L'EGA
VENOSA CENTRALE

Giovanna Guiotto

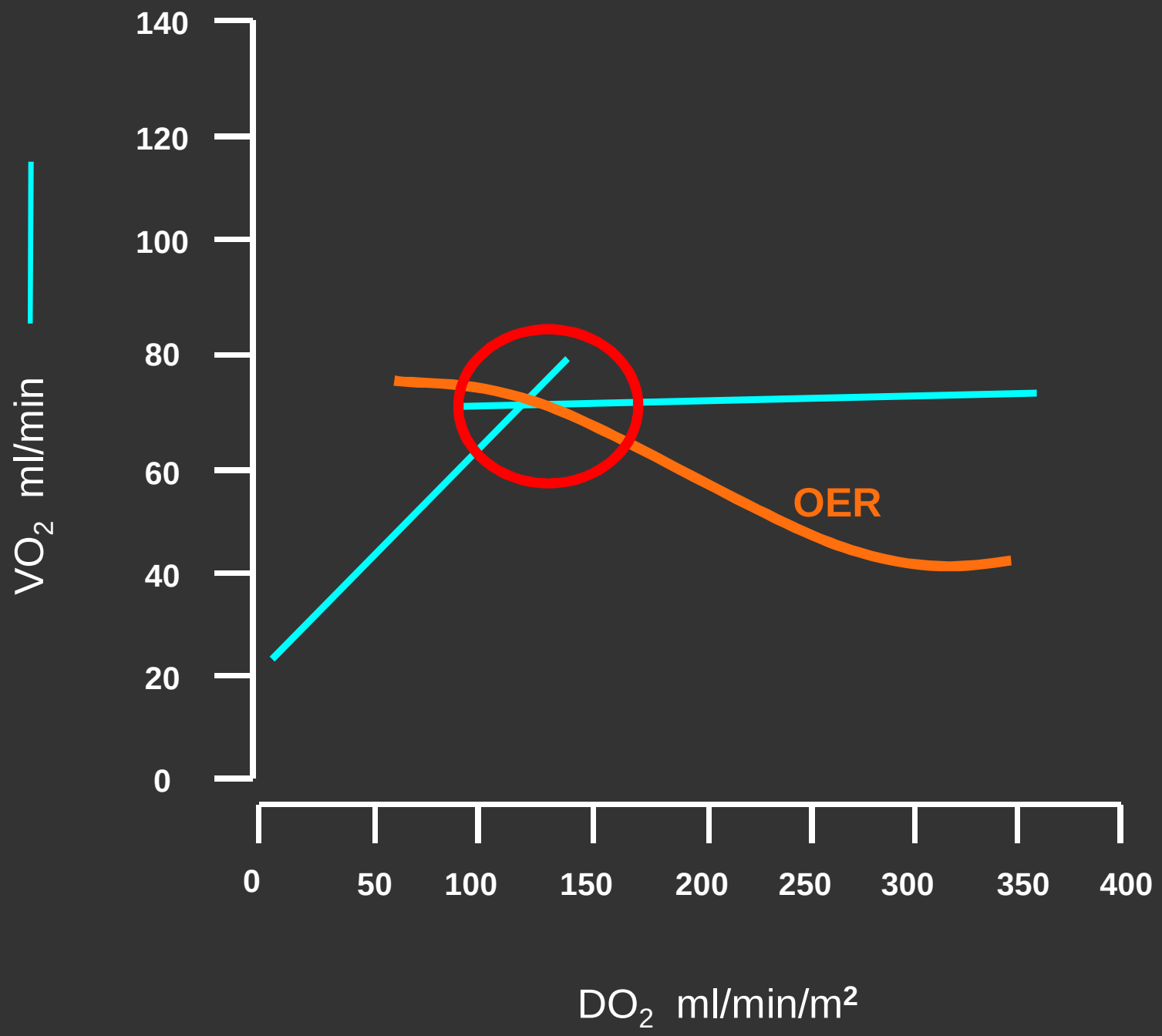
Medicina d'Urgenza-PS
Ospedale San Paolo
Napoli

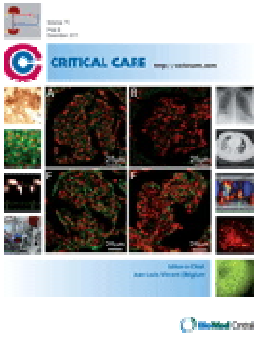
SUPPLY SIDE
(DO_2)

DEMAND
SIDE

O_2 UPTAKE
(VO_2)

The Supply-Dependency

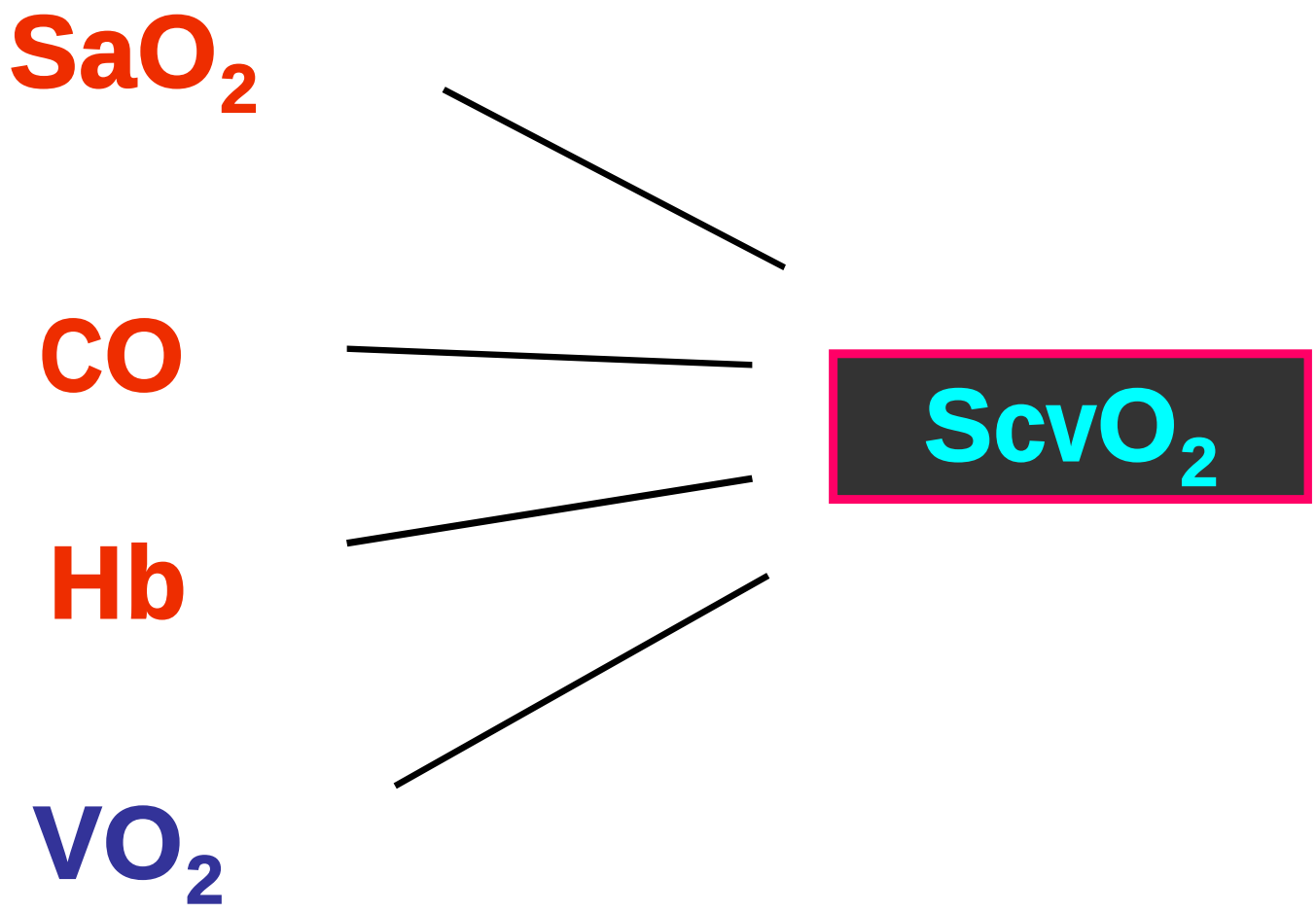




COMMENTARY

SvO_2 to monitor resuscitation of septic patients: let's just understand the basic physiology

Jean-Louis Teboul[1,2*], Olfa Hamzaoui[3] and Xavier Monnet[1,2]



Critical Care 2011, 15:1005

van Beest *et al. Critical Care* 2011, 15:232
http://ccforum.com/content/15/5/232

CRITICAL CARE

REVIEW

Clinical review: use of venous oxygen saturations as a goal – a yet unfinished puzzle

Paul van Beest[1]*, Götz Wietasch[1], Thomas Scheeren[1], Peter Spronk[2,3,4] and Michaël Kuiper[3,4,5]

1) $ScvO_2 = SvO_2$?

2) $ScvO_2$ = therapeutic goal in critically ill patients?

1) $ScvO_2 = SvO_2$?

van Beest *et al. Critical Care* 2011, 15:232
http://ccforum.com/content/15/5/232

CRITICAL CARE

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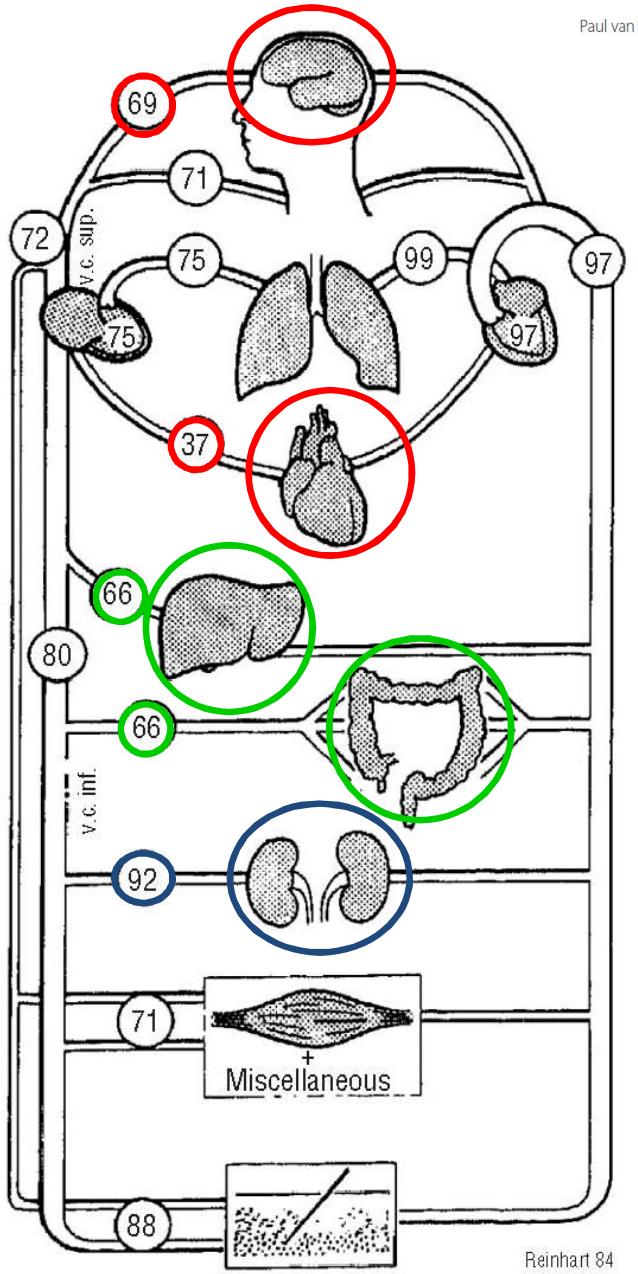
Clinical review: use of venous oxygen saturations as a goal – a yet unfinished puzzle

Paul van Beest[1*], Götz Wietasch[1], Thomas Scheeren[1], Peter Spronk[2,3,4] and Michaël Kuiper[3,4,5]

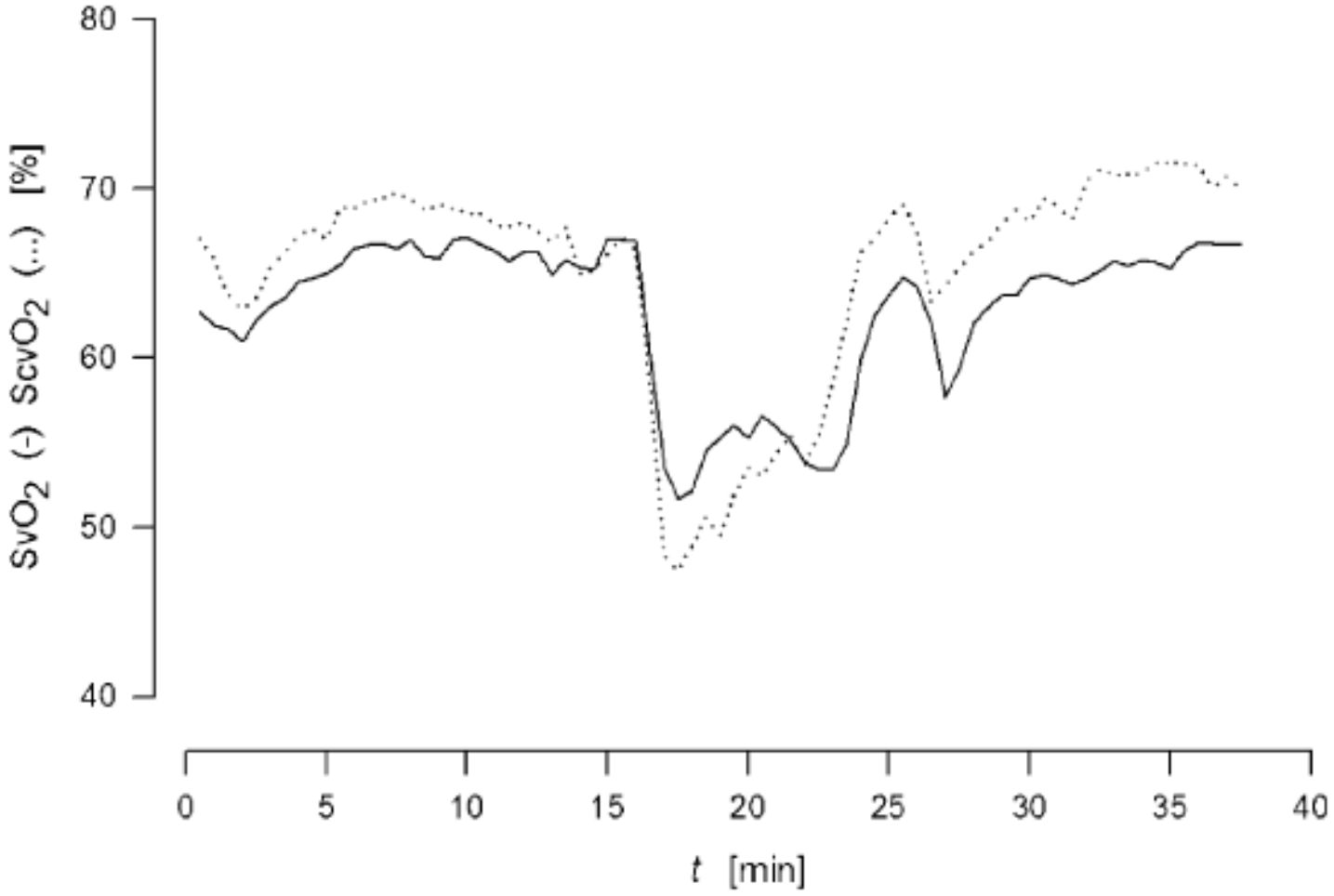


Intensive Care Med (2004) 30:1572–1578
DOI 10.1007/s00134-004-2337-y

ORIGINAL

Konrad Reinhart
Hans-Jörg Kuhn
Christiane Hartog
Donald L. Bredle

Continuous central venous and pulmonary artery oxygen saturation monitoring in the critically ill



Anesthesiology 2005; 103:249–57

Trends but Not Individual Values of Central Venous Oxygen Saturation Agree with Mixed Venous Oxygen Saturation during Varying Hemodynamic Conditions

Michael H. Dueck, M.D., D.E.A.A., Markus Klimek, M.D., D.E.A.A.,† Stefan Appenrodt,‡ Christoph Weigand, M.D.,* Ulf Boerner, M.D.§*

"Exact numerical values of $ScvO_2$ are not equivalent to those of SvO_2 in varying hemodynamic conditions.

However, for clinical purposes, the trend of $ScvO_2$ may be substituted for the trend of SvO_2"

2) ScvO2 = therapeutic goal ?

van Beest *et al. Critical Care* 2011, 15:232
http://ccforum.com/content/15/5/232

CRITICAL CARE

REVIEW

Clinical review: use of venous oxygen saturations as a goal – a yet unfinished puzzle

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Ander and colleagues [35]	Controls $n = 17$, high lactate group $n = 22$, low lactate group $n = 5$; chronic congestive heart failure; ED	$ScvO_2$ lower in high lactate group than in low lactate group (32 ± 12% vs. 51 ± 13%) and control (60 ± 6%); after treatment There was a significant decrease of lactate and increase in $ScvO_2$ in the high lactate group compared with the low lactate group
Scalea and colleagues [40]	$n = 26$, trauma patients with suggested blood loss	Despite stable vital signs, 39% of the patients had $ScvO_2$ <65%; these patients required more transfusions; linear regression analysis demonstrated superiority of $ScvO_2$ to predict blood loss compared with normally allowed parameters
Di Filippo and colleagues [41]	$n = 121$ brain injury after trauma; noncontrolled study	Nonsurvivors showed higher lactate, lower $ScvO_2$ values; patients with $ScvO_2$ ≤65% showed higher 28-day mortality, ICU LOS and hospital LOS than patients with $ScvO_2$ >65%
Pearse and colleagues [65]	$n = 118$, major surgery	After multivariate analysis, lowest CI and lowest $ScvO_2$ were associated with postoperative complications; optimal $ScvO_2$ cut-off value for morbidity prediction was 64.4%; in the first hour after surgery, significant reductions in $ScvO_2$ were observed, without significant changes in CI or oxygen delivery index

2) ScvO2 = therapeutic goal ?

van Beest *et al. Critical Care* 2011, 15:232
http://ccforum.com/content/15/5/232

CRITICAL CARE

REVIEW

Clinical review: use of venous oxygen saturations as a goal – a yet unfinished puzzle

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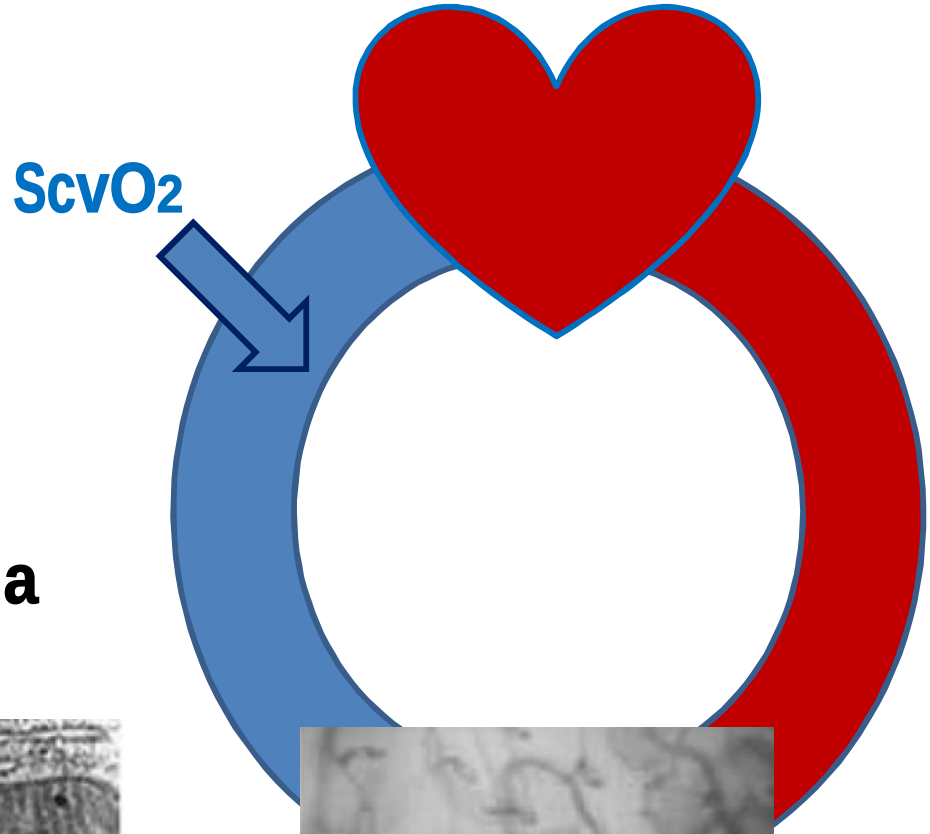
Septic shock

Rivers and colleagues [73]	*n* = 263; RCT; EGDT vs. controls; severe sepsis, septic shock; ED	EGDT (goal $ScvO_2$ ≥70%) showed better survival (absolute 16%), lower lactate; more fluids, red cell transfusion and inotropics
Trzeciak and colleagues [74]	*n* = 16 pre-EGDT; *n* = 22 EGDT	Less PAC utilisation; more fluids and dobutamine used; similar costs
Kortgen and colleagues [75]	*n* = 30 controls; *n* = 30 septic shock Implementation procedure: septic shock	Implementation: use of dobutamine, insulin, hydrocortisone and activated protein C increased Amount of fluids and packed blood cells unaffected Mortality significantly lower after implementation (27% vs. 53%; $P < 0.05$).
Jones and colleagues [76]	*n* = 79 pre-intervention; *n* = 77 post-intervention; ED	Controls: more renal failure at baseline Greater crystalloid volume and vasopressor infusion Mortality 18 vs. 27%
Micek and colleagues [78]	*n* = 60 before implementation order set; *n* = 60 after implementation order set; ED	More appropriate antimicrobial regimen More fluids, more vasopressors Less vasopressor by time of transfer to the ICU
Shapiro and colleagues [80]	*n* = 51 historical controls; *n* = 79 septic shock	Patients received more fluids, earlier antibiotics, more vasopressors, tighter glucose control, more frequent assessment of adrenal function, not more packed blood cells

Oxygen utilization



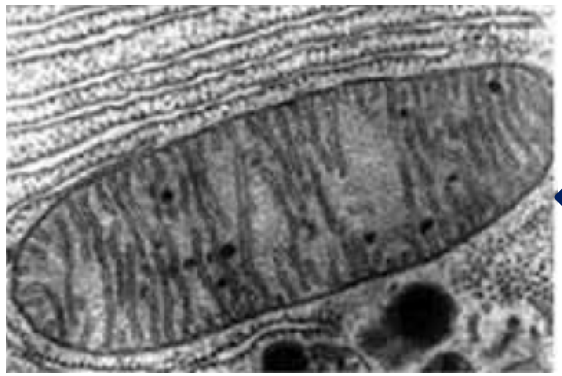
Macrocirculation

O2 supply

DO2 = CO × Hb × SaO2

Mitochondria

O2 use



Microcirculation

O2 diffusion/extraction

Velissaris *et al. Critical Care* 2011, **15**:R177
http://ccforum.com/content/15/4/R177

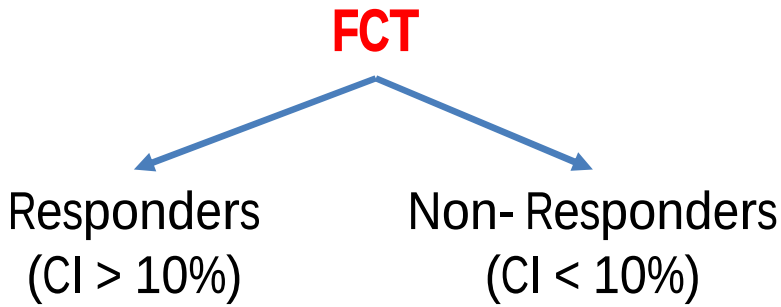
CRITICAL CARE

RESEARCH Open Access

High mixed venous oxygen saturation levels do not exclude fluid responsiveness in critically ill septic patients

Dimitrios Velissaris, Charalampos Pierrakos, Sabino Scolletta, Daniel De Backer and Jean Louis Vincent*

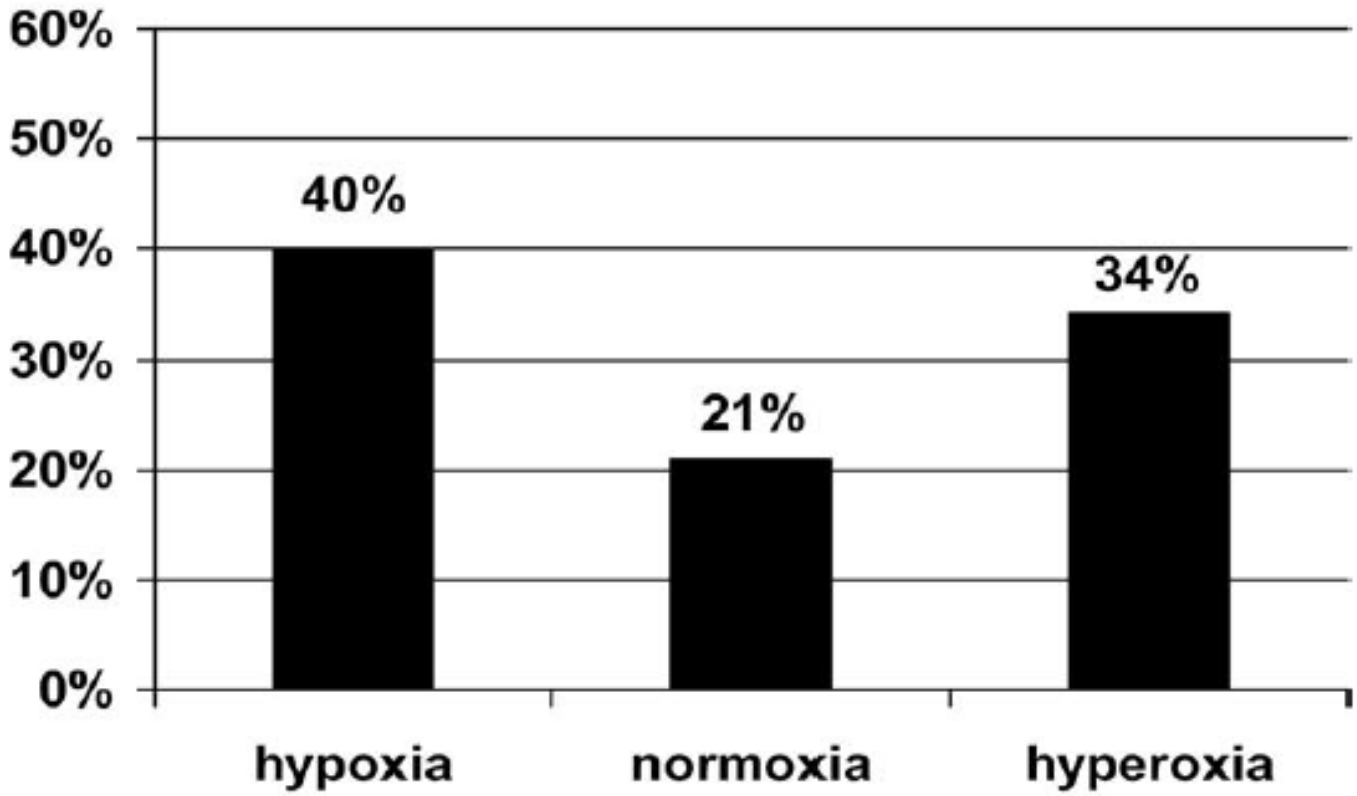
65 critically ill patients with severe sepsis



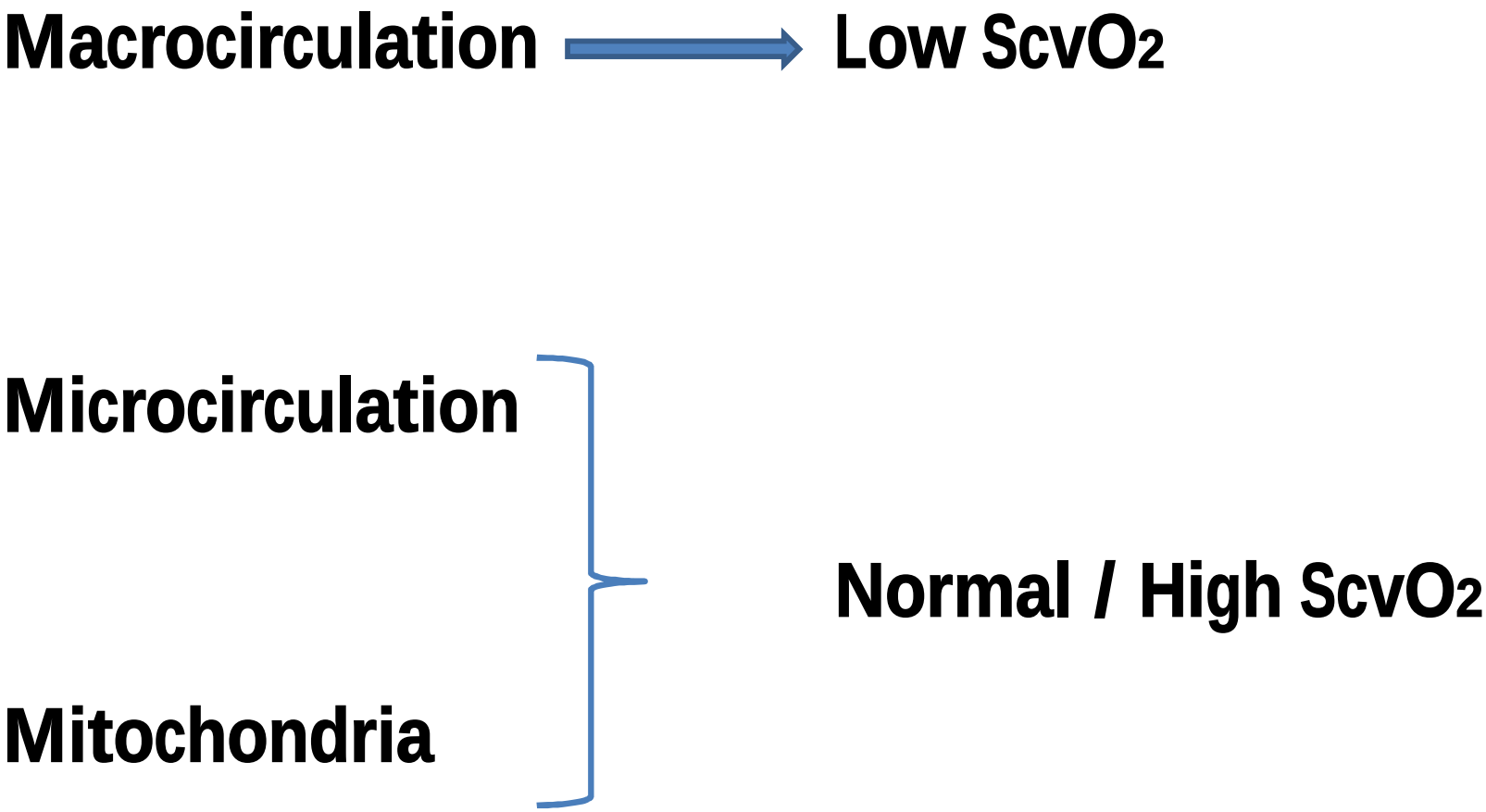
The response of septic patients to a fluid challenge is **independent of baseline SvO2.** The presence of a high SvO2 does not necessarily exclude the need for further fluid administration

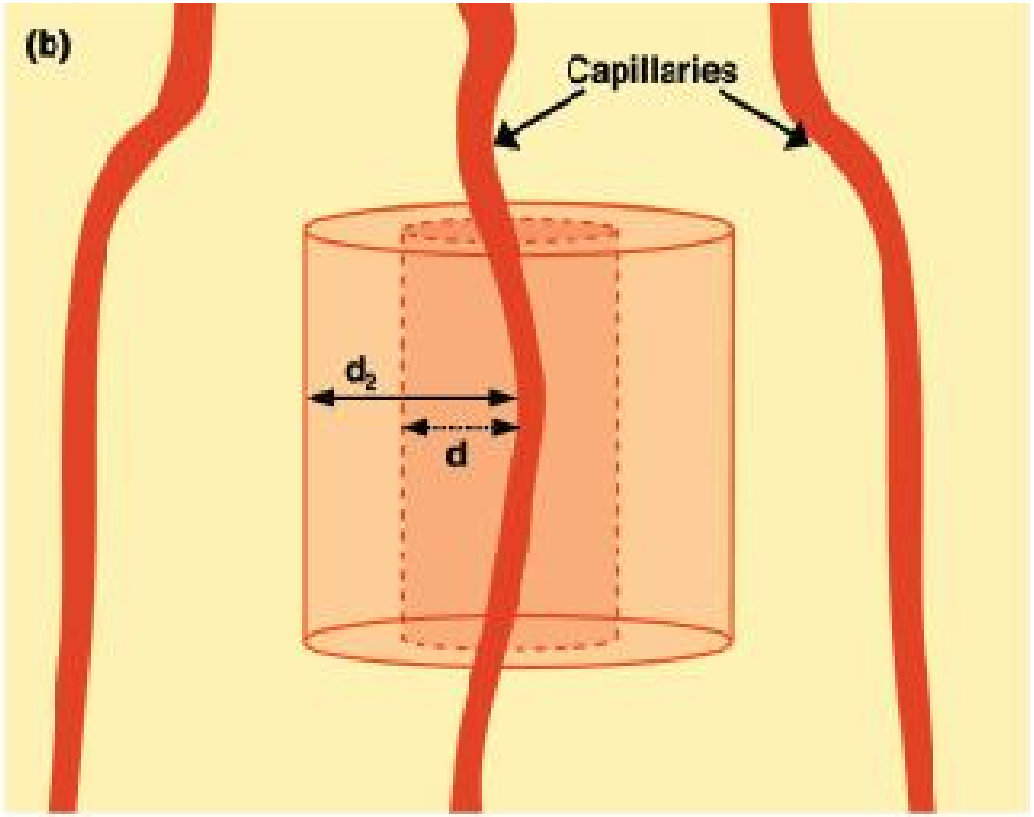
Multicenter Study of Central Venous Oxygen Saturation ($ScvO_2$) as a Predictor of Mortality in Patients With Sepsis

Jennifer V. Pope, MD
Alan E. Jones, MD
David F. Gaieski, MD
Ryan C. Arnold, MD
Stephen Trzeciak, MD,
Nathan I. Shapiro, MD



Ann Emerg Med. 2010;55:40-46

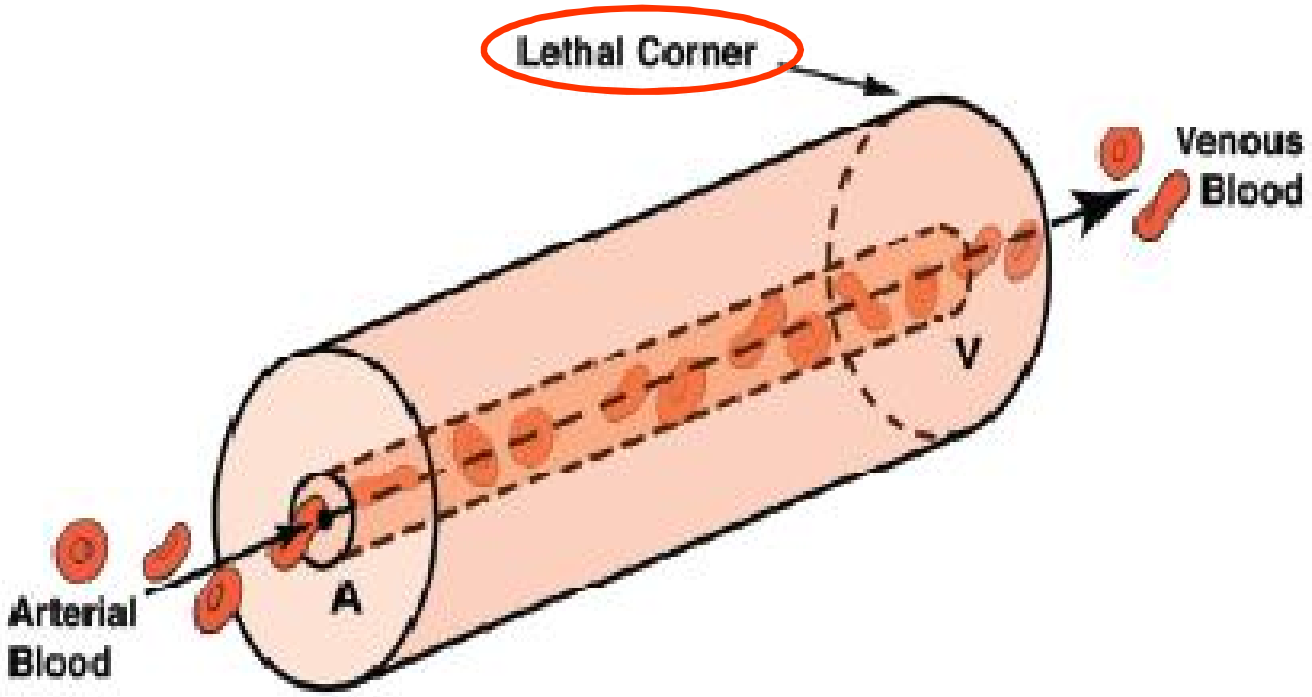

Macrocirculation
Low ScvO2
Microcirculation
Mitochondria
Normal / High ScvO2



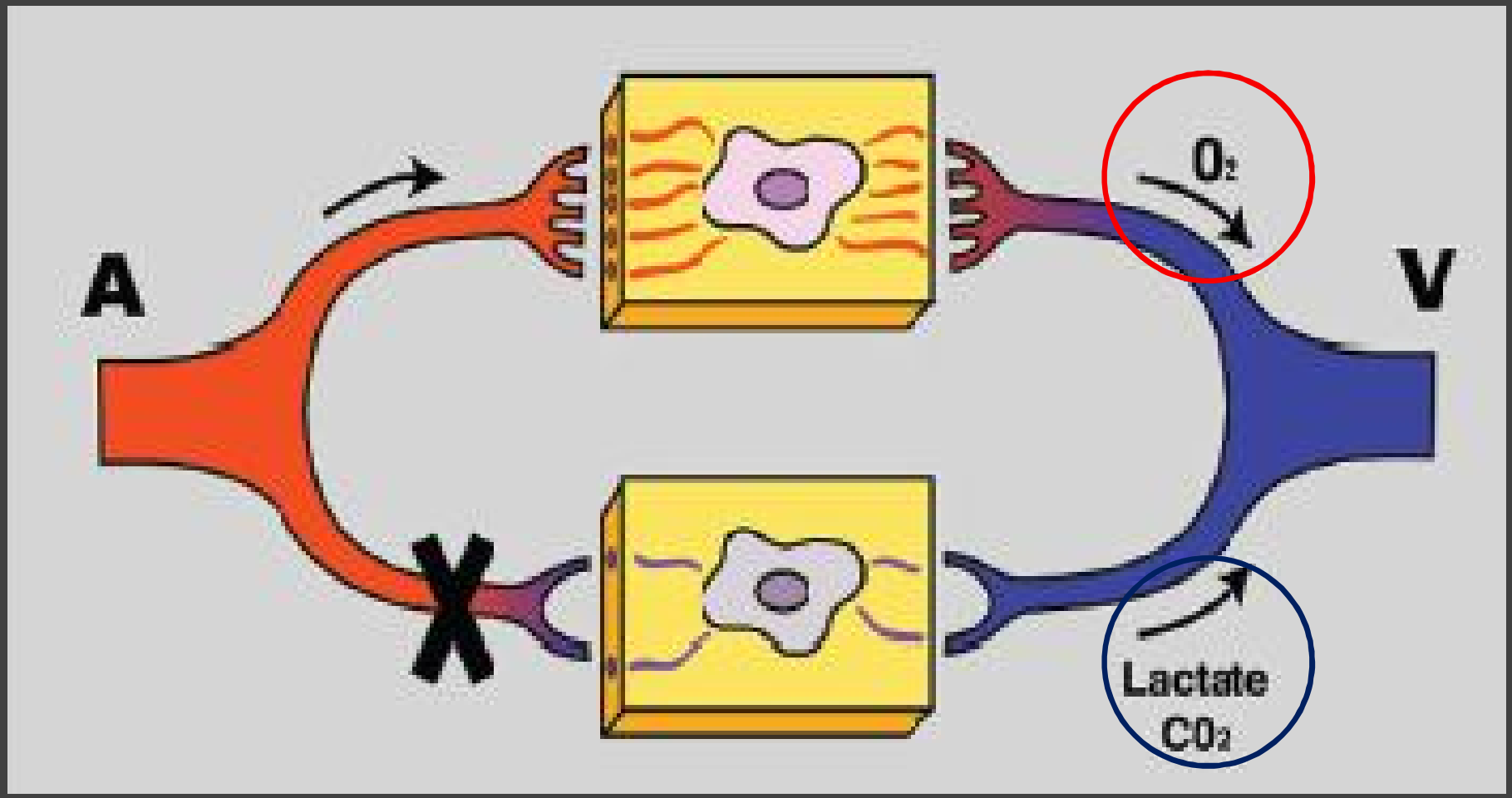
"The Krogh model"

Krogh A.
"The number and the distribution of capillaries in muscle with the calculation of the oxygen pressure necessary for supplying tissue".

Physiol 1919, 52:409-515.

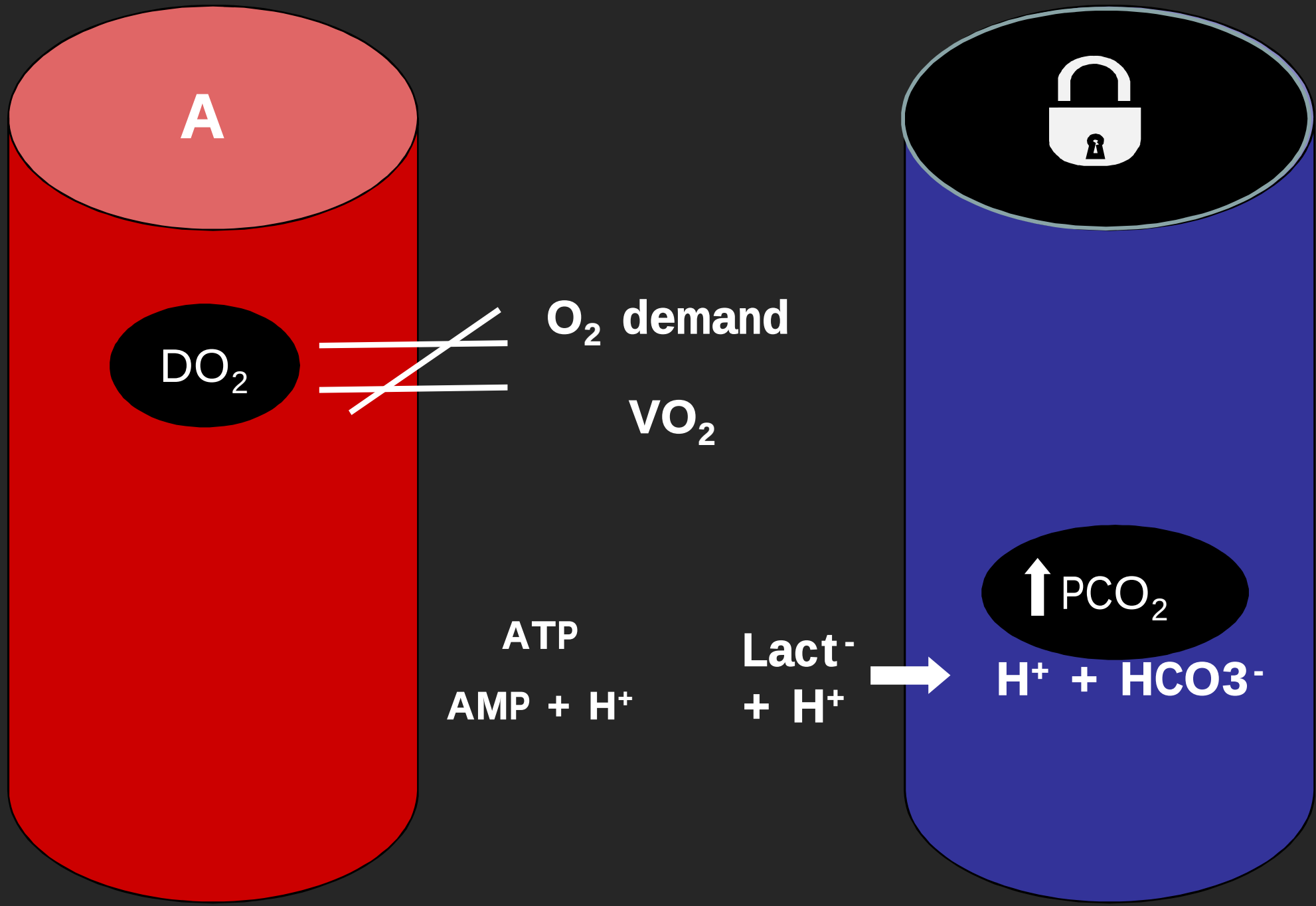


The microcirculatory shunting model of sepsis

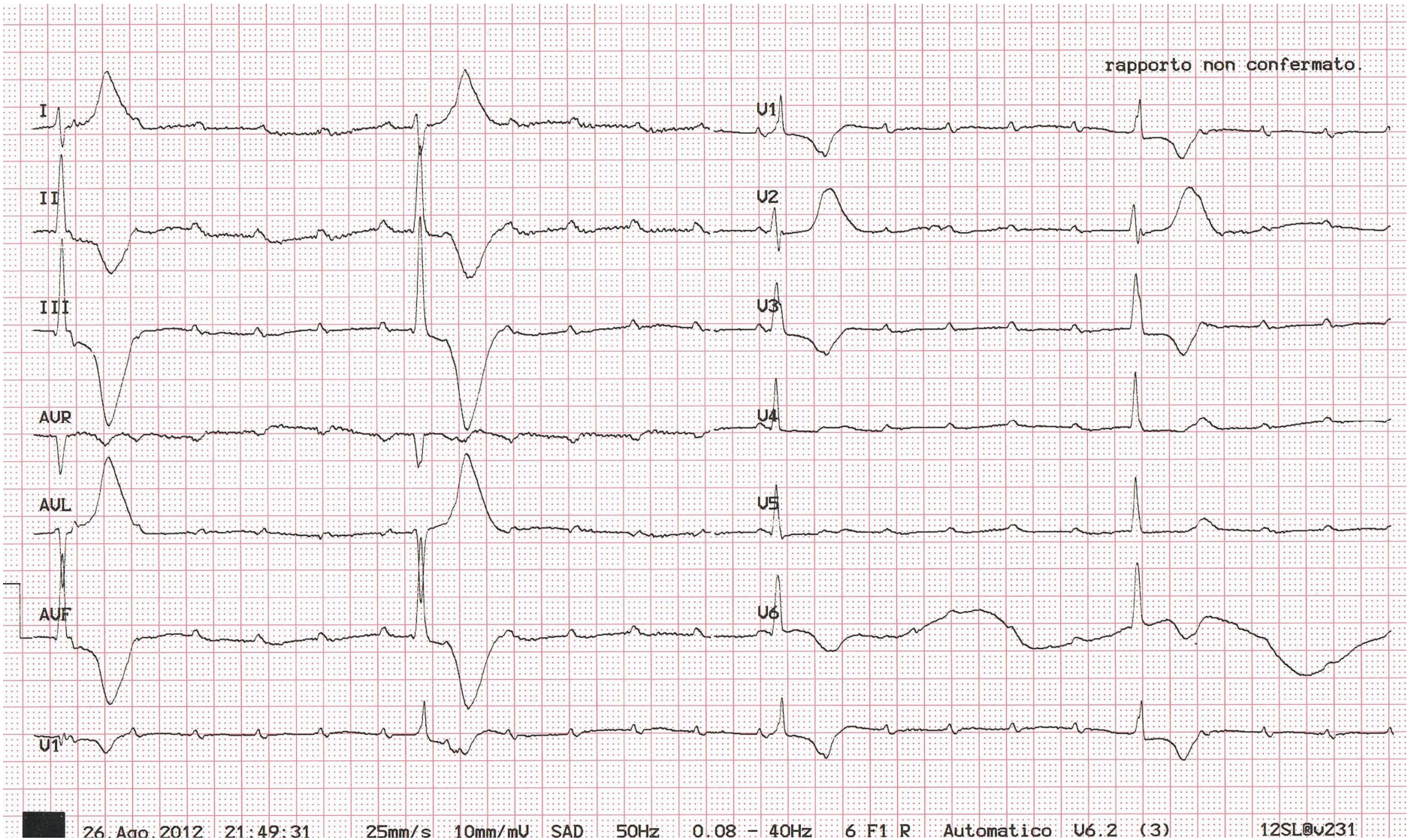


Trzeciak S and Rivers EP. Critical Care 2005, 9:S20-S26

V-A PCO_2 Differences & Hypoperfusion



Angela, 75 aa


rapporto non confermato.
I
II
III
AUR
AUL
AUF
U1
U1
U2
U3
U4
U5
U6
26 Ago 2012 21:49:31 25mm/s 10mm/mV SAD 50Hz 0.08 - 40Hz 6 F1 R Automatico V6.2 (3) 12SL@v231

FiO_2 21%

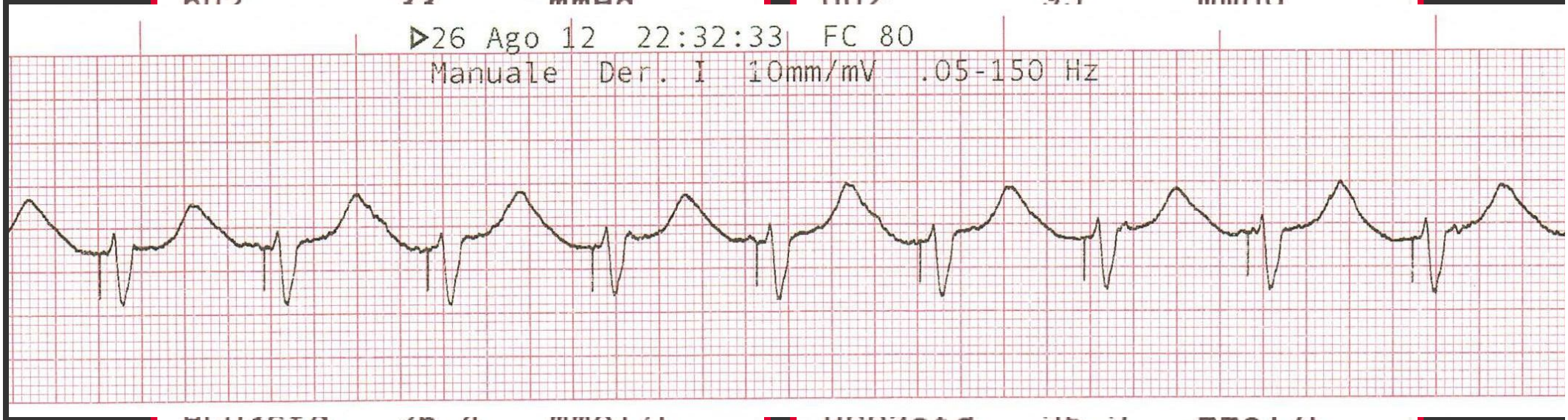
RR 24

$\Delta CO_2 = 11$

OER = 37%

Misurati (37.0C)

pH	7.36	
pCO2	53	mmHg
pO2	[illegible]	mmHg



HCO3std	26.4	mmol/L
TCO2	31.5	mmol/L
BEecf	4.5	mmol/L
BE(B)	3.2	mmol/L
SO2c	61	%
THbc	14.3	g/dL
?A-aDO2	-----	
?pAO2	-----	
?pa02/pAO2	-----	

Misurati (37.0C)

pH	7.39	
pCO2	42	mmHg
pO2	[illegible]	mmHg

HCO3std	25.2	mmol/L
TCO2	26.7	mmol/L
BEecf	0.4	mmol/L
BE(B)	0.3	mmol/L
SO2c	97	%
THbc	13.0	g/dL
A-aDO2	54	mmHg
pAO2	147	mmHg
pa02/pAO2	0.63	

$\Delta CO_2 = 3$

OER = 23%

Misurati (37.0C)

pH	7.37	
pCO2	47	mmHg
pO2	40	mmHg
Na+	136	mmol/L
K+	4.3	mmol/L
Ca++	1.07	mmol/L
Glu	296	mg/dL
Lat	1.1	mmol/L
Hct	43	%

Parametri derivati

Ca++(7.4)	1.06	mmol/L
HCO3-	27.2	mmol/L
HCO3std	25.3	mmol/L
TCO2	28.6	mmol/L
BEecf	1.9	mmol/L
BE(B)	1.3	mmol/L
SO2c	73	%
THbc	13.3	g/dL
?A-aDO2	-----	
?pAO2	-----	
?paO2/pAO2	-----	

Misurati (37.0C)

pH	7.39	
pCO2	44	mmHg
pO2	76	mmHg
Na+	135	mmol/L
K+	4.3	mmol/L
Ca++	1.08	mmol/L
Glu	331	mg/dL
Lat	1.0	mmol/L
Hct	44	%

Parametri derivati

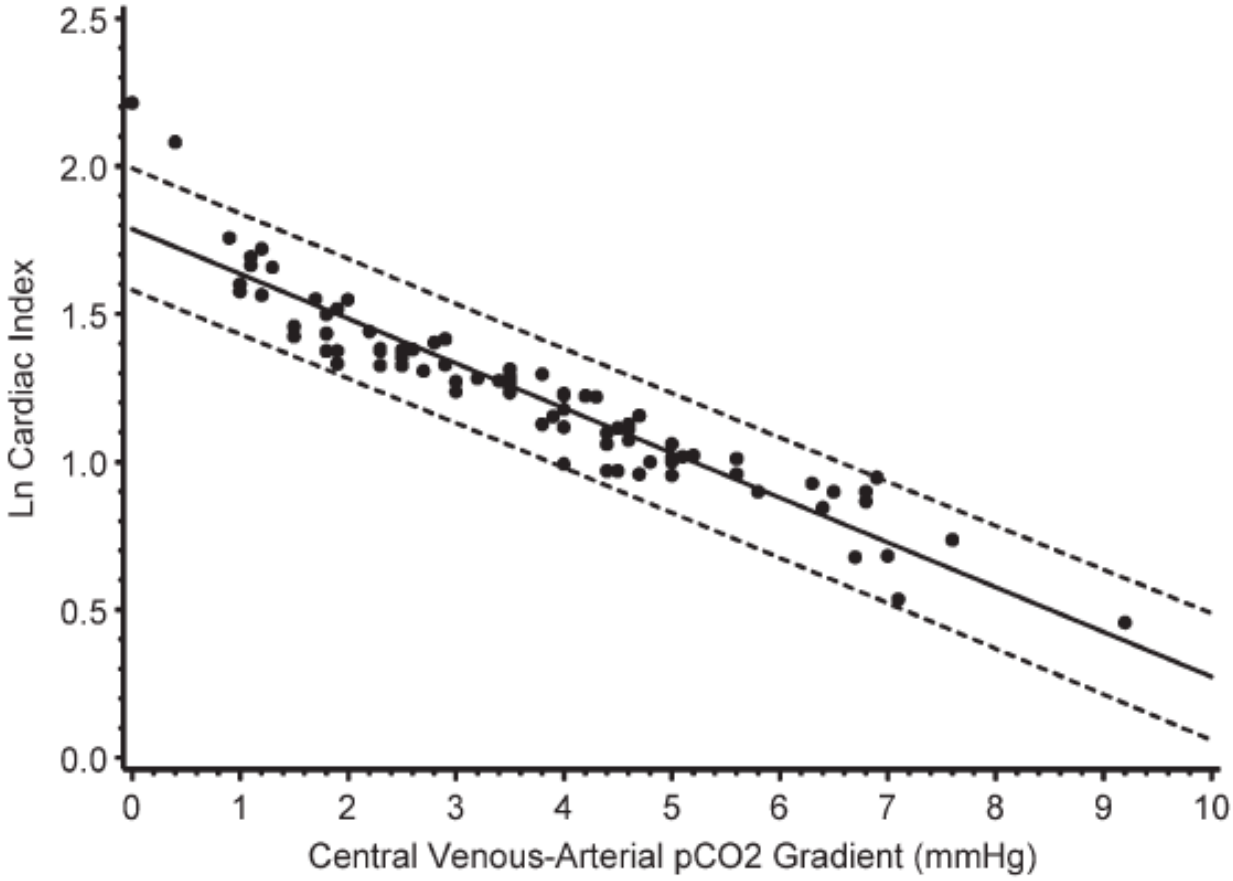
Ca++(7.4)	1.08	mmol/L
HCO3-	26.6	mmol/L
HCO3std	25.8	mmol/L
TCO2	28.0	mmol/L
BEecf	1.6	mmol/L
BE(B)	1.2	mmol/L
SO2c	95	%
THbc	13.6	g/dL
?A-aDO2	-----	
?pAO2	-----	
?paO2/pAO2	-----	

Intensive Care Med (2005) 31:818–822
DOI 10.1007/s00134-005-2602-8

ORIGINAL

Joseph Cuschieri
Emanuel P. Rivers
Michael W. Donnino
Marius Katilius
Gordon Jacobsen
H. Bryant Nguyen
Nikolai Pamukov
H. Mathilda Horst

Central venous-arterial carbon dioxide difference as an indicator of cardiac index

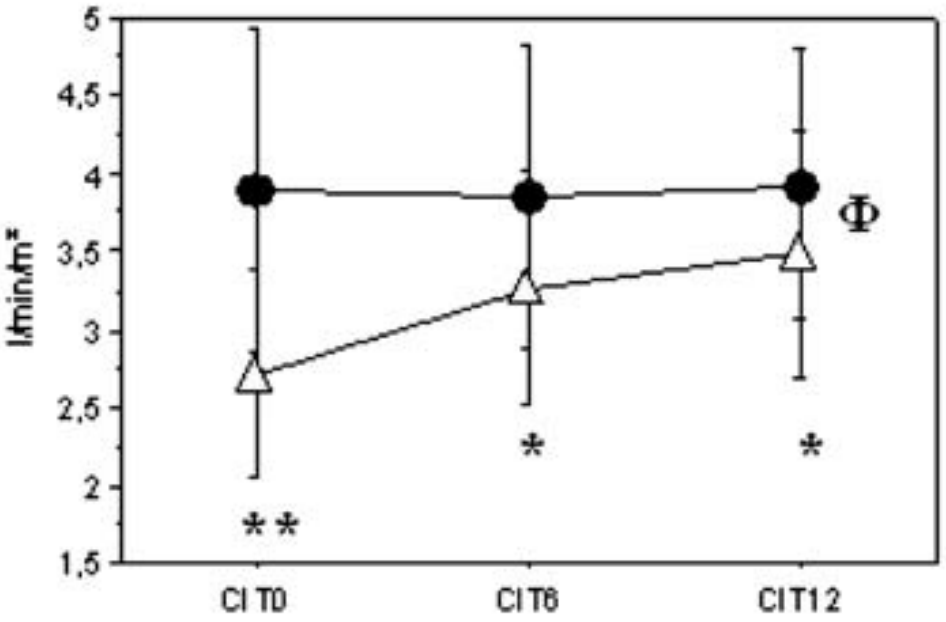


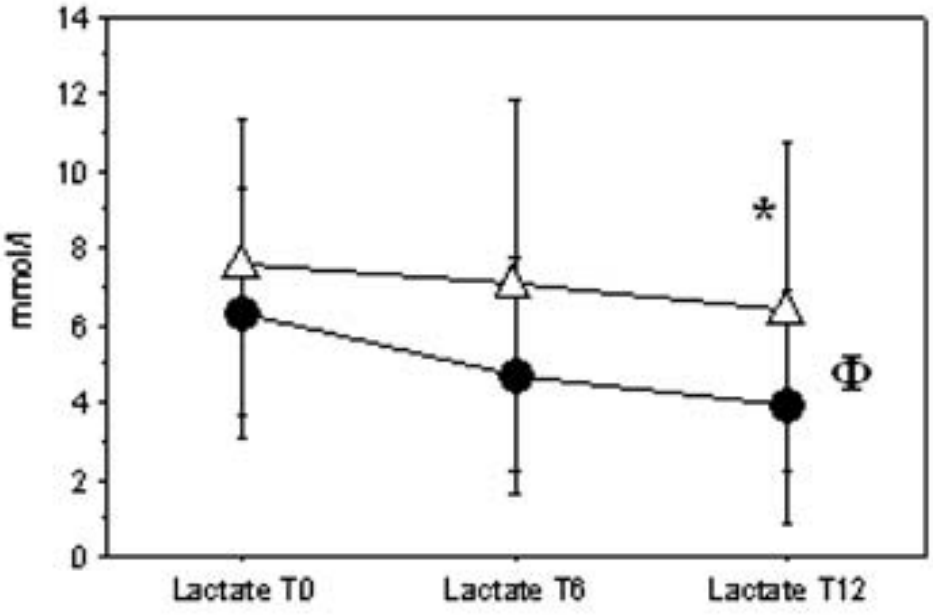
Intensive Care Med (2008) 34:2218–2225
DOI 10.1007/s00134-008-1199-0

ORIGINAL

Fabrice Vallée
Benoit Vallet
Olivier Mathe
Jacqueline Parraguette
Arnaud Mari
Stein Silva
Kamran Samii
Olivier Fourcade
Michèle Genestal

Central venous-to-arterial carbon dioxide difference: an additional target for goal-directed therapy in septic shock?





When the 70% ScvO2 goal value is reached, a **P(cv-a)CO2 > 6 mmHg** might be a useful tool to identify patients who still remain inadequately resuscitated

SUPPLY SIDE
(DO_2)

ΔPCO_2

DEMAND SIDE

$ScvO_2 / \Delta PCO_2$

ΔPCO_2

O_2 UPTAKE
(VO_2)

KEY POINTS

1) From MACRO to MICRO
2) $ScvO_2 \approx SvO_2$ trends
3) Is $ScvO_2$ a therapeutic goal ?
4) Delta PCO_2 better in O_2 demand / VO_2 mismatch
5) From “DARKNESS” to…. **“LIGHT”**