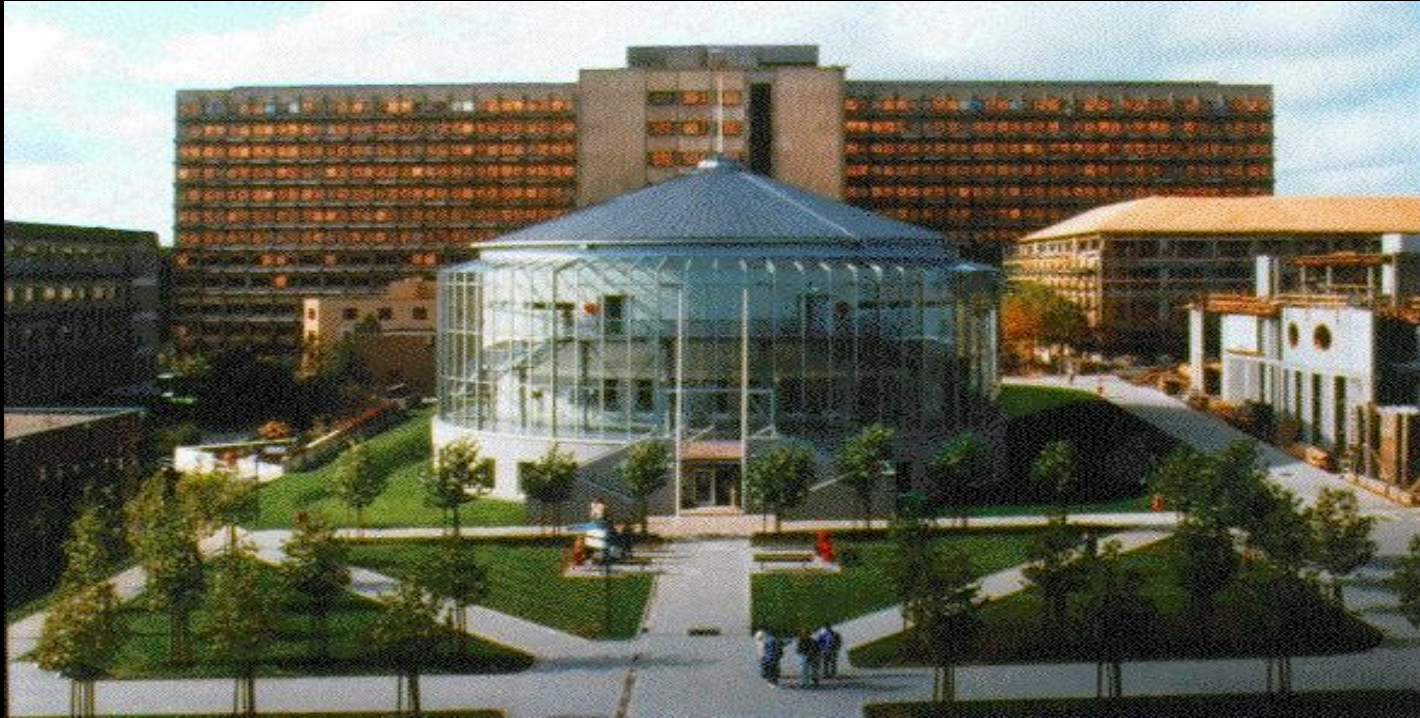


Brain And Sepsis: From Macro- to Microcirculation



Fabio Silvio TACCONE, MD, PhD
Department of Intensive Care
Hôpital Erasme – Brussels (BELGIUM)





Brain and Sepsis



Delirium as a Predictor of Mortality in Mechanically Ventilated Patients in the Intensive Care Unit

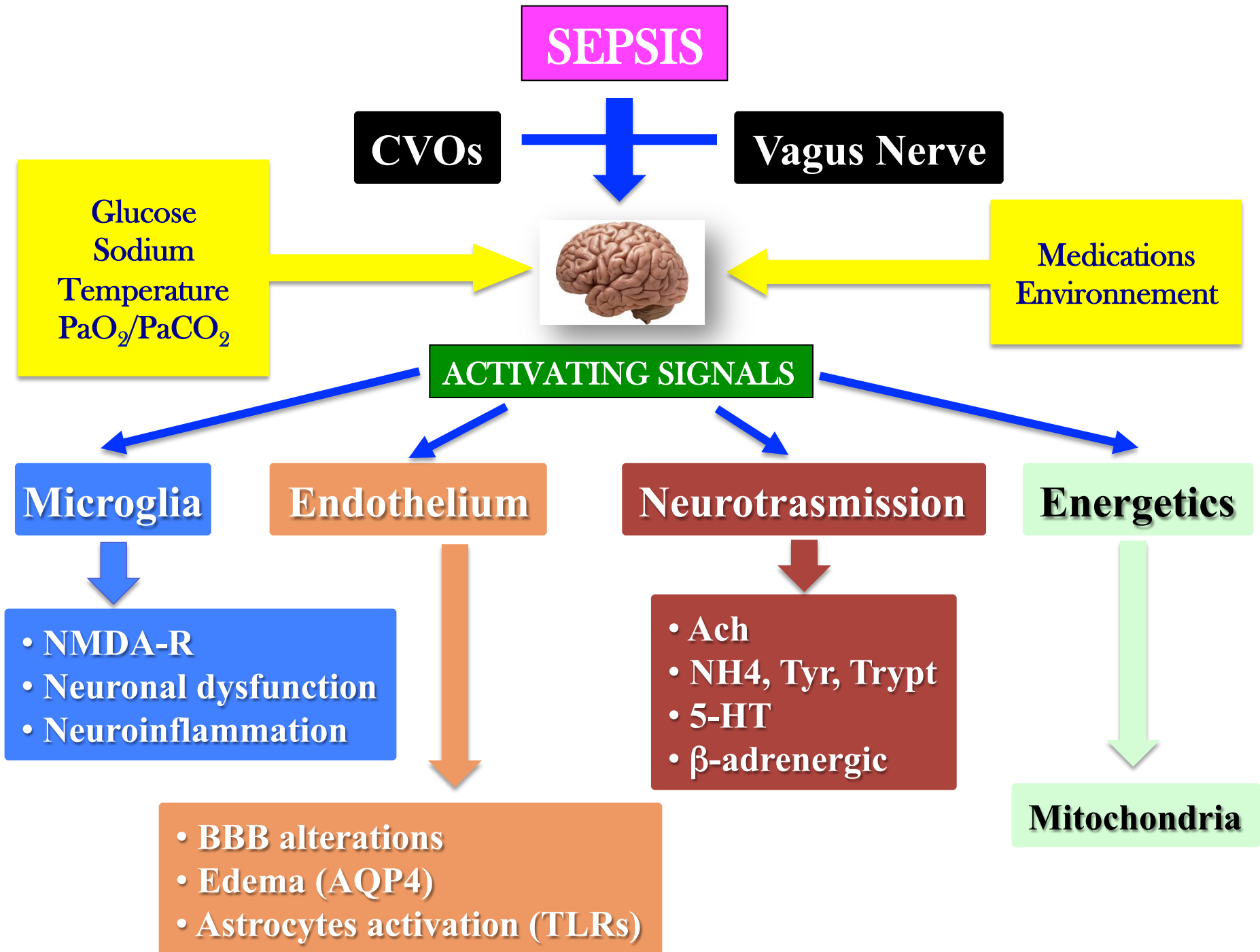
E. Wesley Ely, MD, MPH
 Ayumi Shintani, PhD, MPH
 Brenda Truman, RN, MSN
 Theodore Speroff, PhD
 Sharon M. Gordon, PsyD
 Frank E. Harrell, Jr, PhD
 Sharon K. Inouye, MD, MPH
 Gordon R. Bernard, MD
 Robert S. Dittus, MD, MPH

Table 1. Baseline Characteristics of the Patients*

Characteristic	No. (%)†	
	No Delirium (n = 41)	Delirium (n = 183)
Age, mean (SD), y	54 (17)	58 (17)
Men	18 (44)	95 (52)
Race		
White	32 (78)	145 (79)
Black	9 (22)	38 (21)
Charlson Comorbidity Index, mean (SD)	3.2 (2.8)	3.2 (2.8)
Vision deficits, No./total (%)‡	23/33 (70)	104/153 (68)
Hearing deficits, No./total (%)‡	5/32 (16)	29/152 (19)
mBDRS score, mean (SD)	0.14 (0.6)	0.23 (0.8)
Activities of daily living, mean (SD)	0.81 (2.4)	0.91 (2.3)
APACHE II score, mean (SD)	23.2 (9.6)	25.6 (8.1)
SOFA score, mean (SD)	9.5 (2.9)	9.6 (3.4)

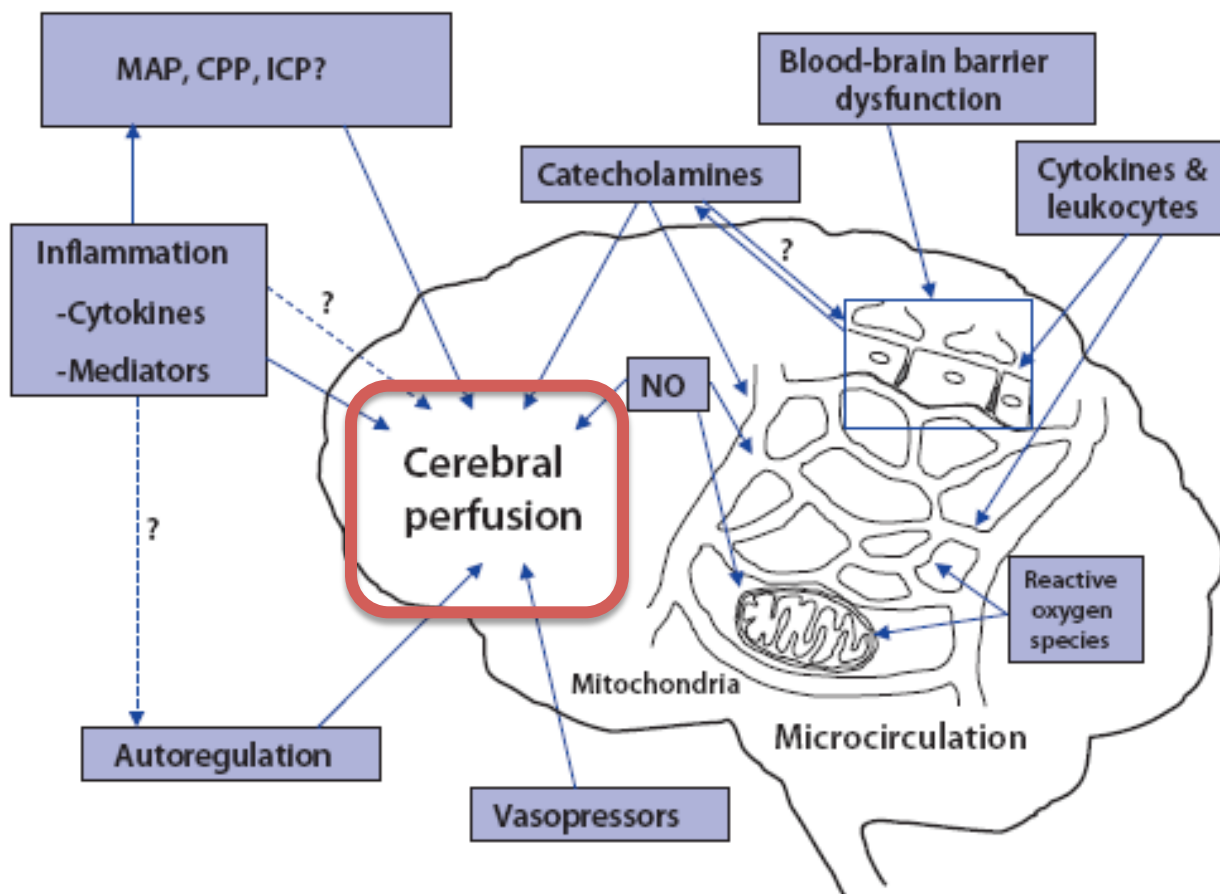
81%





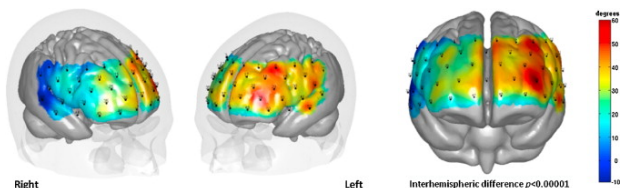
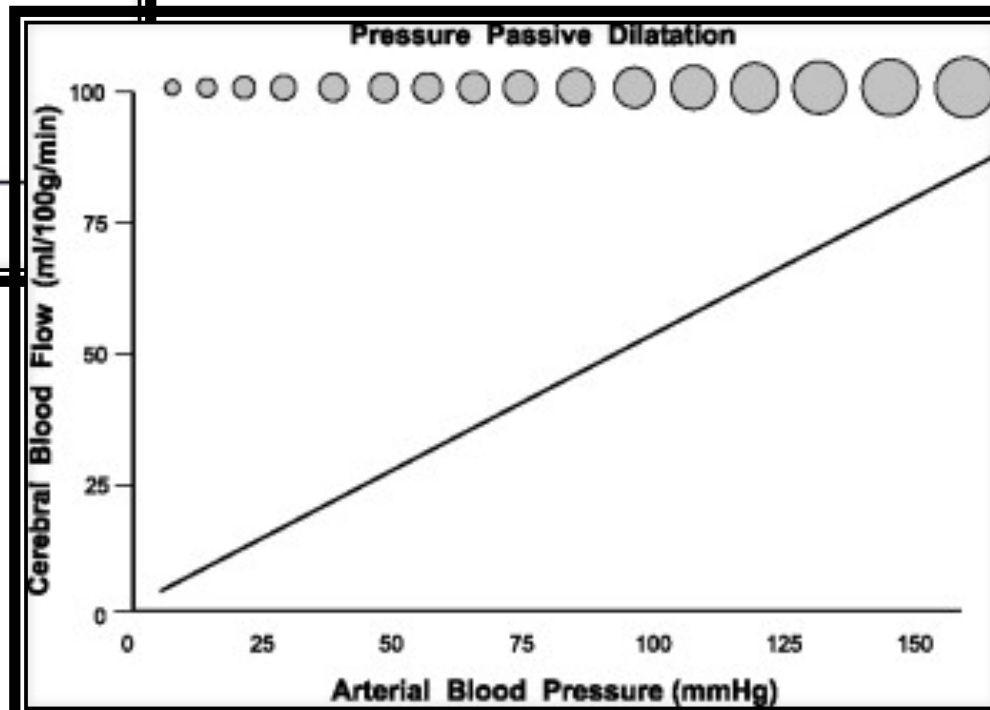
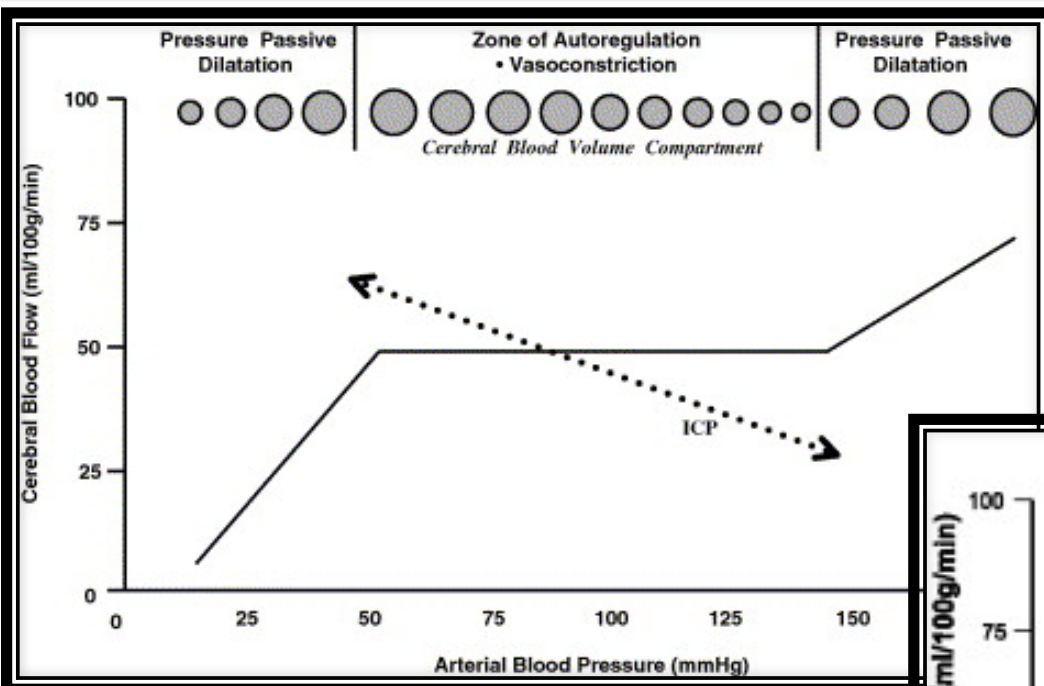


Brain and Sepsis





Human Studies

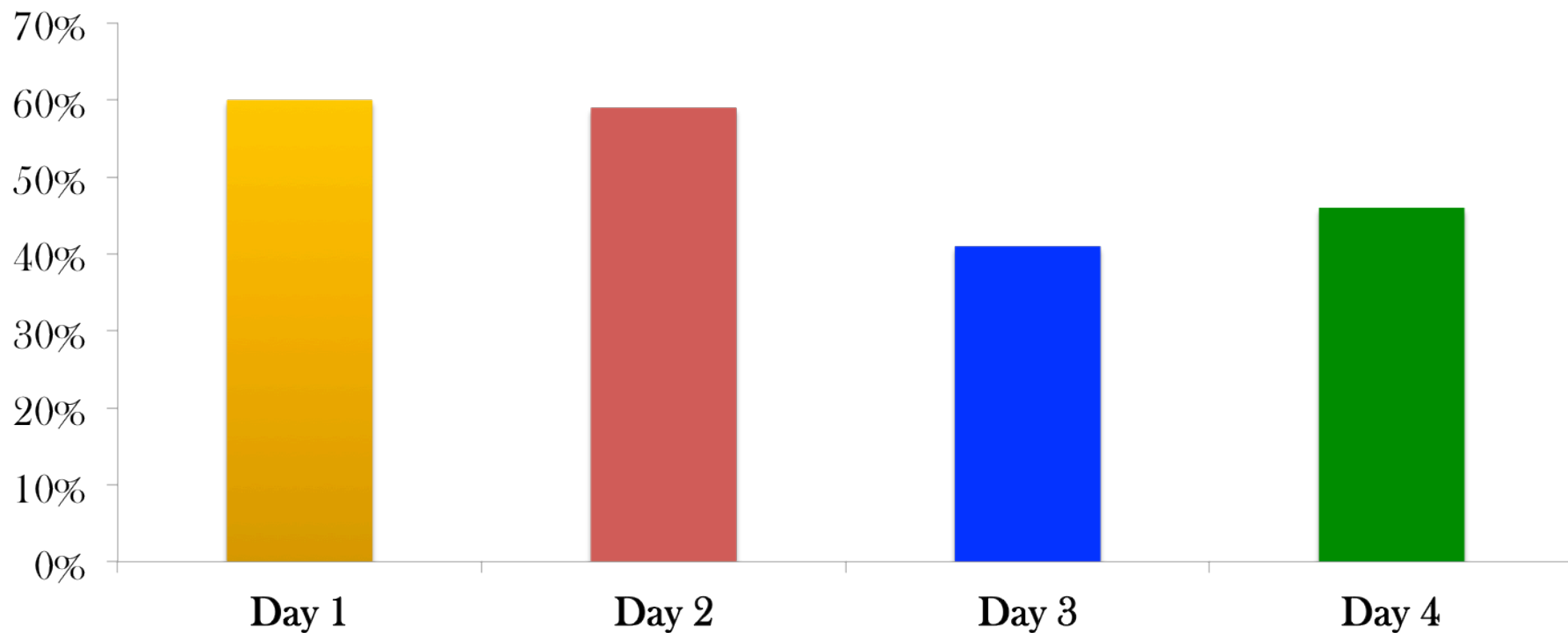




Human Studies

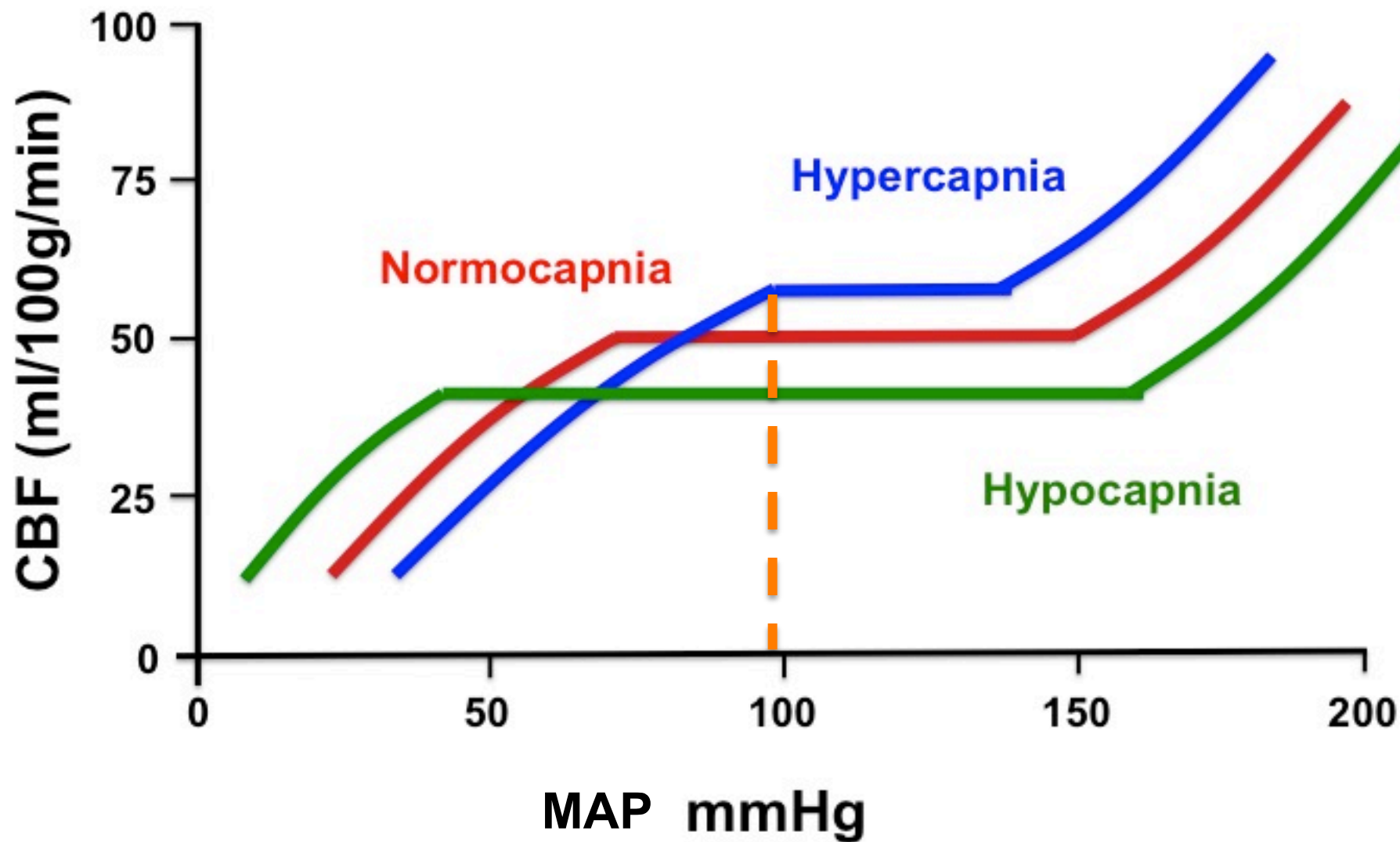
Cerebral Autoregulation

Impaired CA





Human Studies

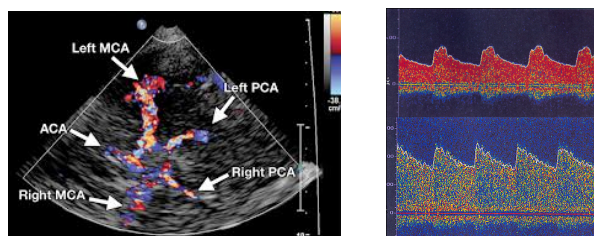




Human Studies

Cerebral Autoregulation is Influenced by Carbon Dioxide Levels in Patients with Septic Shock

Neurocrit Care (2010) 12:35–42



Fabio Silvio Taccone • Diego Castanares-Zapatero •
Daliana Peres-Bota • Jean-Louis Vincent •
Jacques Berre' • Christian Melot

21 adult patients in septic shock
Within 72 hours from shock onset
All on MV
Without any brain disorders

3-4 steps of MAP (NE)

$$CVR = MAP/VMCA$$

$$CAI = \Delta CVR\% / \Delta VMCA\% (0-2)$$

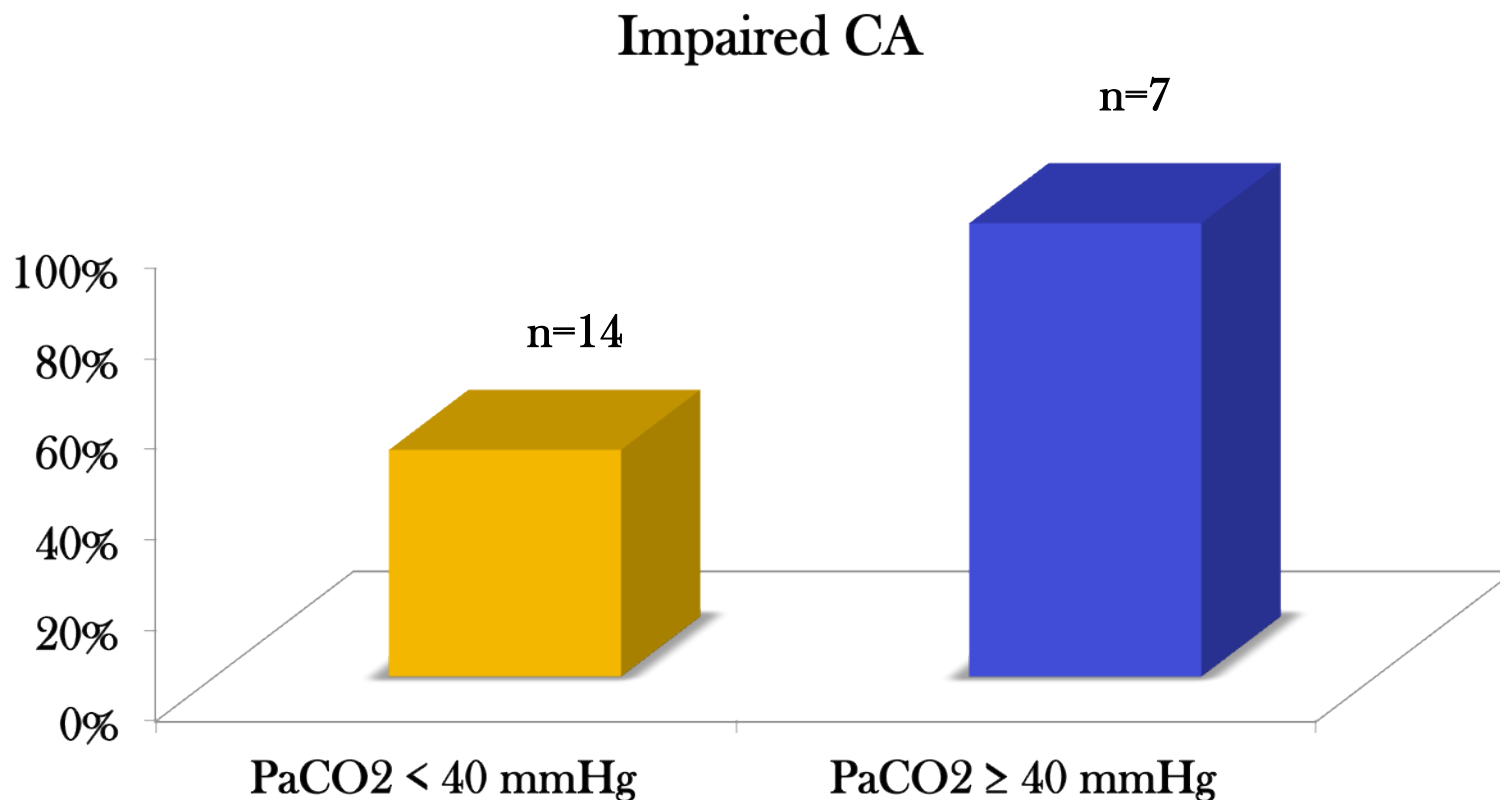
	Baseline	End
Hb (g/dl)	8.5 (6.8–10.4)	8.4 (6.9–10.5)
Na (mEq/l)	138 (127–147)	137 (125–146)
t (°C)	37.1 (35.6–39.3)	37.1 (35.9–39.3)
Glucose (mg/dl)	139 (105–195)	134 (110–182)
pH	7.36 (7.27–7.49)	7.37 (7.25–7.49)
PaO ₂ (mmHg)	88 (60–187)	85 (60–158)
PaCO ₂ (mmHg)	35 (28–49)	35 (26–48)
CI (l/min)	3.7 (2.6–7.1)	3.7 (2.5–6.2)
SVRI (dynes s/cm ⁵ m ²)	1167 (625–2310)	1752 (924–3520)*
Lactate (mmol/l)	1.7 (0.7–4.9)	1.8 (1.1–4.8)



Human Studies

Cerebral Autoregulation is Influenced by Carbon Dioxide Levels in Patients with Septic Shock

Neurocrit Care (2010) 12:35–42





The missing link ...

COMMENTARY

Open Access

Septic-associated encephalopathy - everything starts at a microlevel

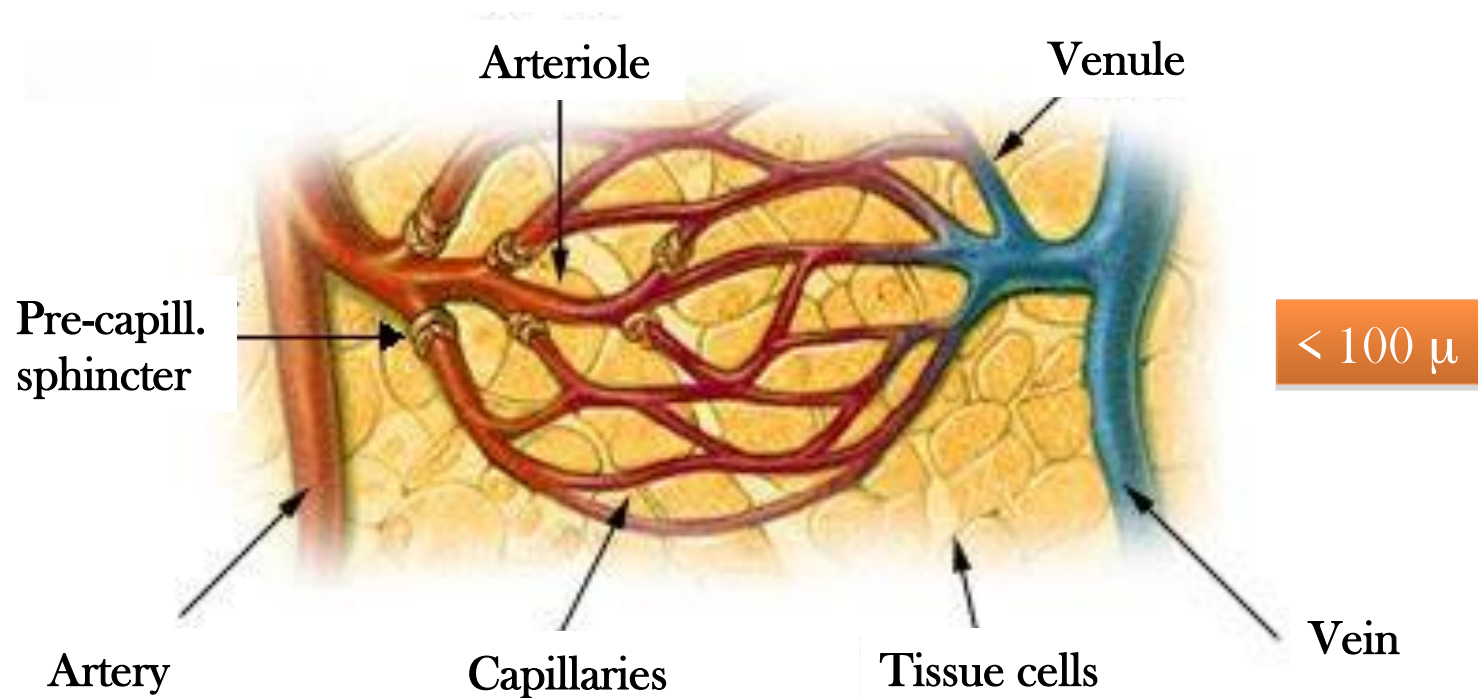
Tarek Sharshar^{1*}, Andrea Polito¹, Anthony Checinski¹, Robert D Stevens²

See related research by Taccone *et al.*, <http://ccforum.com/content/14/4/R140>





Microcirculation

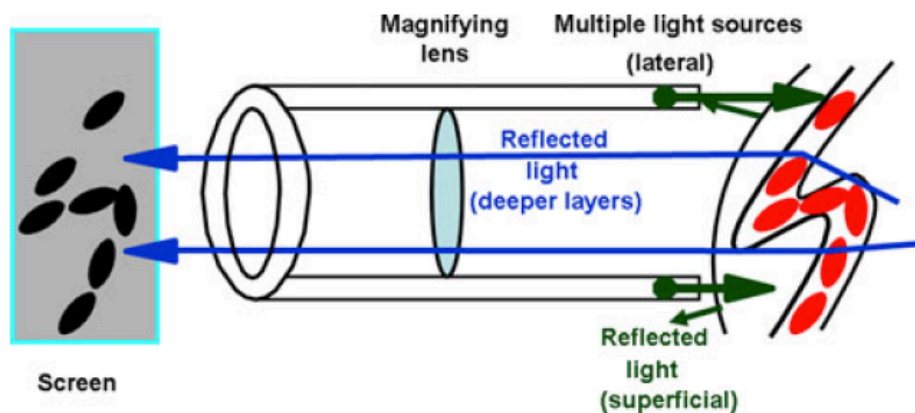


1. Blood pressure
2. Blood flow and tissue perfusion
3. Tissue fluid (swelling or edema)

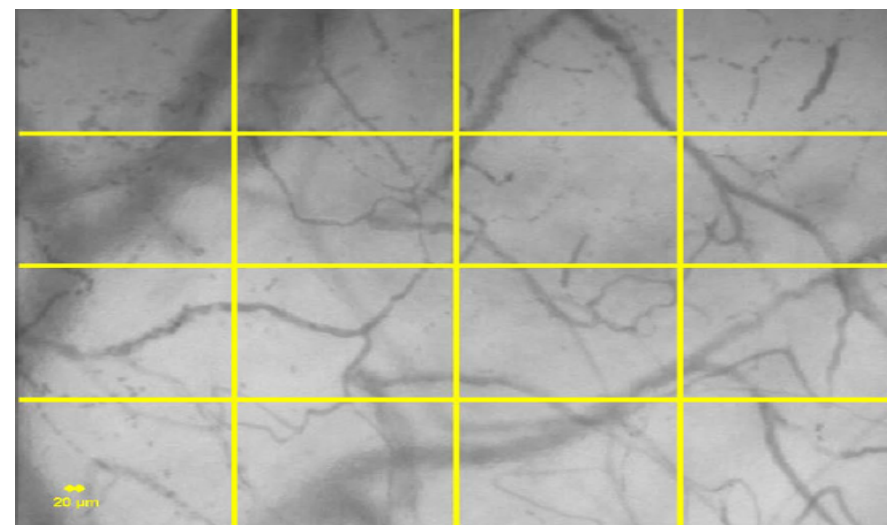
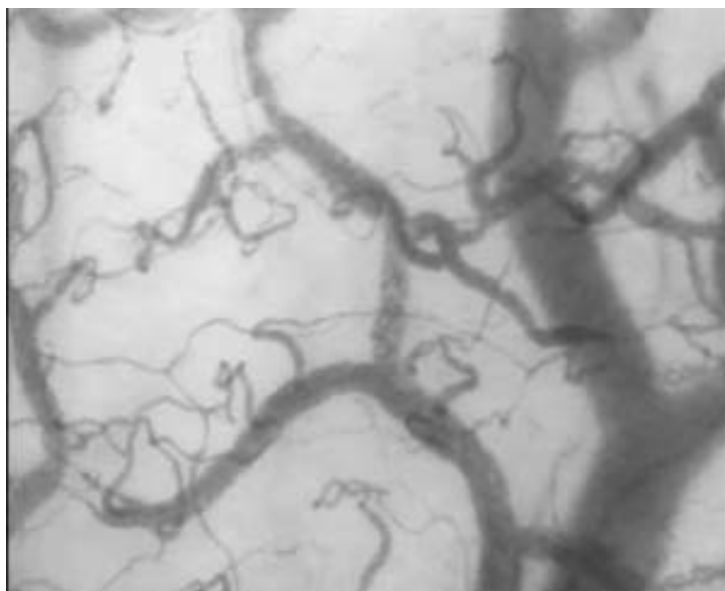
4. Oxygen and nutrients delivery
5. Waste removal
6. Body temperature



Microcirculation

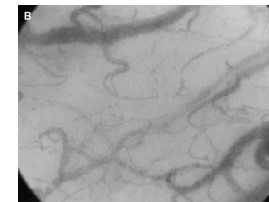
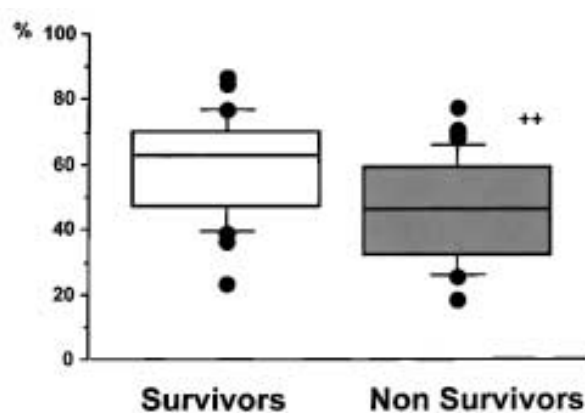
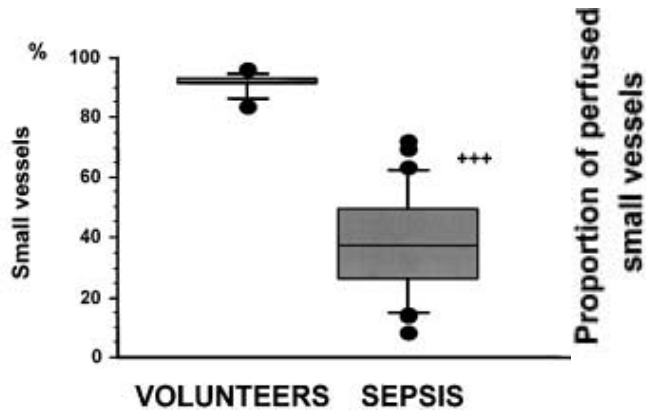


De Backer, Crit Care 2006

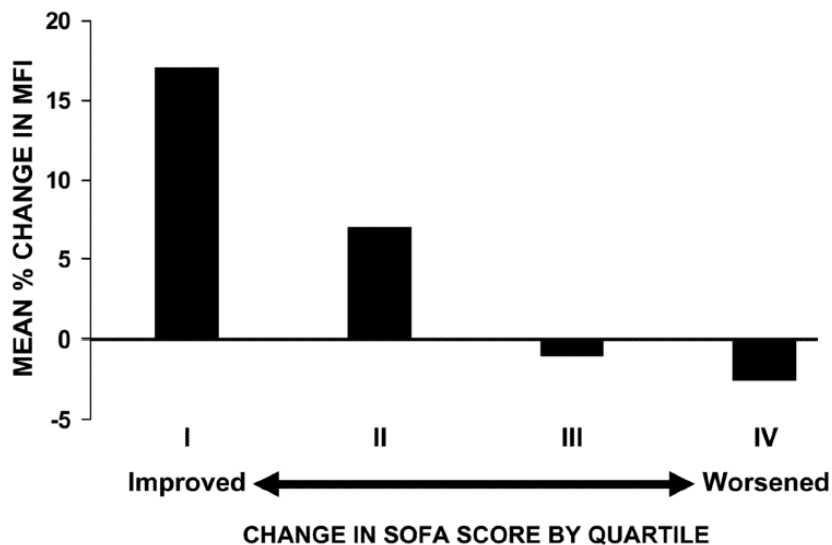




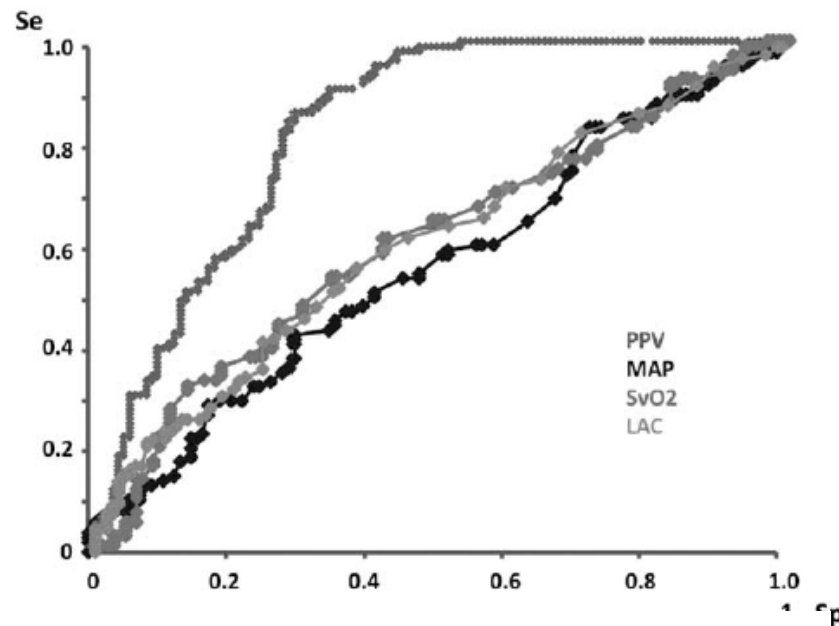
Microcirculation



De Backer, AJRCCM 2002



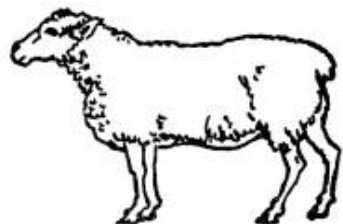
Trzeciak, Intensive Care Med 2008



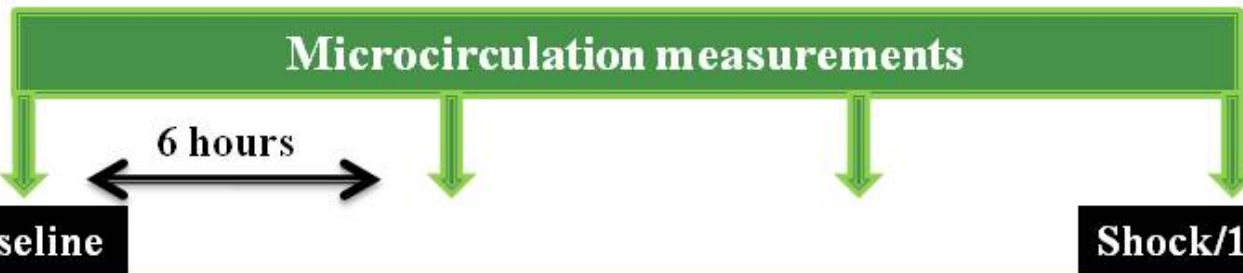
De Backer, Crit Care Med 2013




Experimental Model



SHAM: n = 5
SEPSIS: n = 10



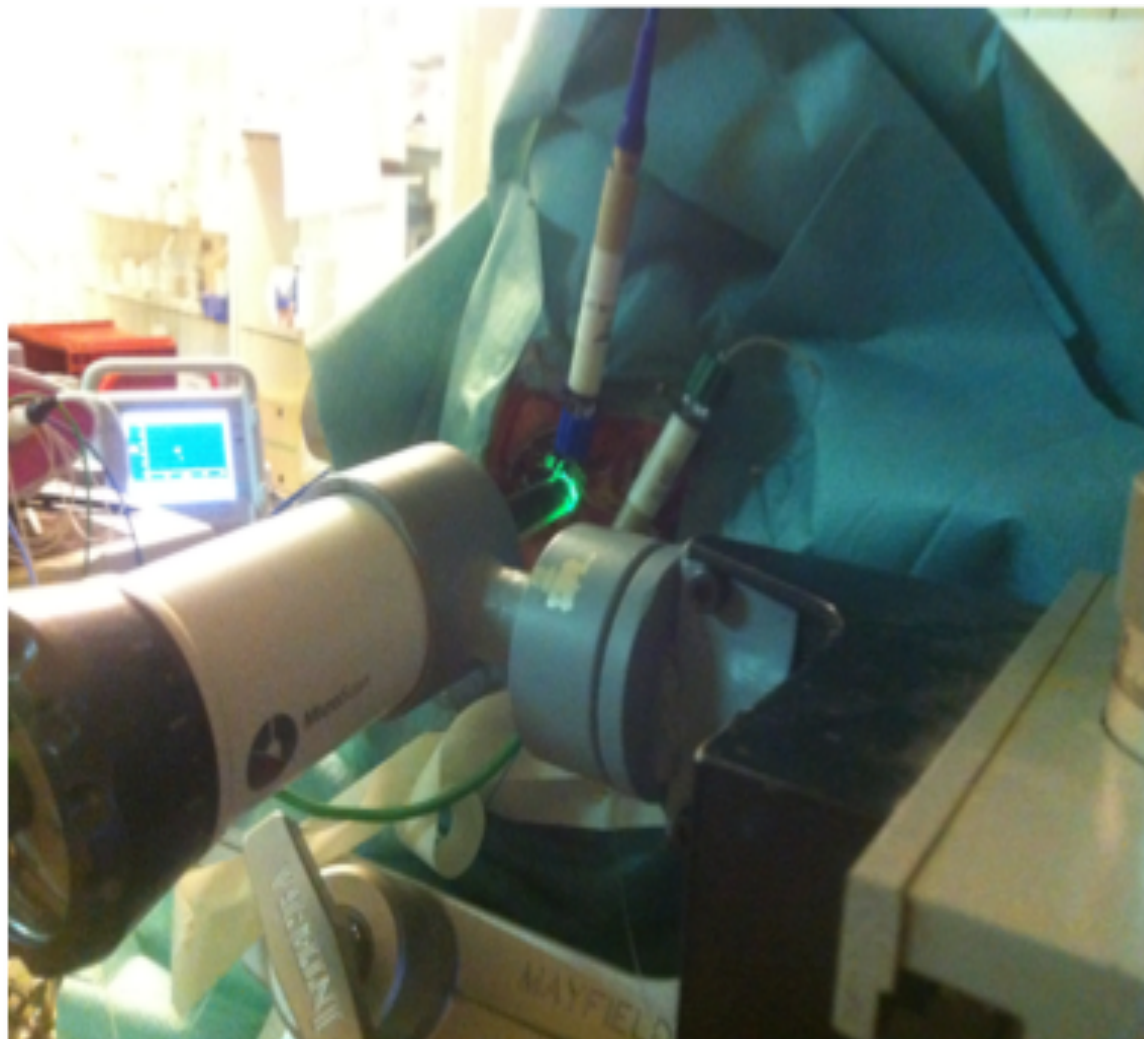

Surgical Procedures


Feces Injection

- Data collection (hourly):
- Systemic Hemodynamics
 - Respiratory Parameters
 - Urine Output
 - Lactate and Glucose levels
 - ABGs

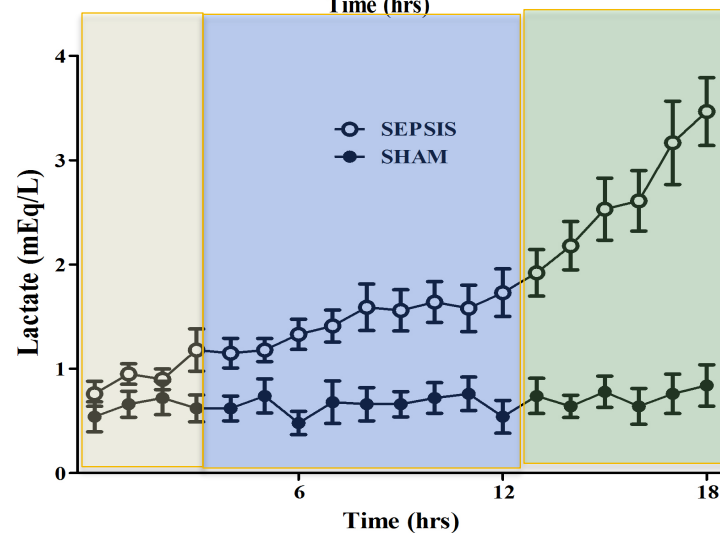
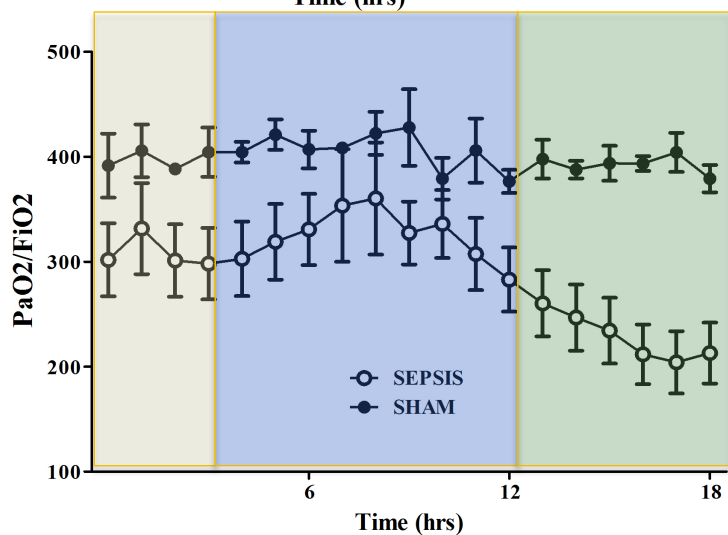
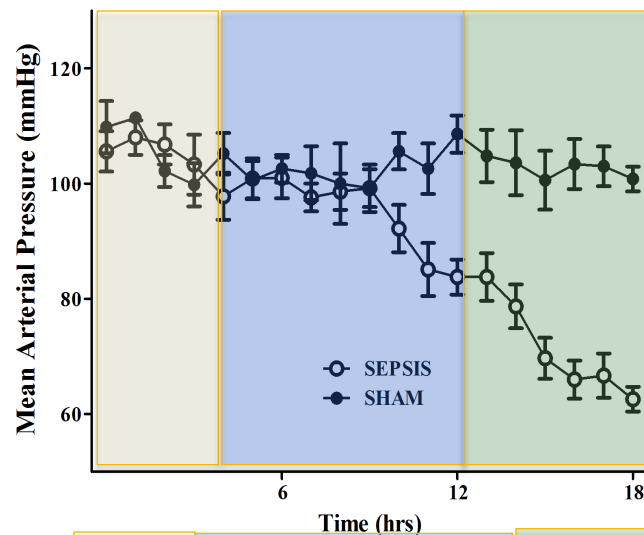
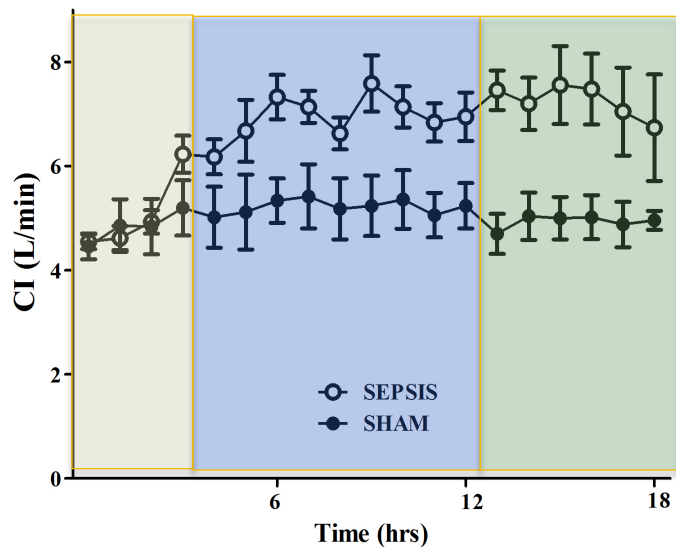


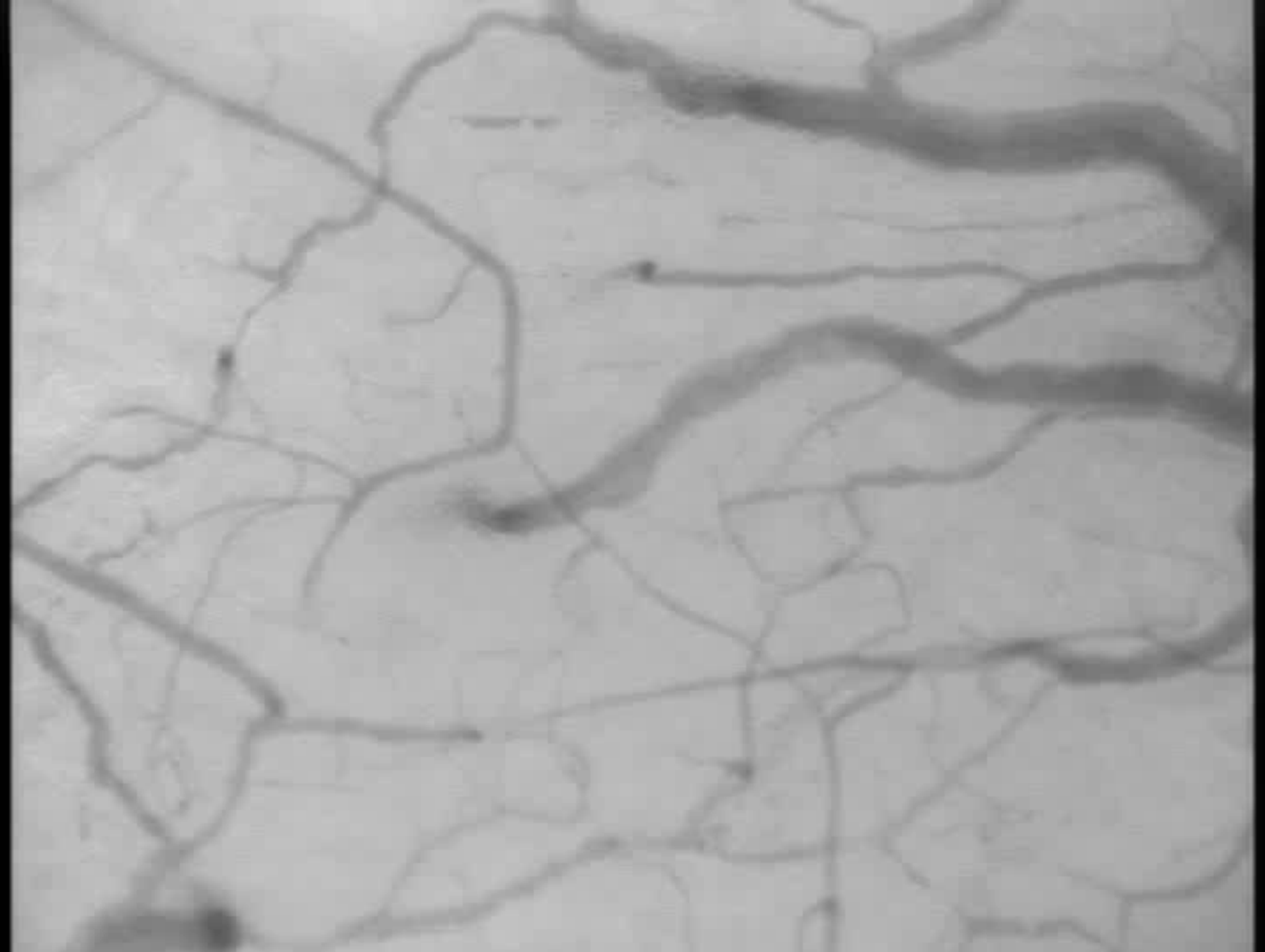
Experimental Model

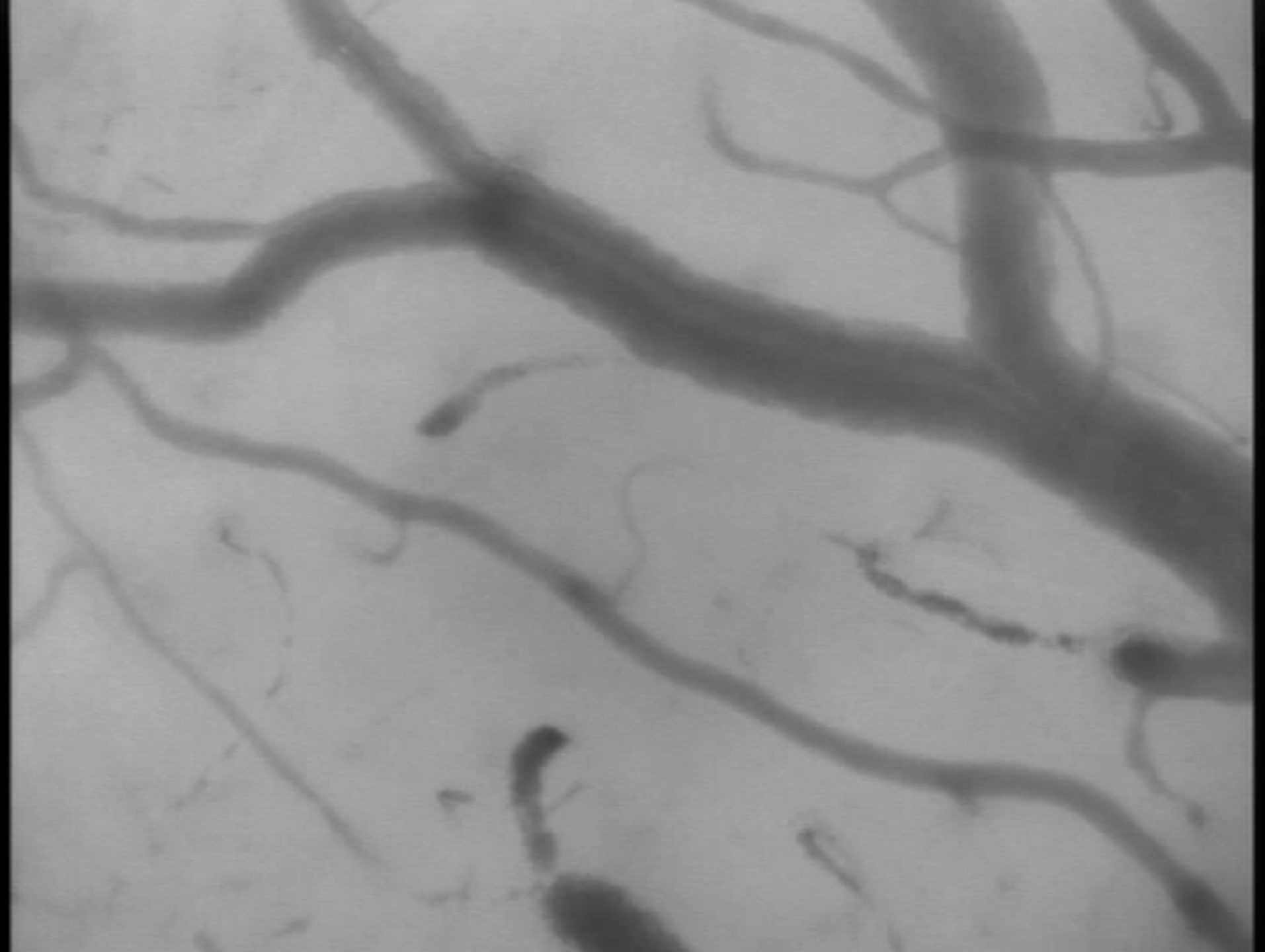




Experiment

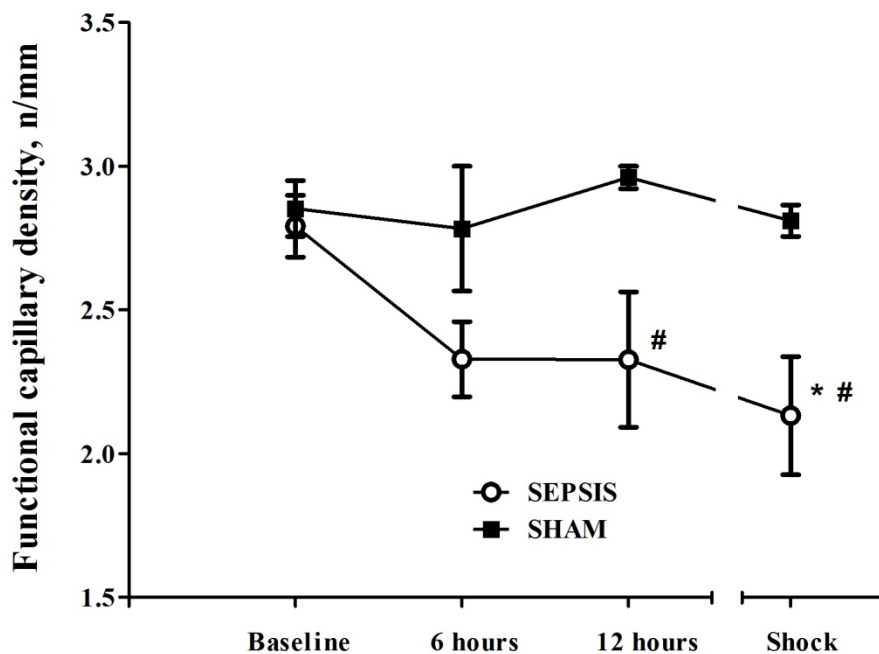






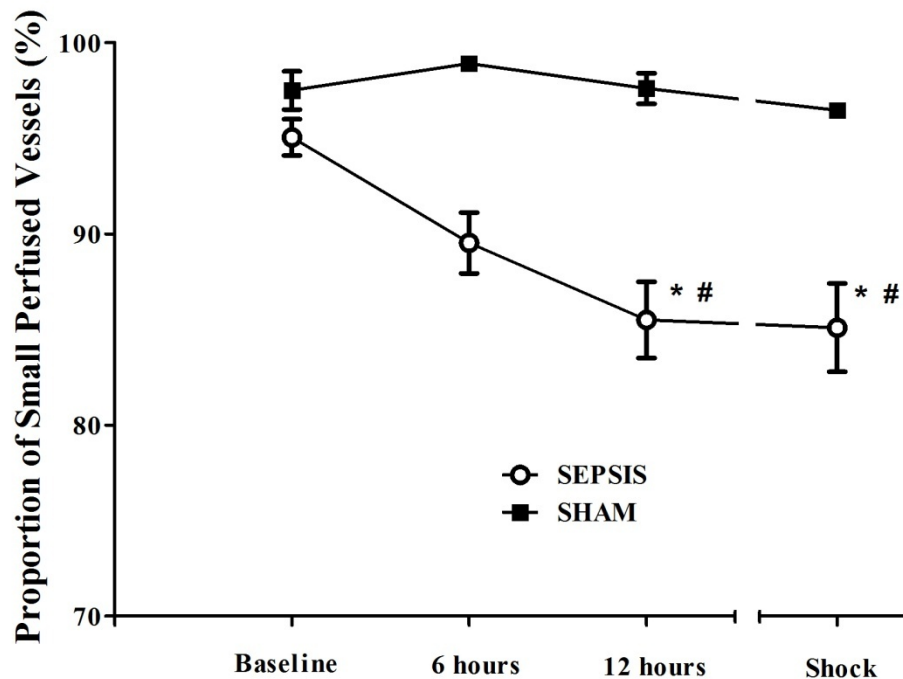
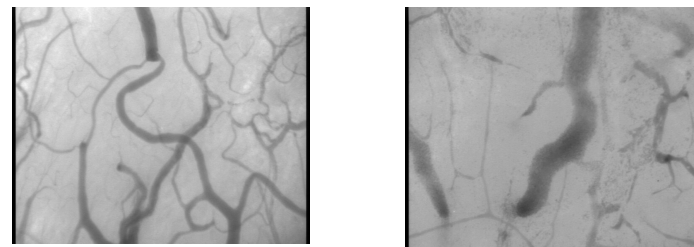


Experiment



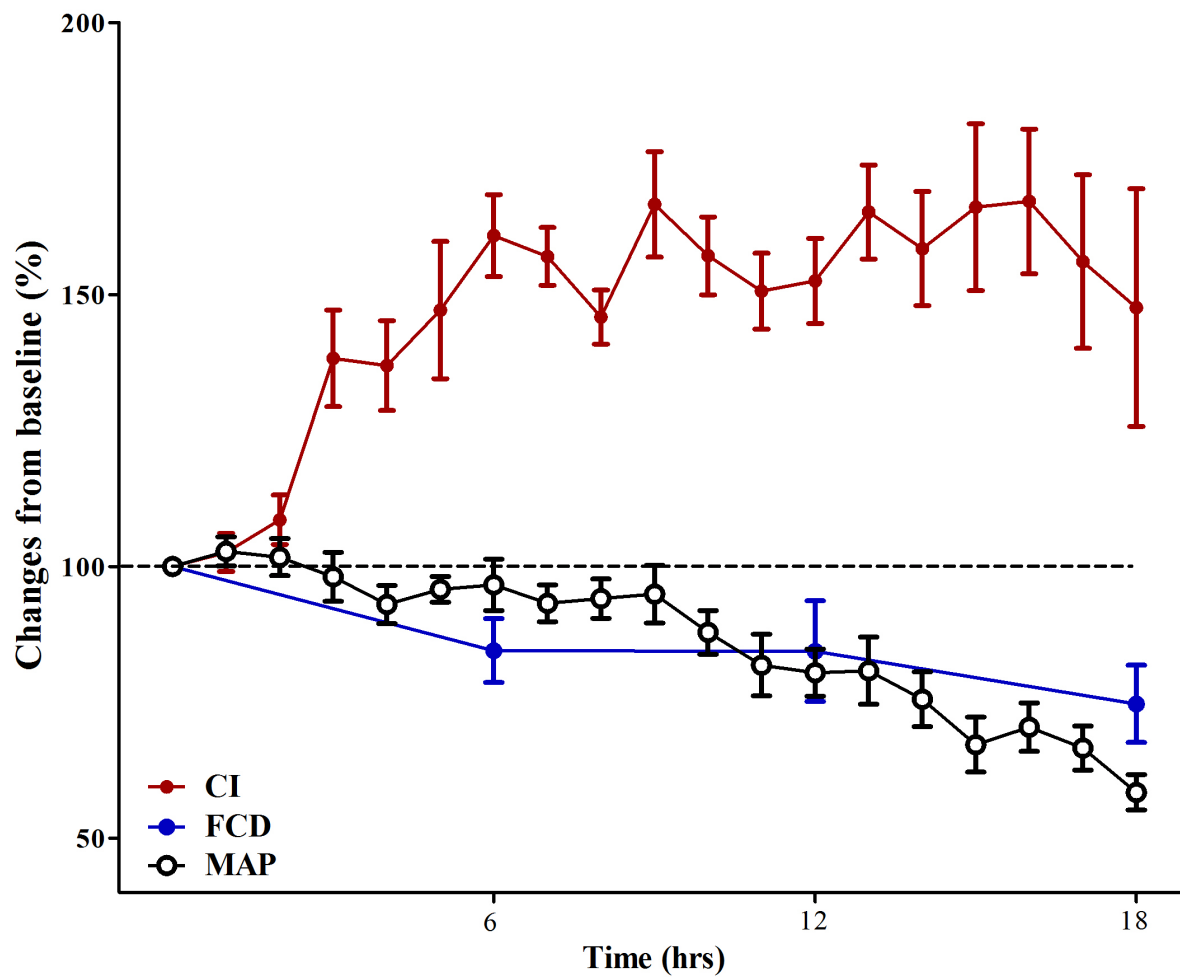
Taccone, Crit Care 2010

Early development of heterogeneity





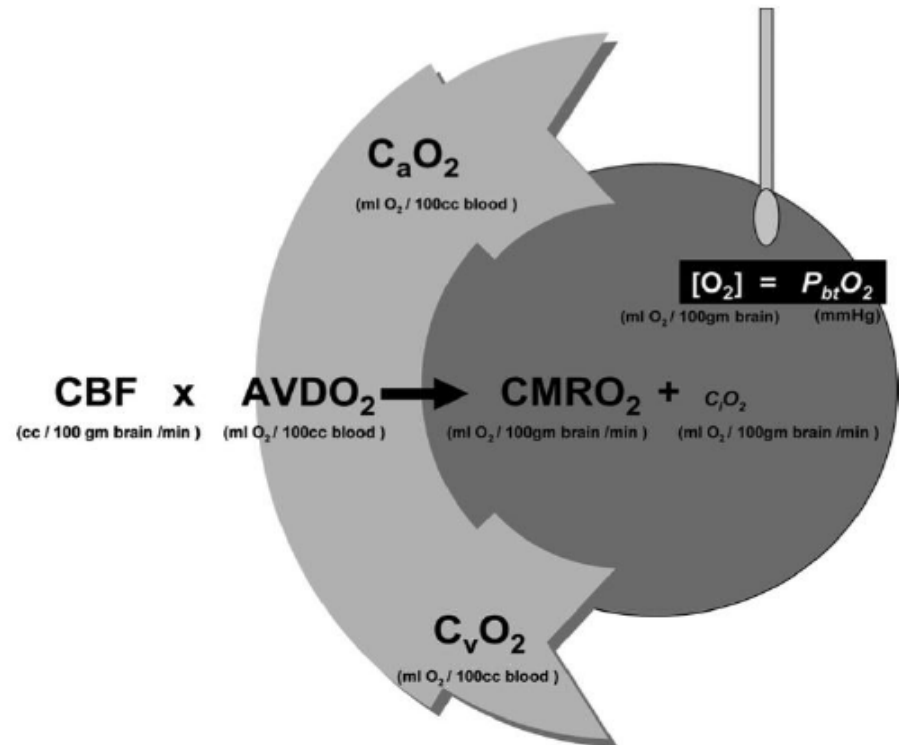
Experiment





Questions

- Which are the consequences on tissue oxygenation ?

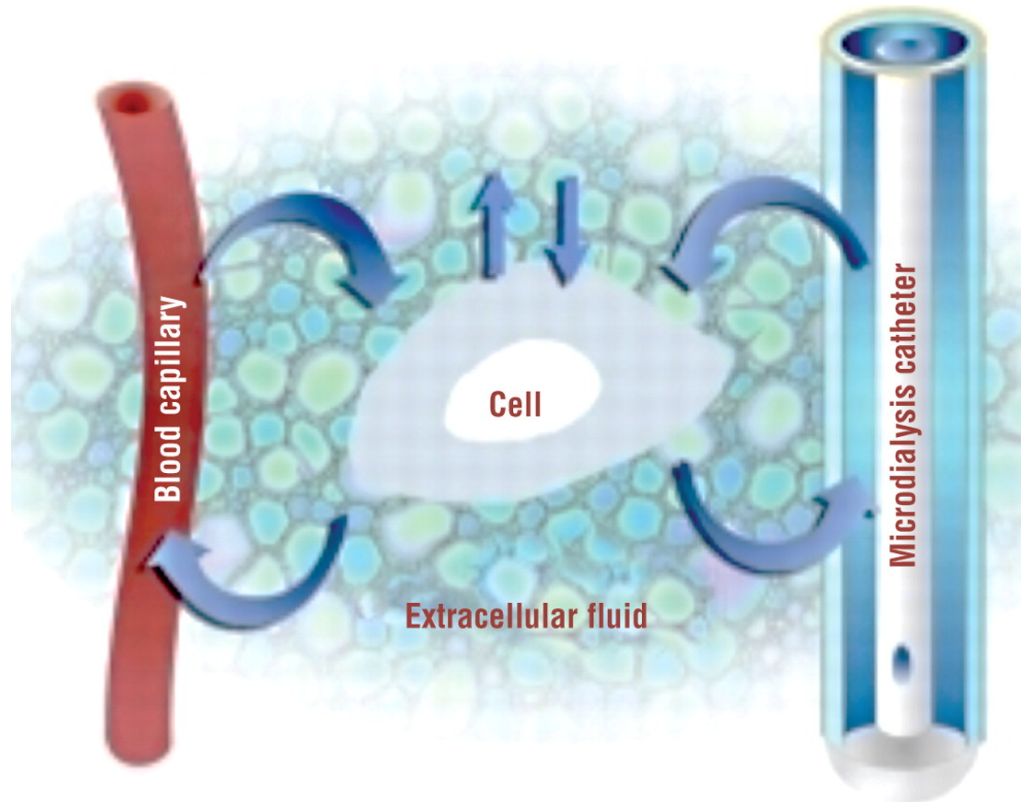


- Partial Ox pressure in the tissue
- 7-15 mm² – 0.5 to 1.0 mm³
- Values: 7-77 mmHg



Questions

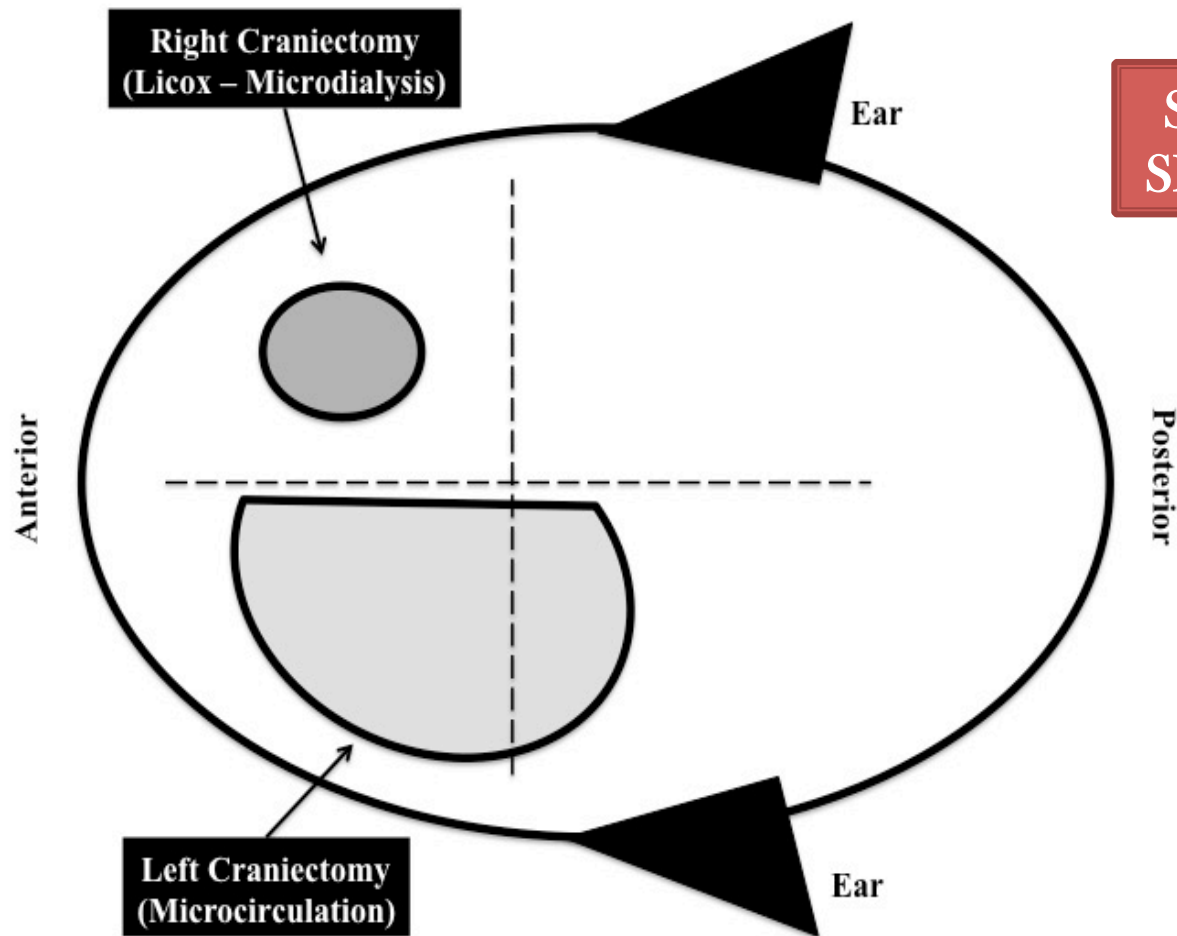
- Which are the consequences on tissue metabolism ?



- Glucose
- Lactate
- Pyruvate
- Glycerol
- Glutamate
- LPR



Experiment



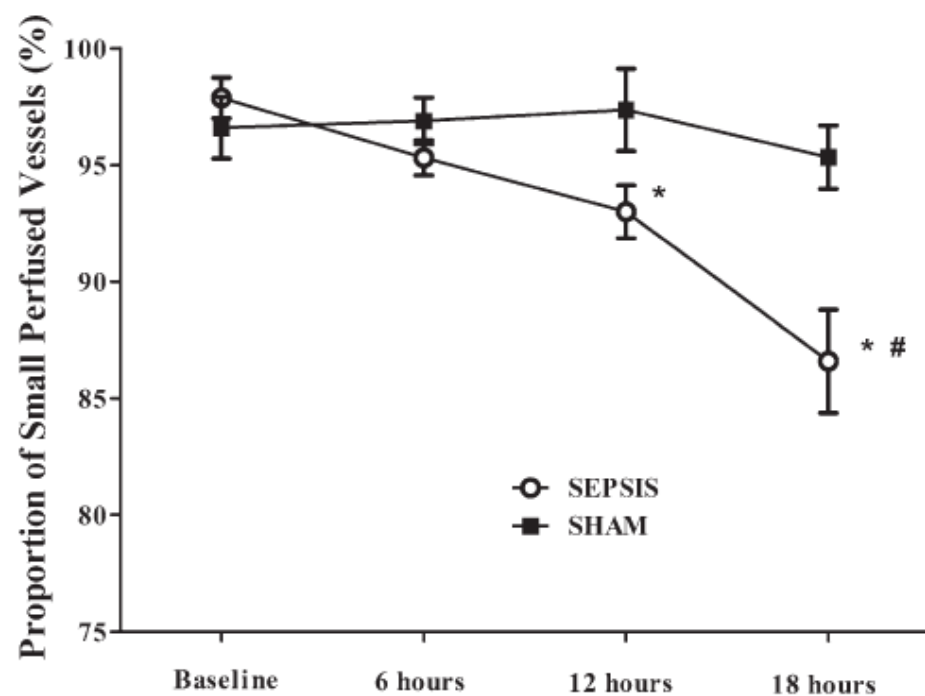
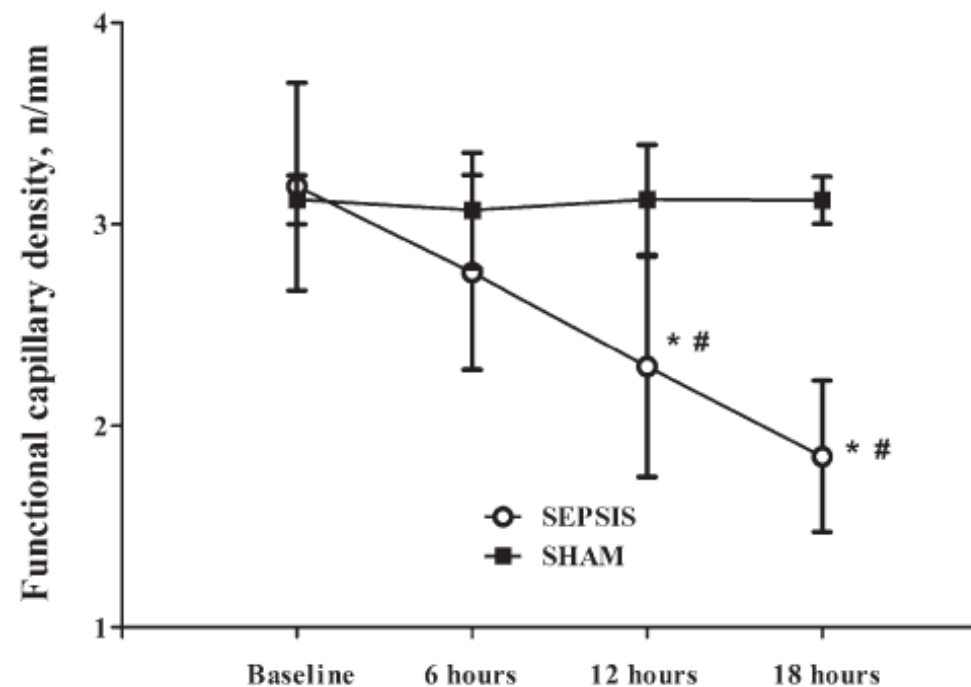
SHAM: n = 5
SEPSIS: n = 10



Experiment

Sepsis Is Associated With Altered Cerebral Microcirculation and Tissue Hypoxia in Experimental Peritonitis*

Fabio Silvio Taccone, MD¹; Fuhong Su, MD, PhD¹; Cathy De Deyne, MD, PhD²; Ali Abdellhai, MD¹; Charalampos Pierrakos, MD¹; Xinrong He, MD¹; Katia Donadello, MD¹; Olivier Dewitte, MD, PhD³; Jean-Louis Vincent, MD, PhD, FCCM¹; Daniel De Backer, MD, PhD¹

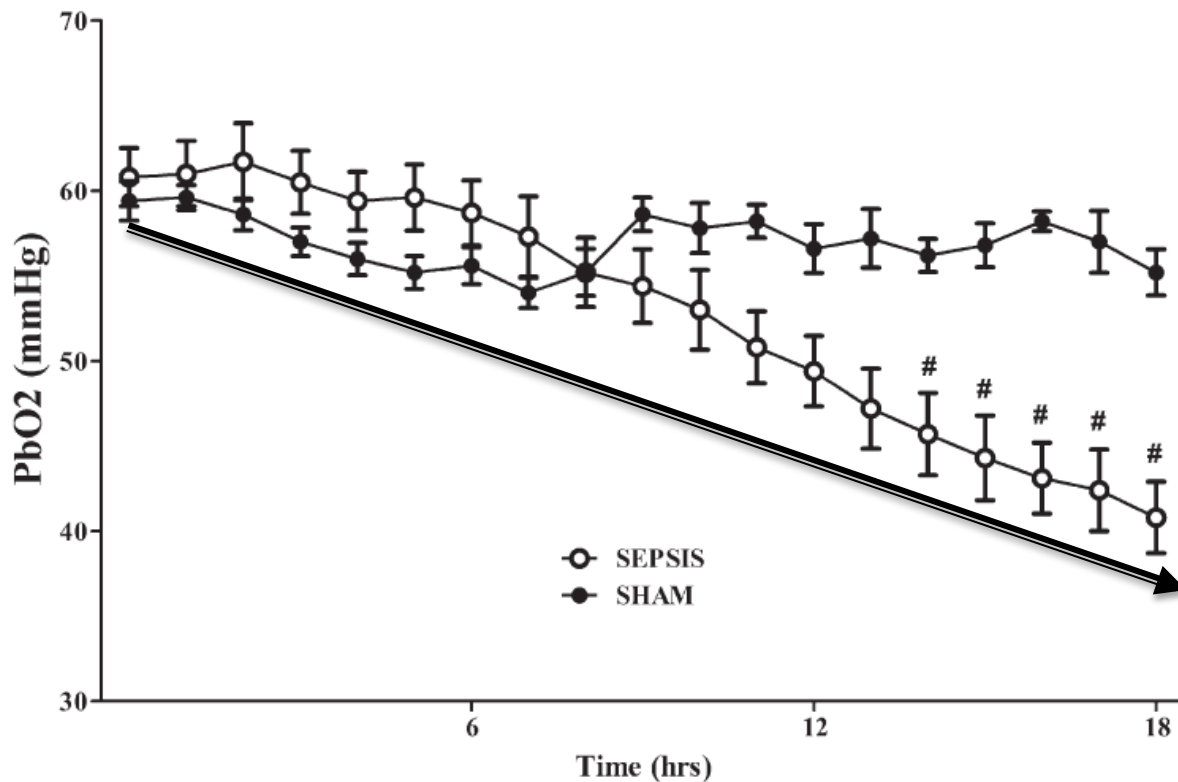




Experiment

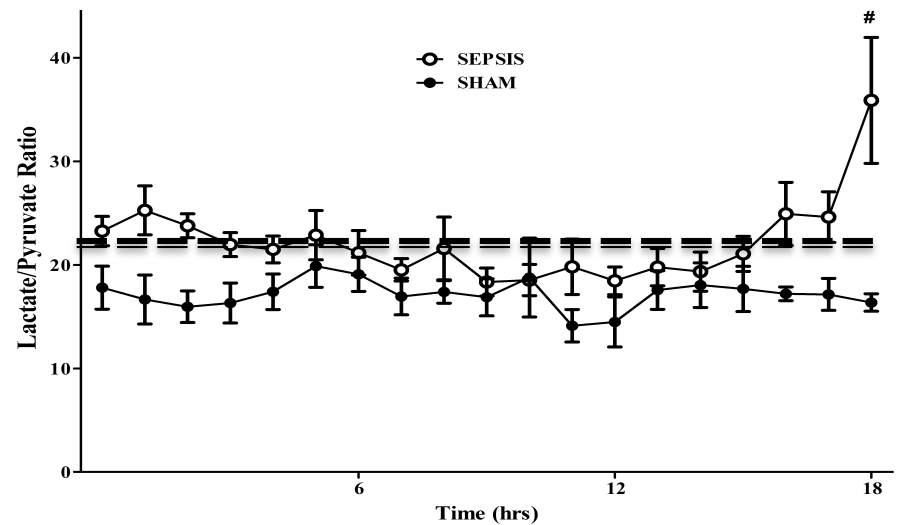
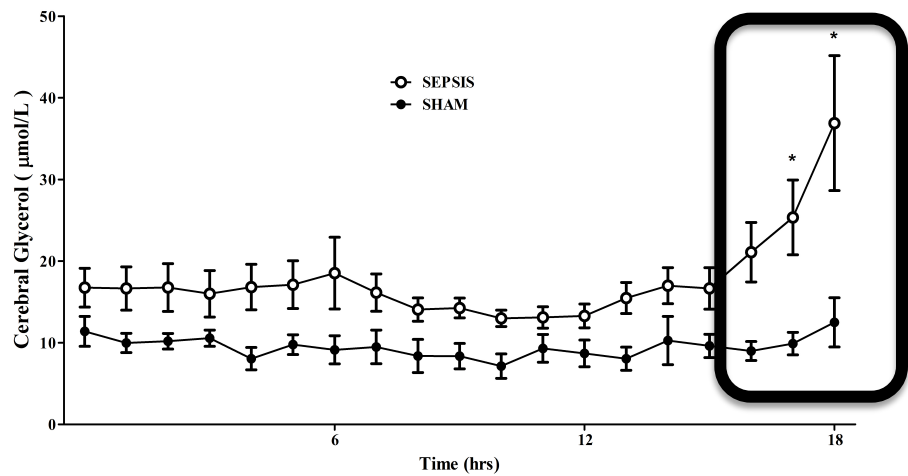
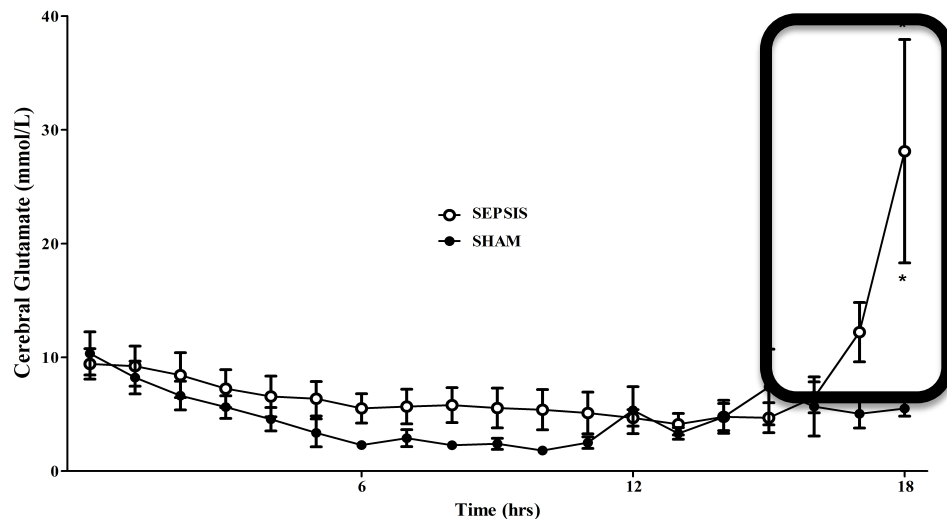
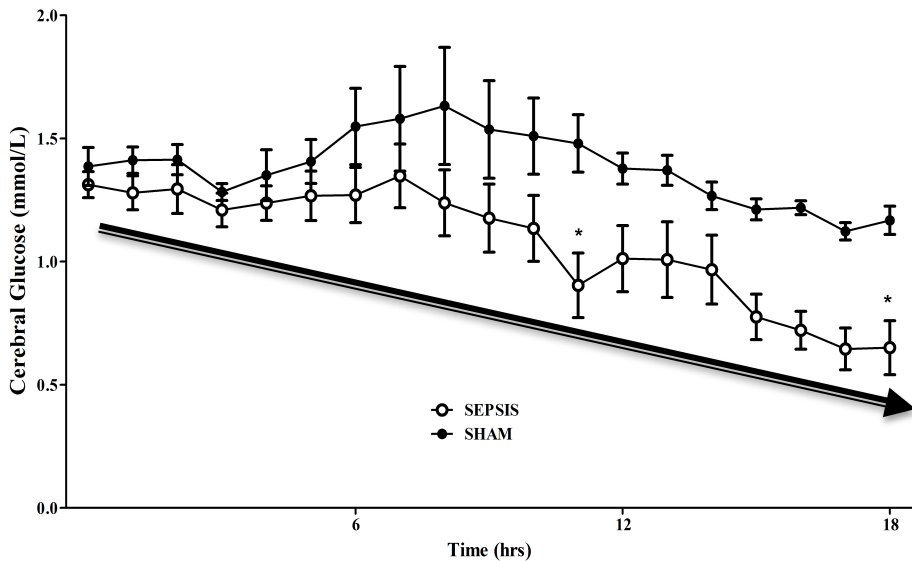
Sepsis Is Associated With Altered Cerebral Microcirculation and Tissue Hypoxia in Experimental Peritonitis*

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Experiment

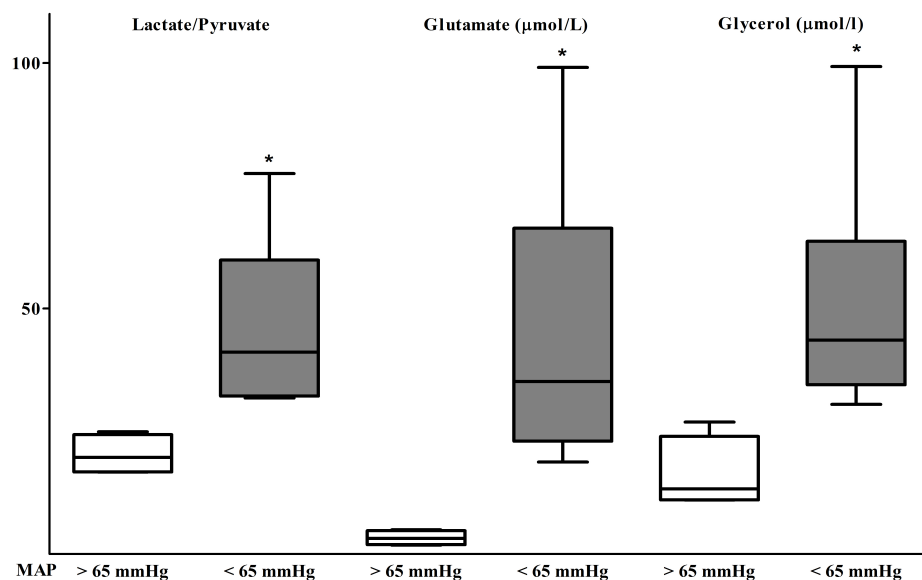




Experiment

Sepsis Is Associated With Altered Cerebral Microcirculation and Tissue Hypoxia in Experimental Peritonitis*

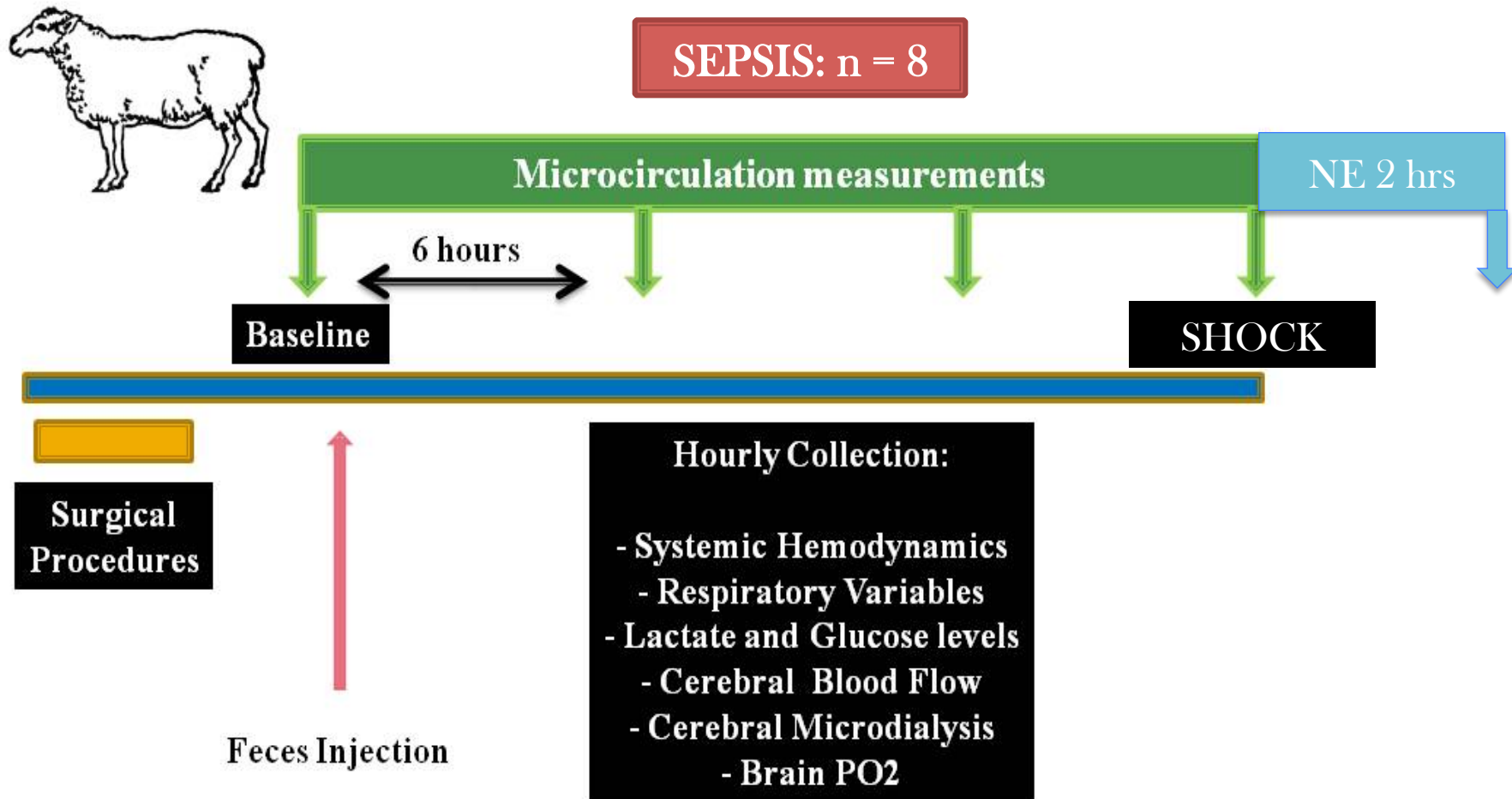
Fabio Silvio Taccone, MD¹; Fuhong Su, MD, PhD¹; Cathy De Deyne, MD, PhD²; Ali Abdellhai, MD¹; Charalampos Pierrakos, MD¹; Xinrong He, MD¹; Katia Donadello, MD¹; Olivier Dewitte, MD, PhD³; Jean-Louis Vincent, MD, PhD, FCCM¹; Daniel De Backer, MD, PhD¹



	MAP	cGLU	LPR	FCD	PbO ₂
MAP	-	r = 0.50 p = 0.16	r = - 0.23 p = 0.48	r = 0.57 p = 0.14	r = 0.59 p = 0.13
cGLU	r = 0.50 p = 0.16	-	r = - 0.23 p = 0.47	r = 0.22 p = 0.50	r = 0.38 p = 0.28
LPR	r = - 0.23 p = 0.48	r = - 0.23 p = 0.47	-	r = - 0.15 p = 0.63	r = - 0.25 p = 0.47
FCD	r = 0.57 p = 0.14	r = 0.22 p = 0.50	r = - 0.15 p = 0.63	-	r = 0.74 p = 0.08
PbO ₂	r = 0.59 p = 0.13	r = 0.38 p = 0.28	r = - 0.25 p = 0.47	r = 0.74 p = 0.08	-

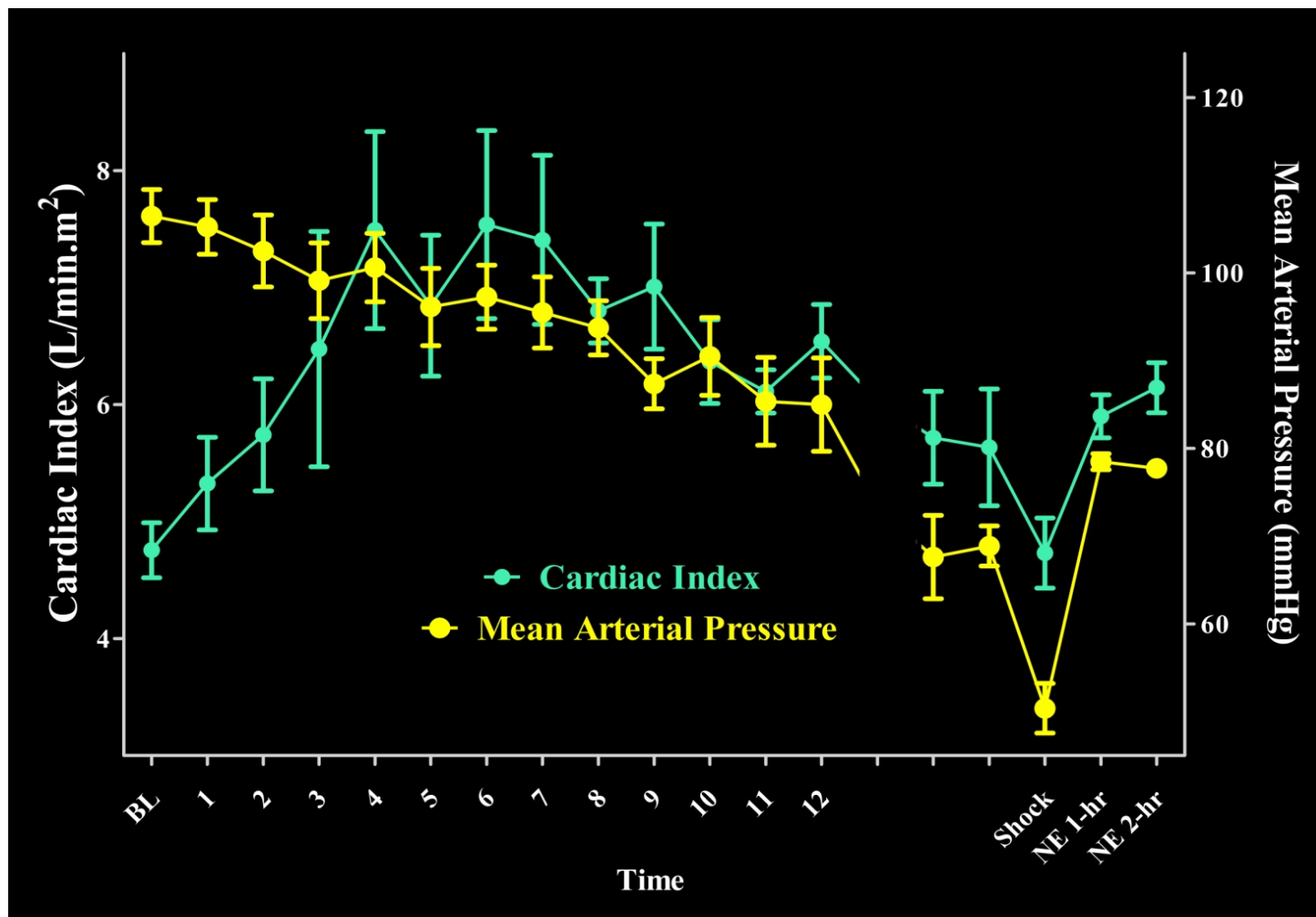


Experiment





Experiment





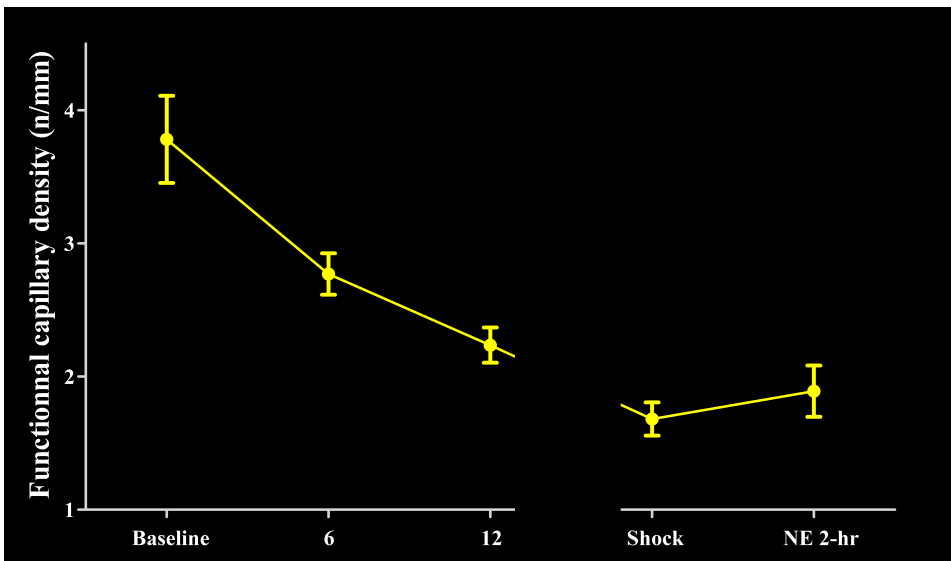
Experiment



	Baseline	Shock	NE 2-hrs	p value
FCD (n/mm)	3.5 [2.9 – 5.7]	1.7 [1.2 – 2.3]	1.9 [1.1 – 2.7]	<0.001
PSPV (%)	99 [92 – 100]	85 [72 – 95]	81 [76 – 89]	0.002
PbO₂ (mmHg)	58 [55 – 59]	42 [35 – 46]	49 [43 – 51]	< 0.001
LPR	17.1 [11.3 – 25.2]	40.8 [37.4 – 71.6]	27.6 [21.1 – 34.8]	< 0.001
Glycerol (mmol/L)	12.2 [6.6 – 25.6]	17.0 [6.7 – 42.5]	22.5 [10.4 – 49.5]	0.005
Glutamate (mmol/L)	7.6 [3.4 – 15.8]	9.4 [8.2 – 42.6]	15.6 [7.4 – 52.5]	0.01
Glucose (mmol/L)	1.08 [0.55 – 2.42]	0.45 [0.02 – 0.88]	0.90 [0.25 – 1.25]	0.02

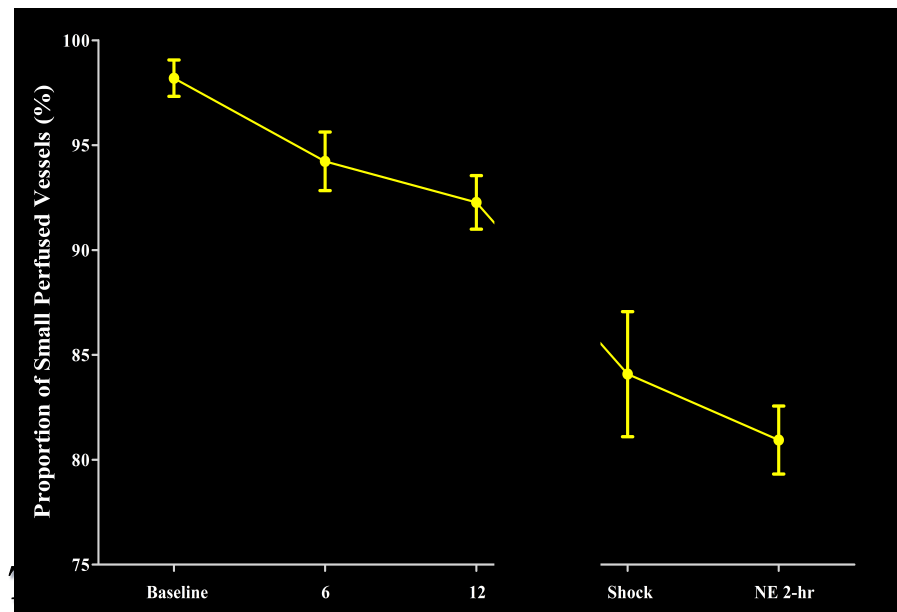


Experiment



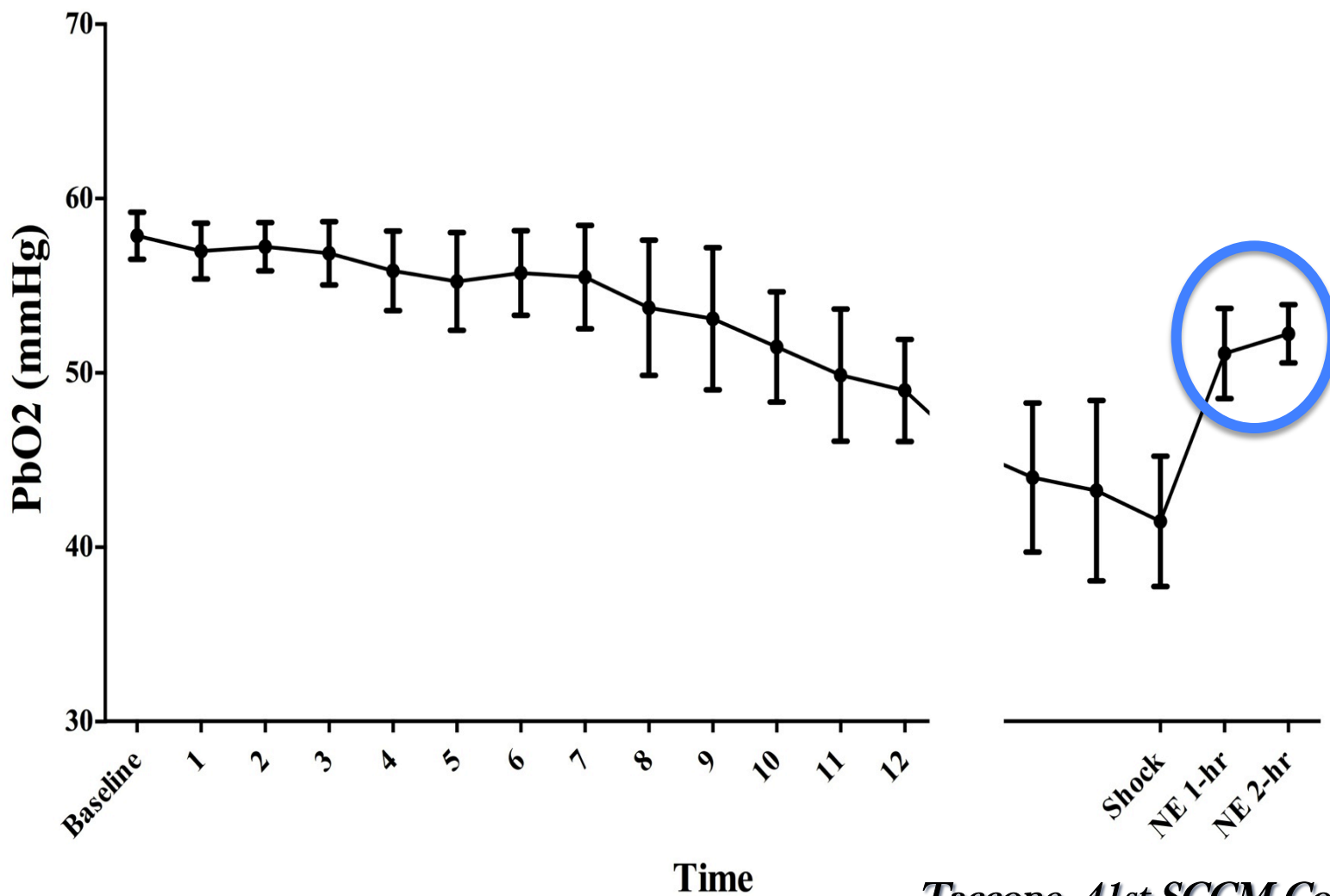
Taccone, 41st SCCM Congress

No effect of NE on cerebral microcirculation



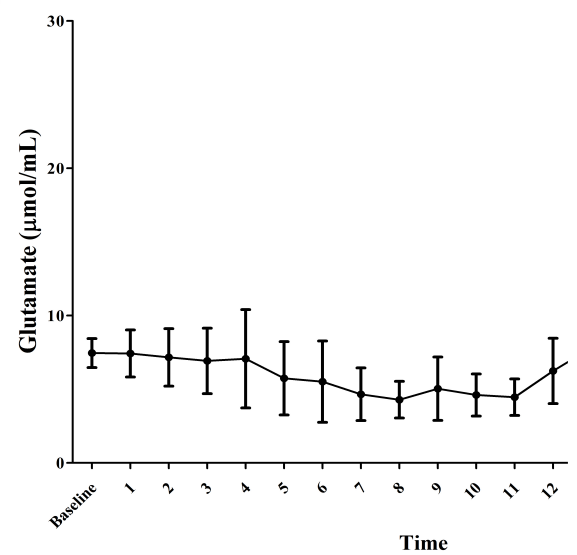
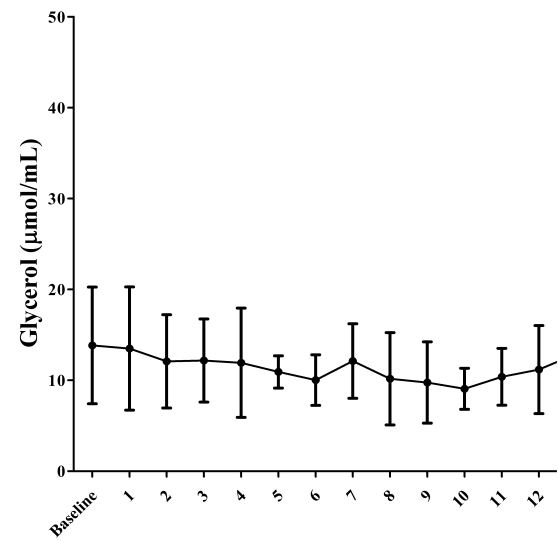
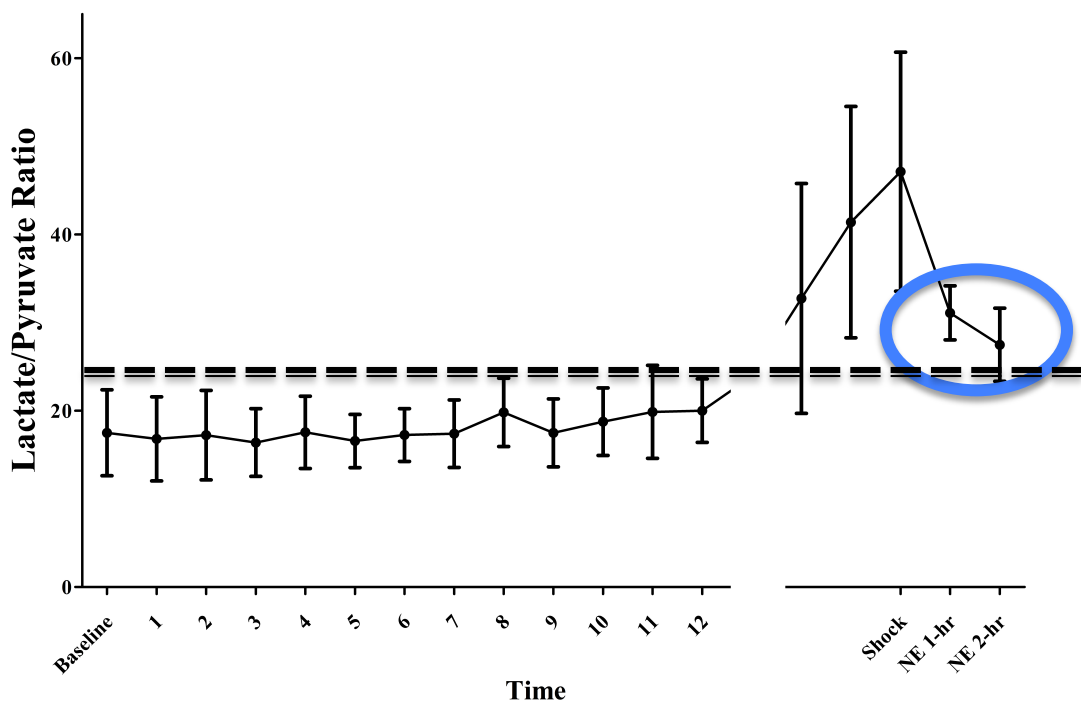


Experiment





Experiment



Taccone, 41st SCCM Congress



Conclusions

- Alterations in brain perfusion may contribute to the development of encephalopathy during sepsis – role of PaCO₂ on CA
- Brain microcirculation is altered during early phase of sepsis
- Microvascular disturbances are more important at shock onset and are independent from systemic hemodynamics
- These microvascular alterations are associated with changes in brain oxygenation and, at shock onset, of brain metabolism
- Reversal of hypotension using NE did not significantly affect microcirculation and brain metabolism

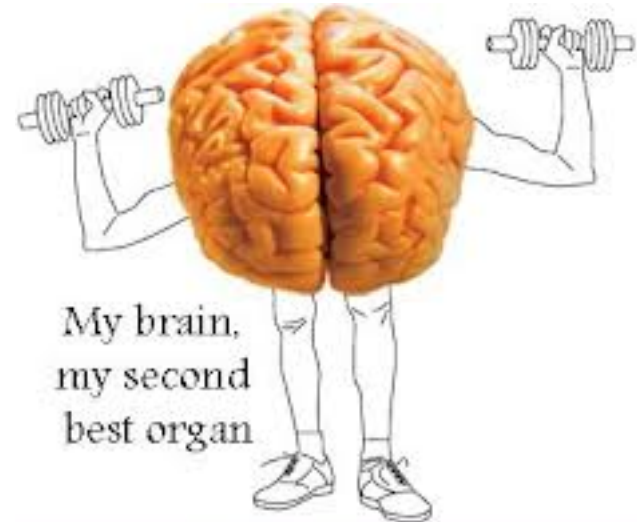


Acknowledgments





THANKS ...



More pics on www.imfunny.net

