 [57-63]	62 [60-64]	67 [59-69]	<b>73 [69-76]</b>
Diuresis (mL/Kg/6h)	-	6.9 [5.4-8.5]	7 [5.1-8.5]	7.3 [4.7-8]	<b>6.9 [4.3-9.9]</b>
Mottling score	0 [0-1]	0 [0-0]	0 [0-0]	0 [0-0]	<b>0 [0-0]</b>
Lactate arterial level (mmol/L)	1.8 [1.2-3.1]	-	1.1 [0.9-1.2]	-	<b>1.1 [1.0-1.3]</b>
SOFA score	<b>4 [3-6]</b>	-	-	-	<b>2 [1-4]</b>

Variables	<b>Hypotension (N=100)</b>		<b>NO hypotension (n = 24)</b>
	MAP Target>65mmHg (n = 89)	Permissive hypotension (n = 11)	
<b>Male gender</b>	51 (57)	5 (45)	<b>16 (67)</b>
<b>Age, years</b>	69 (59-82)	74 (66-79)	<b>65(57-81)</b>
<b>SAPS II</b>	62 (45-75)	41 (29-48) <sup>b</sup>	<b>43 (35-51) <sup>b</sup></b>
<b>ICU stay, days</b>	6 (2-10)	2 (2-5)	<b>5 (2-7)</b>
<b>Hospital stay, days</b>	18 (6-36)	15 (6-16)	<b>17 (9-40)</b>
<b>Primary site of infection (%)</b>			
Lung	26 (29)	0	<b>2(8)</b>
Urinary tract	15(17)	5(45)	<b>3(12)</b>
Abdomen	19(21)	3(27)	<b>1(4)</b>
Soft tissue	6(7)	0	<b>5(21)</b>
Other	23(26)	3(27)	<b>11(54)</b>
<b>Vasopressors, days</b>	2 (1-4)	0 (0-0) <sup>a</sup>	<b>0 (0-0) <sup>a</sup></b>
<b>Mechanical ventilation, (%)</b>	31 (37)	0 (0) <sup>b</sup>	<b>1 (5) <sup>b</sup></b>
<b>Hemodialysis, n (%)</b>	20 (24)	1 (9)	<b>2 (8)</b>
<b>In-ICU mortality, n (%)</b>	34 (38)	0 (0)	<b>3 (12)</b>
<b>In-hospital mortality, n (%)</b>	<b>38 (42)</b>	<b>0 (0)</b>	<b>5 (20)</b>

# Conclusion

Maladie complexe !

Indices cliniques au lit du malade

- Marbrures
- TRC
- Diurèse
- Conscience
- Température

Evaluation-Triage (urgence)

Guider la prise en charge

- pour FAIRE
- pour NE PAS FAIRE

# Effect of Reduced Exposure to Vasopressors on 90-Day Mortality in Older Critically Ill Patients With Vasodilatory Hypotension

## A Randomized Clinical Trial

Multicentrique (n=65) Grande Bretagne

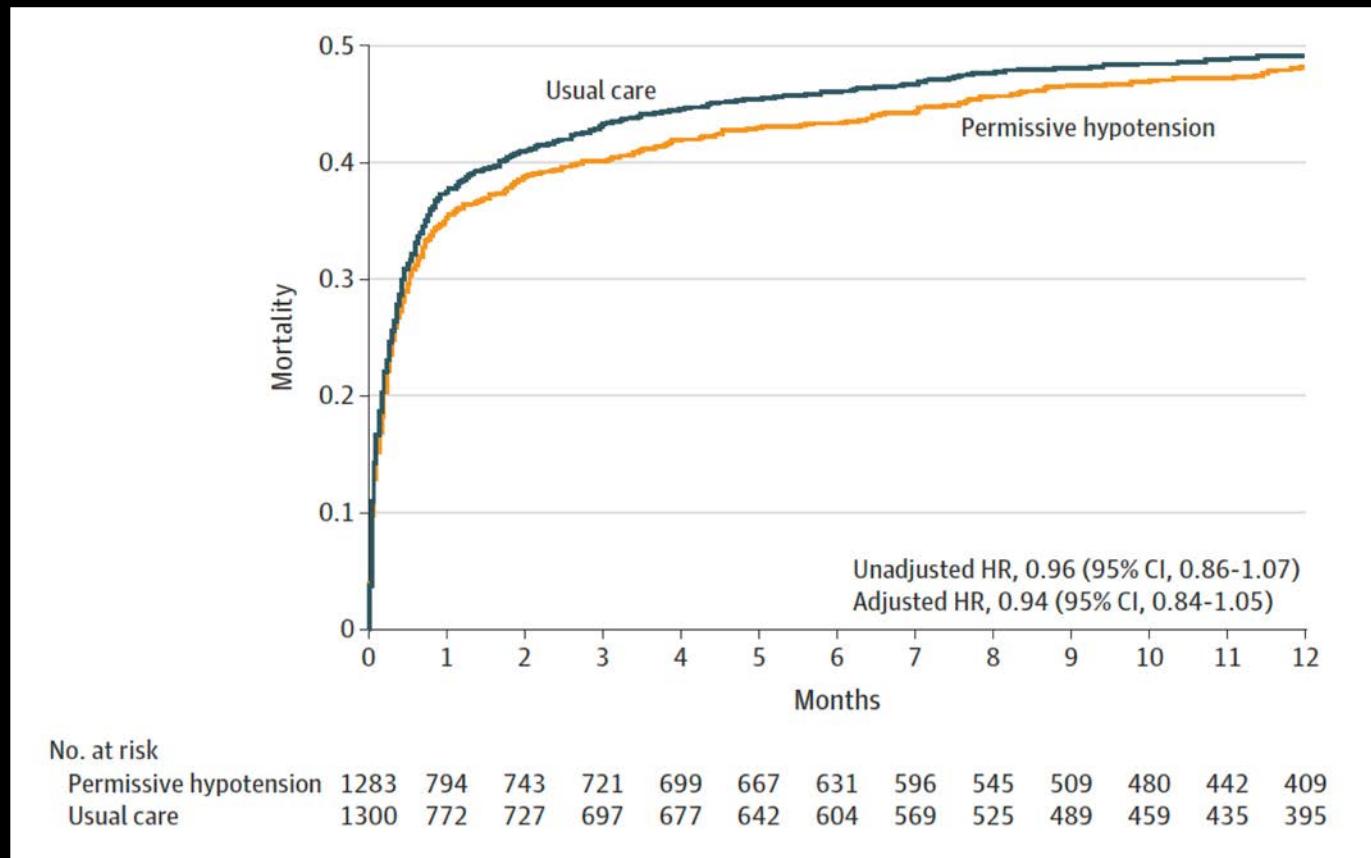
Comparaison de 2 objectifs de réanimation du choc chez patients de plus de 75 ans

-Soit PAM entre 60 et 65 mmHg

-Soit PAM > 65 mmHg

- Inclusion: <6 heures du début des vasopresseurs

2583 patients inclus en 1 an 1/2  
Age 75 (5) ans, APACHE II 21 (6,5)  
Sepsis (30%) choc septique (48%)  
Mortalité J 90 40%



# Autres approches thérapeutiques

Traitement ciblant spécifiquement  
la perfusion microcirculatoire ?

1. Albumine
2. Vitamine C
3. Ilomédine
- 4...



# Hypotension permissive ? Balance hydrique et fonction rénale

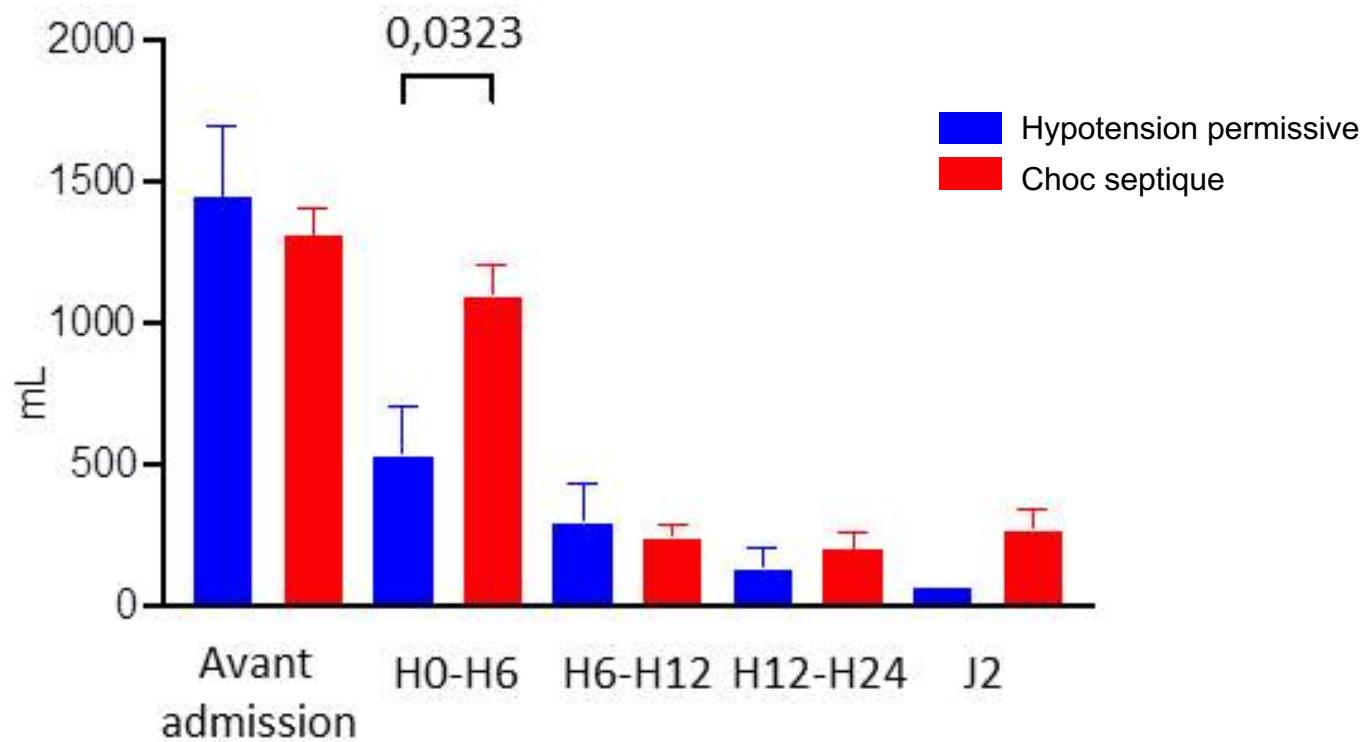
## Caractéristiques générales des patients

Caractéristiques n (%) ou médiane [IQR]	Hypotension permissive n= 15	Choc septique n = 79	p
Age	59 [50-73]	67 [57-78]	0,22
Sexe masculin	11 (73)	43 (54)	0,17
Simplified Acute Physiology Score 2	45 [27-46]	60 [45-86]	0,0001
Comorbidités			
Diabète	4 (27)	18 (23)	
Hypertension artérielle	4 (27)	33 (42)	
Maladie cardiovasculaire	7 (47)	29 (32)	
Porte d'entrée infectieuse			
Pulmonaire	4 (27)	38 (43)	
Digestive	4 (27)	13 (15)	
Paramètres biologiques à l'admission			
Plaquettes (Giga/L)	176 [98-259]	142 [80-229]	0,4
Créatininémie ( $\mu$ mol/L)	139 [84-189]	125 [94-207]	0,65
Procalcitonine (ng/mL)	16 [3-41]	13 [4-49]	0,8
Réserve alcaline (mmol/L)	21 [19-24]	19 [14-23]	0,1
Lactate artériel (mmol/L)	1.7 [1.1-2.9]	4 [2.7-6.7]	<0.0001

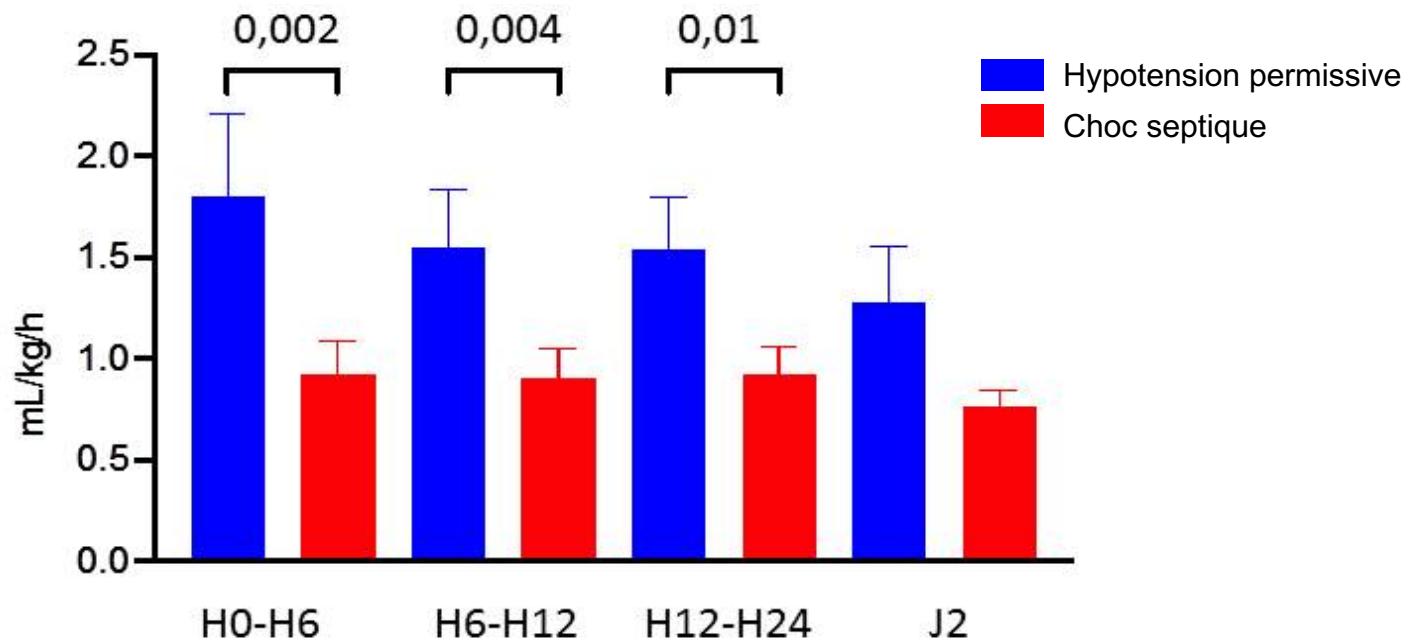
# Hypotension permissive ? Balance hydrique et fonction rénale

Caractéristiques n (%) ou médiane [IQR]	Hypotension permissive n= 15	Choc septique n = 79	p-value
<b>Suppléances d'organes</b>			
Administration vasopresseurs	0 (0)	79 (100)	0,0001
Ventilation mécanique invasive	0	56 (71)	<0,0001
Epuration extra-rénale	0	16 (20)	0,06
<b>Pronostic</b>			
Mortalité en réanimation	0	30 (38)	0,004
Mortalité à l'hôpital	1 (6)	35 (44)	0,006
Durée de séjour réanimation : jours Tous les patients	3 [2-5]	5 [2-10]	0,4
Durée de séjour réanimation : jours Patients survivants à 24h	3 [2-5]	7 [4-14]	0,0004
Durée de séjour à l'hôpital : jours	13 [6-39]	13 [5-37]	0,8

# Hypotension permissive ? Expansion volémique



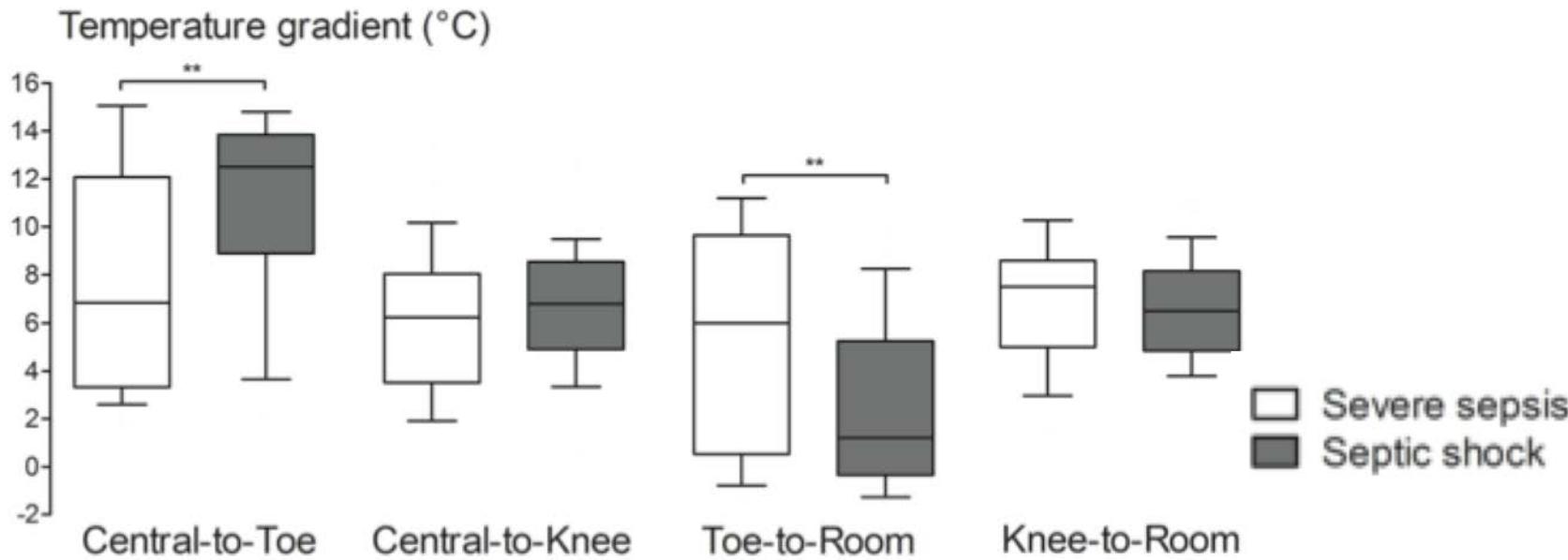
# Hypotension permissive ? diurèse





# Toe-to-room temperature gradient correlates with tissue perfusion and predicts outcome in selected critically ill patients with severe infections

Simon Bourcier<sup>1,2</sup>, Claire Pichereau<sup>1,2</sup>, Pierre-Yves Boelle<sup>3</sup>, Safaa Nemlaghi<sup>1,4</sup>, Vincent Dubée<sup>1,2</sup>, Gabriel Lejour<sup>1</sup>, Jean-Luc Baudel<sup>1</sup>, Arnaud Galbois<sup>1,4</sup>, Jean-Rémi Lavillegrand<sup>1</sup>, Naike Bigé<sup>1</sup>, Jalel Tahiri<sup>1</sup>, Guillaume Leblanc<sup>1,5</sup>, Eric Maury<sup>1,2,6</sup>, Bertrand Guidet<sup>1,2,6</sup> and Hafid Ait-Oufella<sup>1,2,7\*</sup>

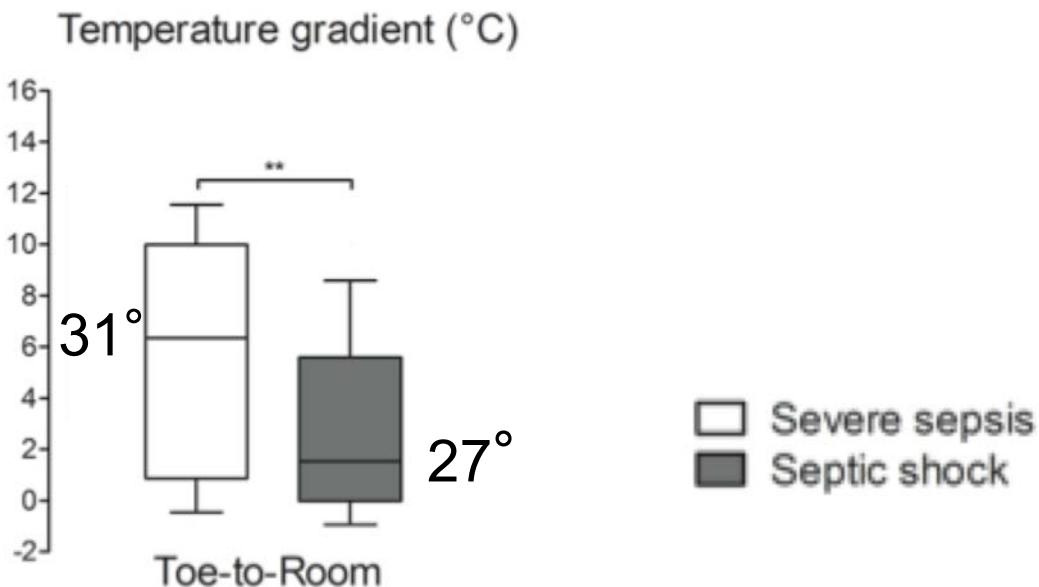




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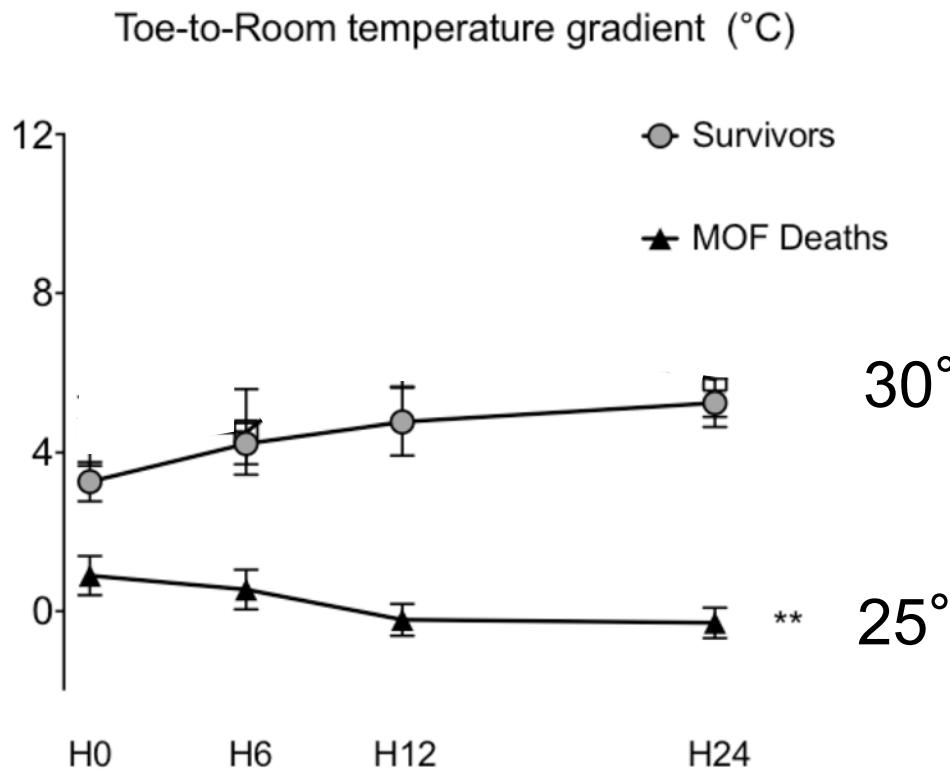
Température pièce :  
25° C





# Toe-to-room temperature gradient correlates with tissue perfusion and predicts outcome in selected critically ill patients with severe infections

Simon Bourcier<sup>1,2</sup>, Claire Pichereau<sup>1,2</sup>, Pierre-Yves Boelle<sup>3</sup>, Safaa Nemlaghi<sup>1,4</sup>, Vincent Dubée<sup>1,2</sup>, Gabriel Lejour<sup>1</sup>, Jean-Luc Baudel<sup>1</sup>, Arnaud Galbois<sup>1,4</sup>, Jean-Rémi Lavillegrand<sup>1</sup>, Naike Bigé<sup>1</sup>, Jalel Tahiri<sup>1</sup>, Guillaume Leblanc<sup>1,5</sup>, Eric Maury<sup>1,2,6</sup>, Bertrand Guidet<sup>1,2,6</sup> and Hafid Ait-Oufella<sup>1,2,7\*</sup>





# Fluid administration for acute circulatory dysfunction using basic monitoring: narrative review and expert panel recommendations from an ESICM task force

1. Acute circulatory dysfunction can be recognized by a thorough clinical examination including assessment of the three windows of tissue perfusion-altered mentation, skin abnormalities, and oliguria-together with a combined analysis of heart rate and blood pressure
2. Whenever possible, we recommend measuring blood lactate concentrations and integrating this information with clinical examination
3. The purpose of fluid administration during hypovolemia is to improve tissue perfusion through increased cardiac output
4. We suggest that, in a clinical context of hypovolemia such as bleeding, severe diarrhea, and trauma, the presence of hypotension and tachycardia or oliguria should trigger fluid administration
5. The absence of arterial hypotension does not exclude hypovolemia and the need for fluid administration

# Effet vasculo-protecteur de l'albumine?

1. *Expansion volémique*
2. Anti-inflammatoire
3. anti-oxydant
4. Augmente la biodisponibilité du NO
5. Effet barrière
6. Fixation des métaux
7. Etc..



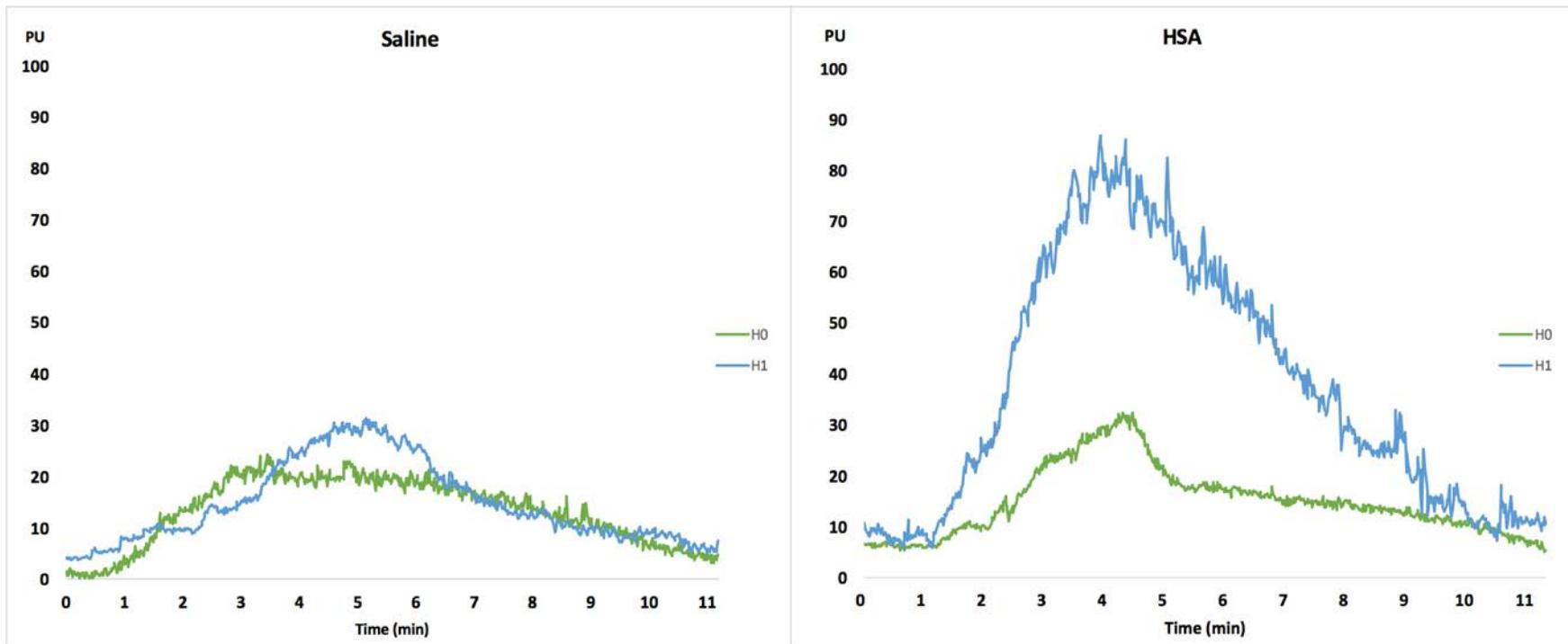
# Approche expérimentale

- Etude prospective en réanimation médicale
- Patients en choc septique
- Après expansion volémique par cristalloïdes (30mL/kg)
- Entre H6 et H24 du début des vasopresseurs
- **Randomisation: 500ml de NaCl 0,9% vs 100ml d'Albumine 20%**

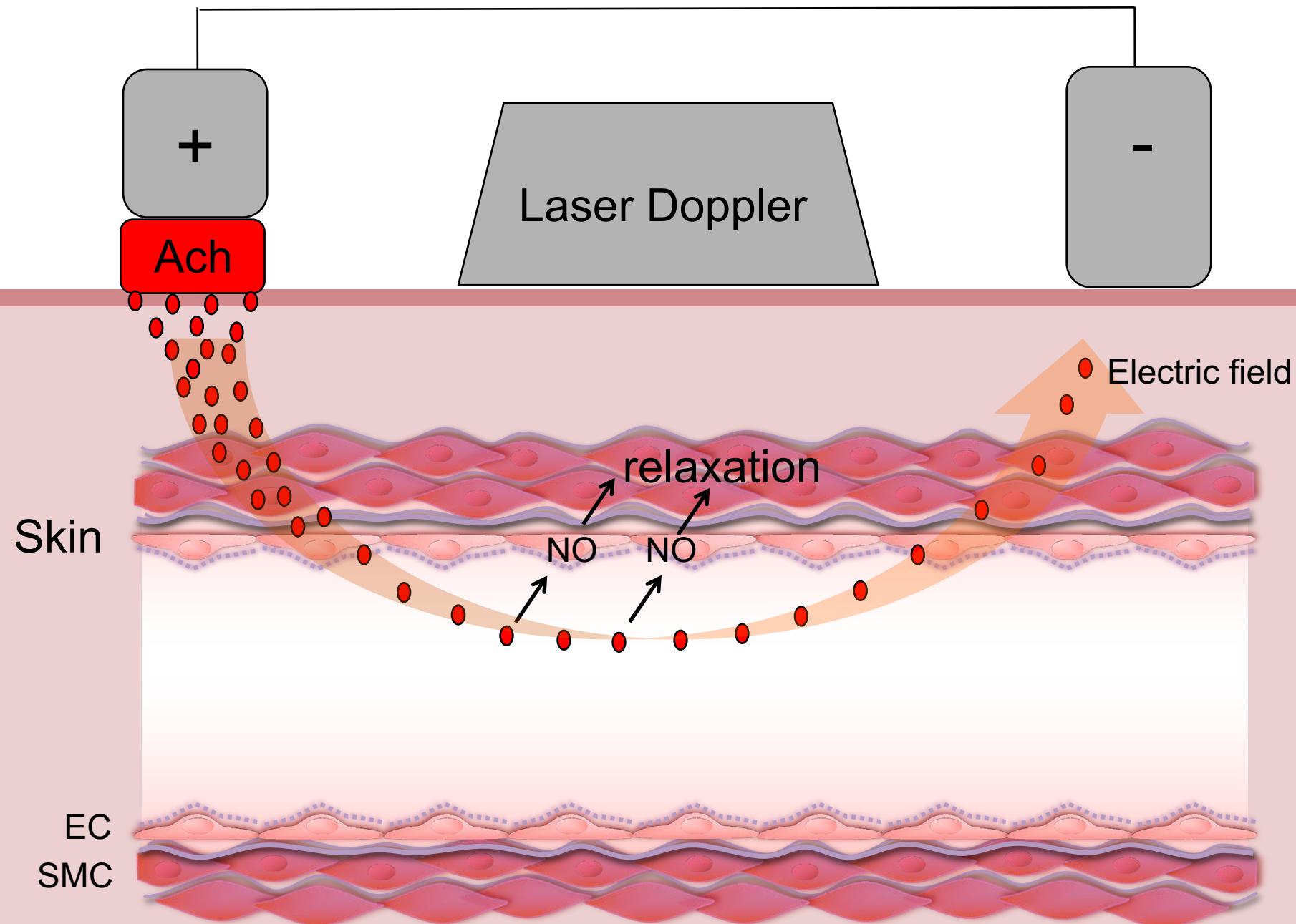
# Effets microcirculatoires de l'albumine

Parameters	Saline (N=15)		HSA (N=15)	
	Baseline	H1	Baseline	H1
Age	83 [65-86]	–	64 [53-78]*	–
SOFA	7 [4-9]	–	7 [5-9]	–
MAP (mmHg)	73 [64-77]	76 [69-77]	74 [69-80]	80 [70-86]
Heart rate (/min)	89 [78-105]	87 [75-112]	88 [74-103]	84 [67-94]
Norepinephrine (µg/kg/min)	0.40 [0.20-1.0]	0.40 [0.20-1.0]	0.25 [0.20-1.0]	0.25 [0.20-1.0]
Cardiac index (L/min/m <sup>2</sup> )	3.3 [2.6-5.2]	3.3 [2.6-5.2]	3.2 [2.8-4.5]	3.4 [2.7-4.5]
Index CRT (s)	2.2 [1.7-4.0]	2.9 [2.1-4.1]	2.6 [1.8-3.8]	2.1 [1.5-2.8]
Arterial lactate (mmol/L)	2.3 [1.5-3.6]	–	2.3 [1.1-4.2]	–
Albuminemia (g/L)	29 [28-34]	–	28 [27-30]	–
Baseline blood flow (PU)	6.5 [3.0-8.3]	4.5 [2.0-6.0]	4.7 [3.5-6.7]	7 [3-15]
Endothelial response AUC	3295 [1148-5938]	2388 [1914-10455]	3082 [879-4902]	5857 [2888-16679] # \$

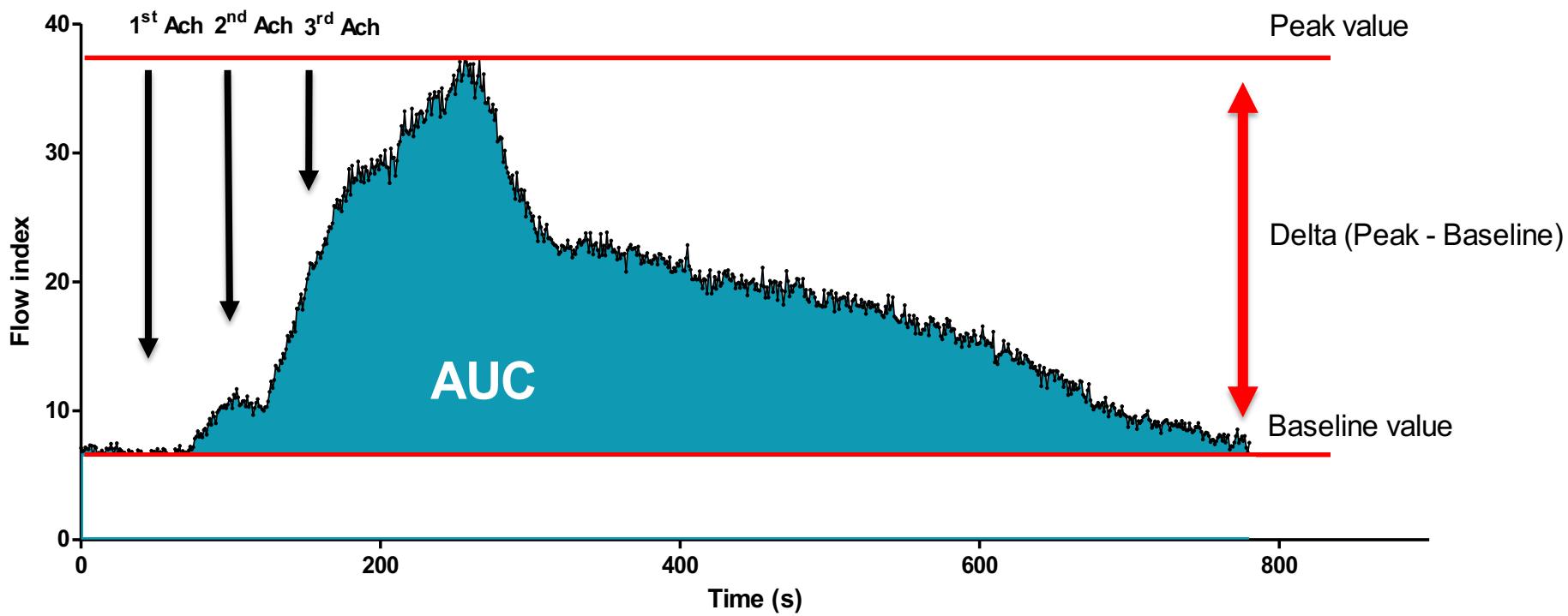
# Effets microcirculatoires de l'albumine



# Iontophorèse à l'acétylcholine



# Iontophorèse à l'acetylcholine

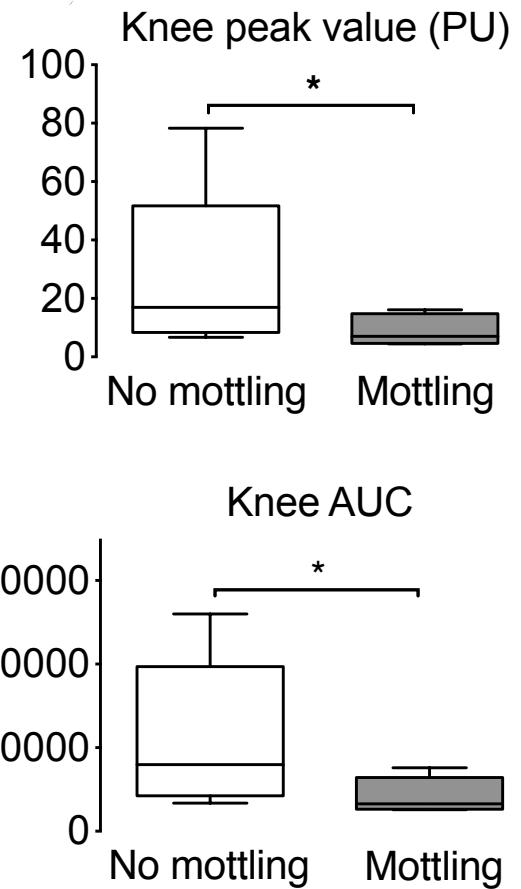
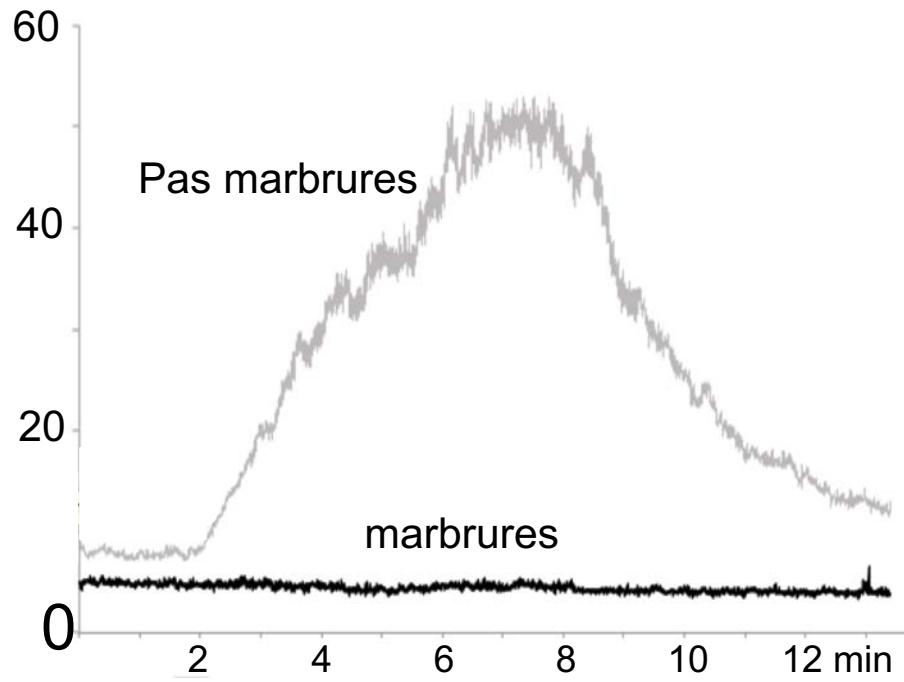


Bourcier et al. Crit Care 2017

Joffre et al. Crit Care Med 2018

# Dysfonction endothéliale dans les zones de marbrures

Flux microcirculatoire cutané



# Cardiogenic shock complicating acute myocardial infarction: Predictors of death

David Hasdai, MD,<sup>a</sup> David R. Holmes Jr, MD,<sup>b</sup> Robert M. Califf, MD,<sup>c</sup> Trevor D. Thompson, BS,<sup>c</sup> Judith S. Hochman, MD,<sup>d</sup> Matthias Pfisterer, MD,<sup>e</sup> and Eric J. Topol, MD,<sup>f</sup> for the GUSTO-I Investigators *Petab Tikva, Israel; Rochester, Minn; Durham, NC; New York, NY; Basel, Switzerland; and Cleveland, Ohio*

## Sous-étude de GUSTO-I 2968 choc cardiogénique post-IM

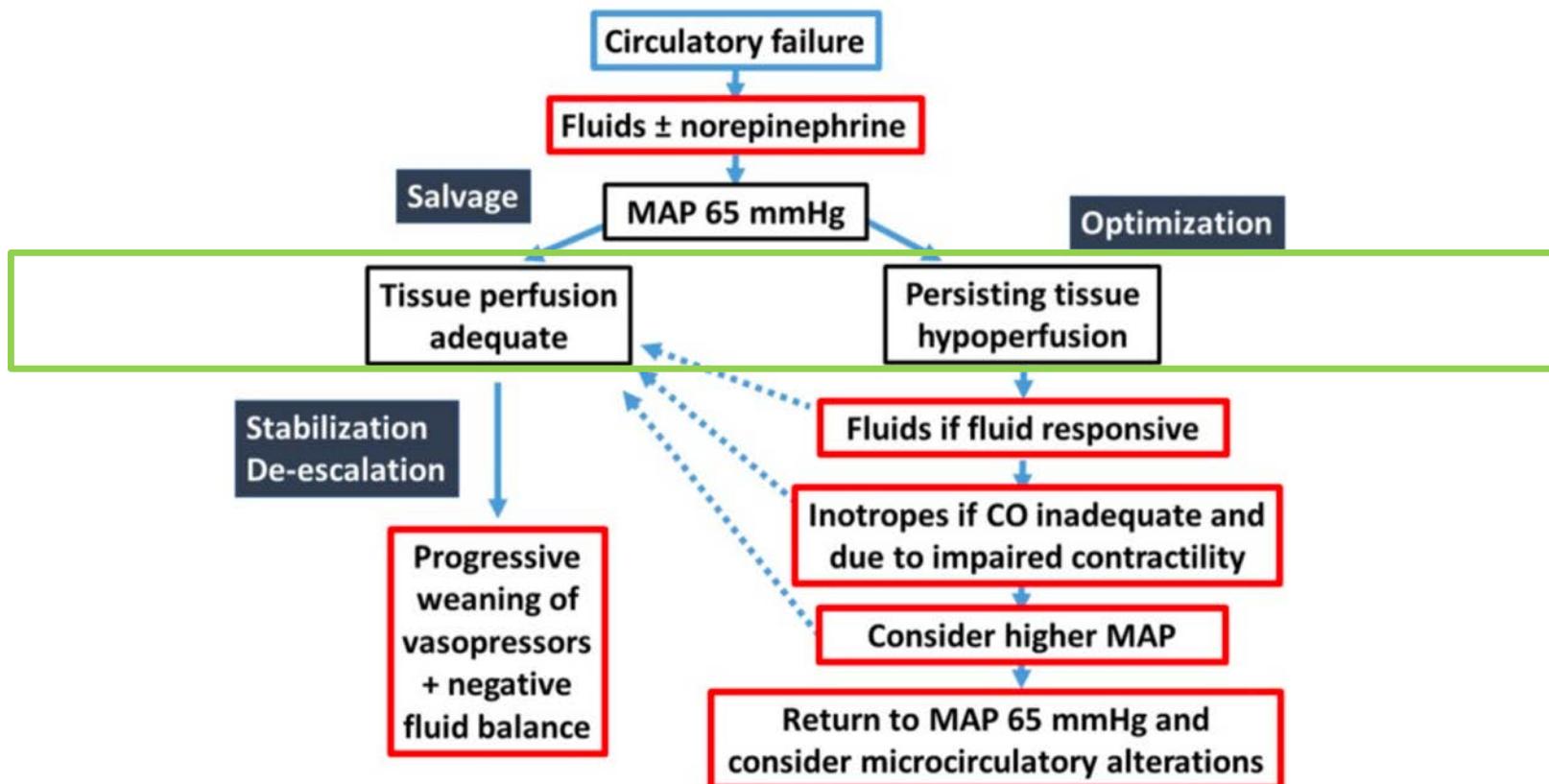
Characteristic	Wald chi-square	Odds ratio	95% Confidence interval
Oliguria	146.98	3.42	(2.80, 4.17)
Altered sensorium	48.66	2.05	(1.68, 2.51)
Cold, clammy skin	25.81	1.84	(1.45, 2.32)
Right ventricular infarction	20.14	0.59	(0.47, 0.74)
Mitral regurgitation	18.23	0.52	(0.39, 0.70)
Ventricular rupture	17.16	12.72	(3.82, 42.38)
Ventricular-septal defect	14.29	3.65	(1.87, 7.15)
Prior congestive heart failure	13.97	1.63	(1.26, 2.11)
Extramyocondial factors corrected	11.53	0.64	(0.50, 0.83)
Arrhythmia	9.50	1.35	(1.11, 1.63)
Pulmonary edema	7.79	1.32	(1.09, 1.60)

Overall model chi-square = 441.23 with 11 degrees of freedom, n = 2478. Concordance index = 0.775, validated model = 0.770.

# Minimizing catecholamines and optimizing perfusion



Daniel De Backer \* and Pierre Foulon



2583 patients inclus en 1 an 1/2  
 Age 75 (5) ans, APACHE II 21 (6,5)  
 Sepsis (30%) choc septique (48%)  
 Mortalité J 90 40%

	Permissive hypotension (N=1261 <sup>a</sup> )	Usual care (N=1276 <sup>a</sup> )	Difference in means (95% CI)
Total duration of vasopressors post randomization (hours)			
Mean (SD)	46.0 (52.4)	55.9 (60.8)	-9.9 (-14.3, -5.5)
Norepinephrine equivalents			
Total dose (mg) <sup>b</sup>	31.5 (57.4) [n=1261]	44.3 (76.4) [n=1276]	-12.8 (-18.0, -7.6)
Mean (SD)			

# Un effet sur l'utilisation des vasopresseurs

Outcome	Permissive hypotension	Usual care	Adjusted effect estimate <sup>a</sup> (95% CI)
Mortality at discharge from the ICU, n/N (%)			
<i>No chronic hypertension</i>	214 / 655 (32.7)	213 / 670 (31.8)	OR 1.05 (0.76, 1.34)
<i>Chronic hypertension</i>	148 / 557 (26.6)	167 / 567 (29.5)	OR 0.74 (0.51, 0.97)
Mortality at discharge from acute hospital, n/N (%)			
<i>No chronic hypertension</i>	274 / 667 (41.1)	274 / 678 (40.4)	OR 1.03 (0.77, 1.29)
<i>Chronic hypertension</i>	210 / 565 (37.2)	245 / 572 (42.8)	OR 0.69 (0.50, 0.88)