IX congresso nazionale
SIMEU
TORINO 6-8 NOVEMBRE 2014

Accesso Venoso Centrale: ne faccio a meno?

Fernando Schiraldi: NO

Giovanna Guiotto: SI

Medicina d'Urgenza, OM e PS
Ospedale San Paolo - Napoli

The good reasons for CVC

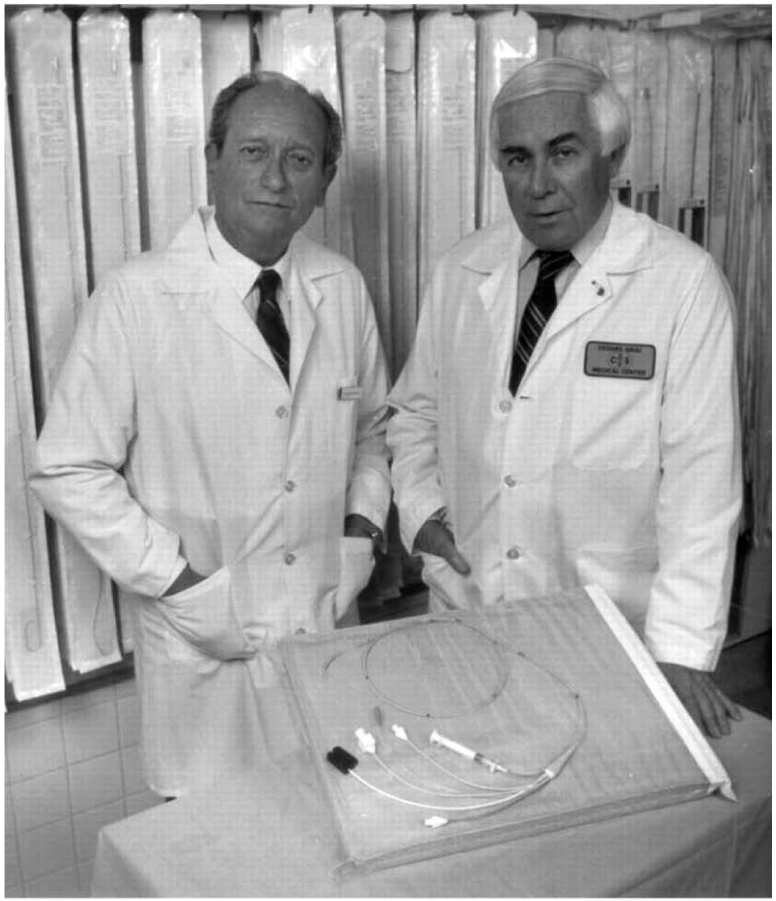
- Continous CVP monitoring
- $ScvO_2$ evaluation
- $\Delta PCO2$ evaluation
- PICCO, LIDCO…..
- Transvenous PMK insertion
- Hypertonic infusions
- ……..

"Monitoring is context-specific"

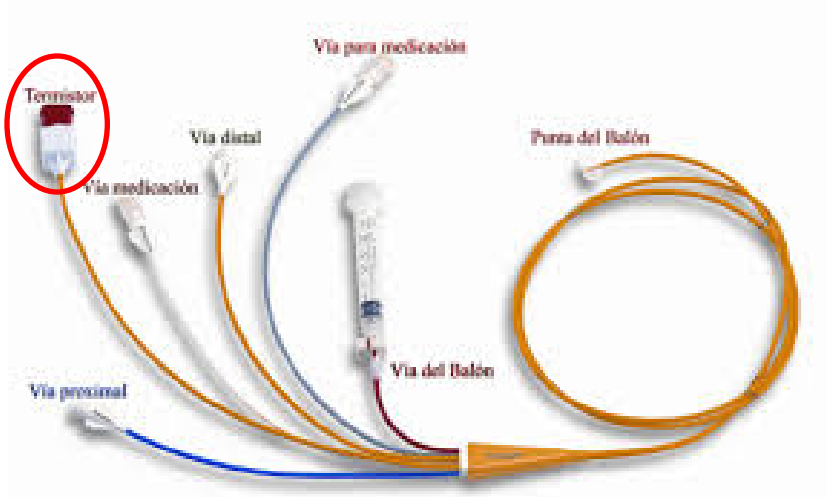
MR Pinsky, D Payen. Crit Care 2005;9:566-572

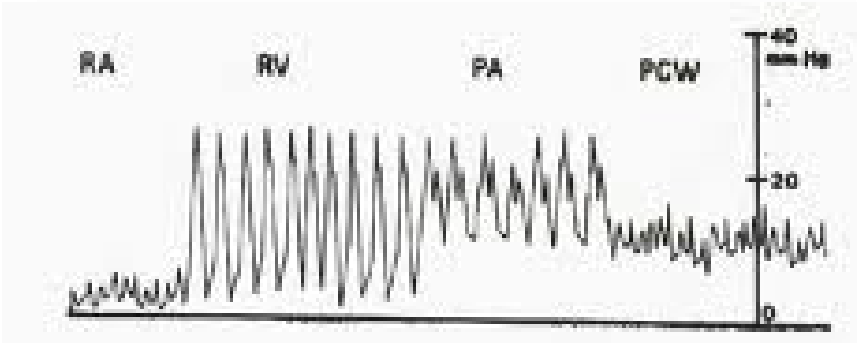
CATHETERIZATION OF THE HEART IN MAN WITH USE OF A FLOW-DIRECTED BALLOON-TIPPED CATHETER*

H. J. C. SWAN, M.B., PH.D., F.R.C.P., WILLIAM GANZ, M.D., C.SC., JAMES FORRESTER, M.D., HAROLD MARCUS, M.D., GEORGE DIAMOND, M.D., AND DAVID CHONETTE



William Ganz and H.J.C. Swan





N Engl J Med 1970

Need For Functional Hemodynamic Monitoring

EXAMPLE

An unstable hypoperfused patient could have

1. ↓ filling
2. ↓ contractility
3. ↓ vascular tone
4. Any obstructive condition

Vincent *et al. Critical Care* 2011, **15**:229
http://ccforum.com/content/15/4/229

CRITICAL CARE

REVIEW

Clinical review: Update on hemodynamic monitoring - a consensus of 16

Jean-Louis Vincent[1]*, Andrew Rhodes[2], Azriel Perel[3], Greg S Martin[4], Giorgio Della Rocca[5], Benoit Vallet[6], Michael R Pinsky[7], Christoph K Hofer[8], Jean-Louis Teboul[9], Willem-Pieter de Boode[10], Sabino Scolletta[11], Antoine Vieillard-Baron[12], Daniel De Backer[1], Keith R Walley[13], Marco Maggiorini[14] and Mervyn Singer[15]

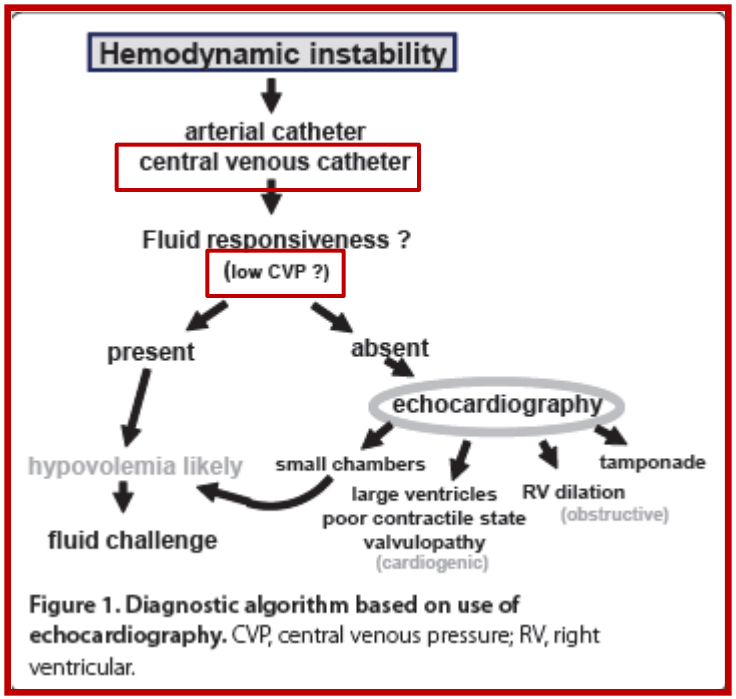


Figure 1. Diagnostic algorithm based on use of echocardiography. CVP, central venous pressure; RV, right ventricular.

MORE RESPECT FOR THE CVP

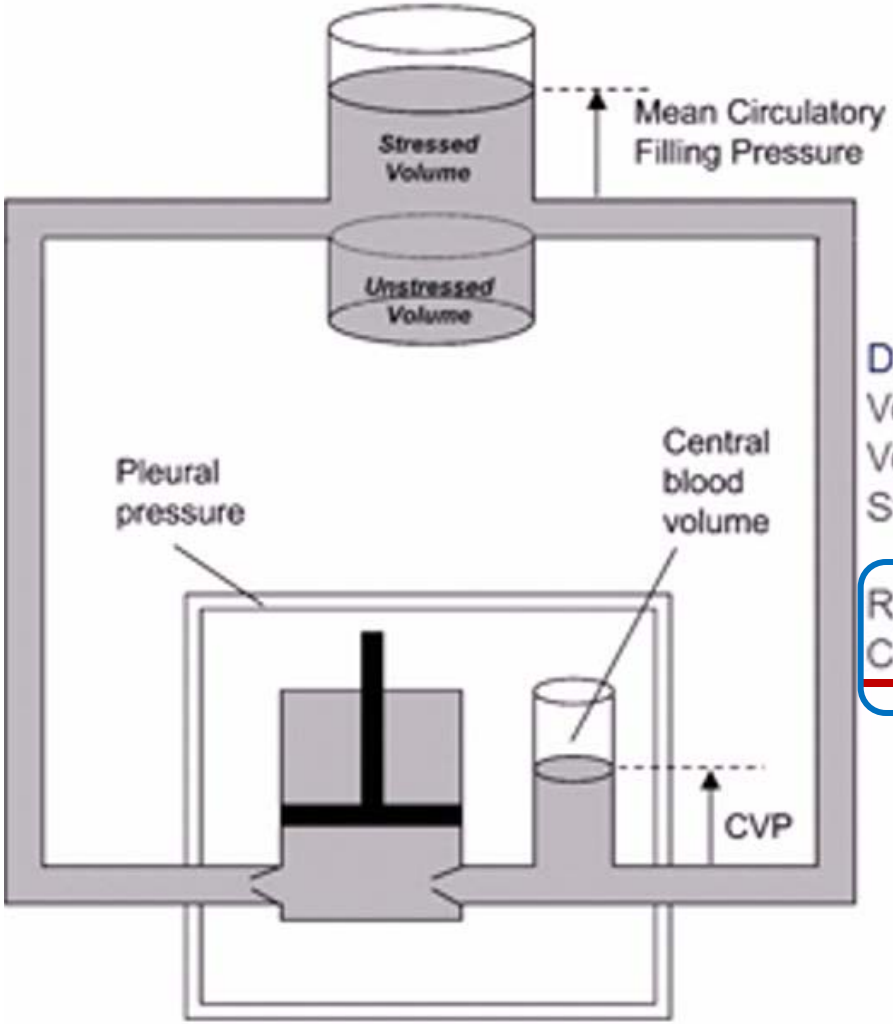
Magder S. Intensive Care Med 1998;24:651-53

….or IVCCI

Bench-to-bedside review: An approach to hemodynamic monitoring - Guyton at the bedside

Sheldon Magder*

CRITICAL CARE



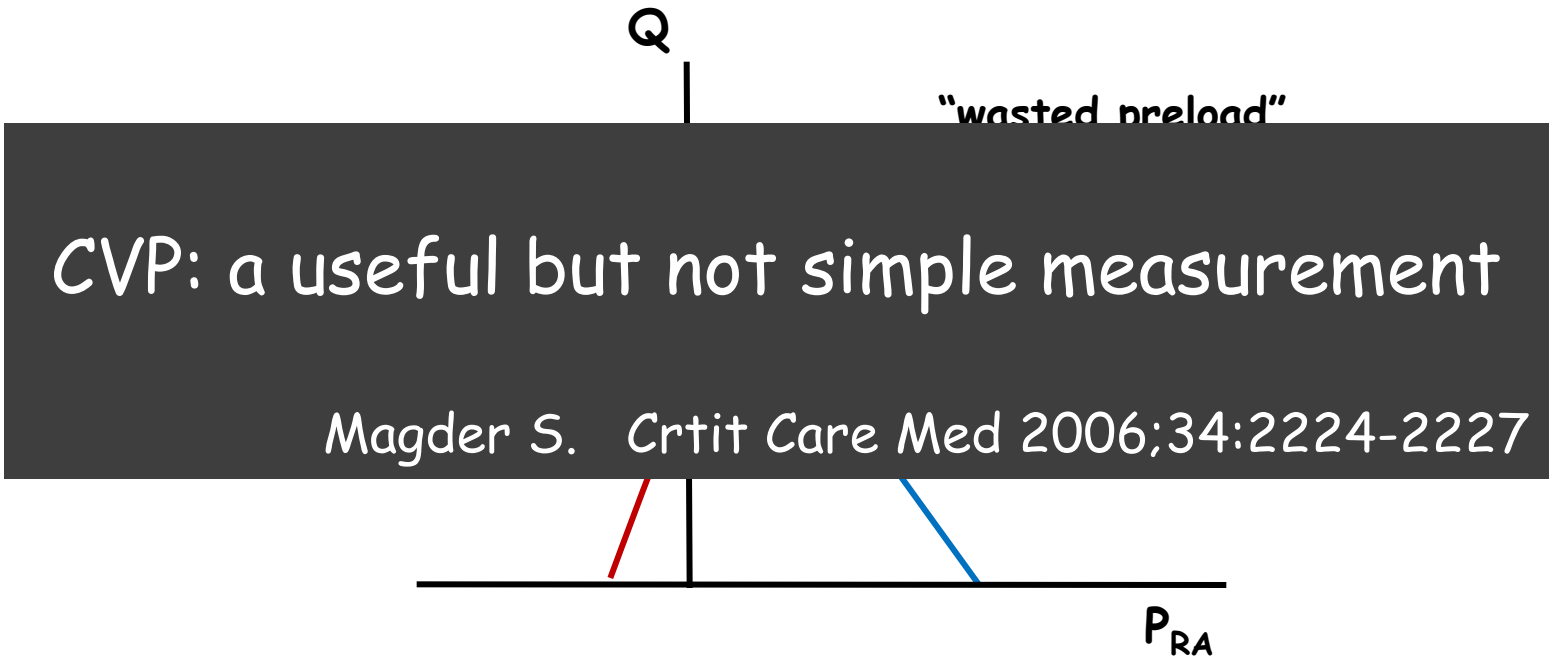
VR = MSP-CVP

Determinants Venous Return
Volume
Venous Capacitance
Stressed Volume ⇉ MCFP

Resistance to Venous Return
CVP

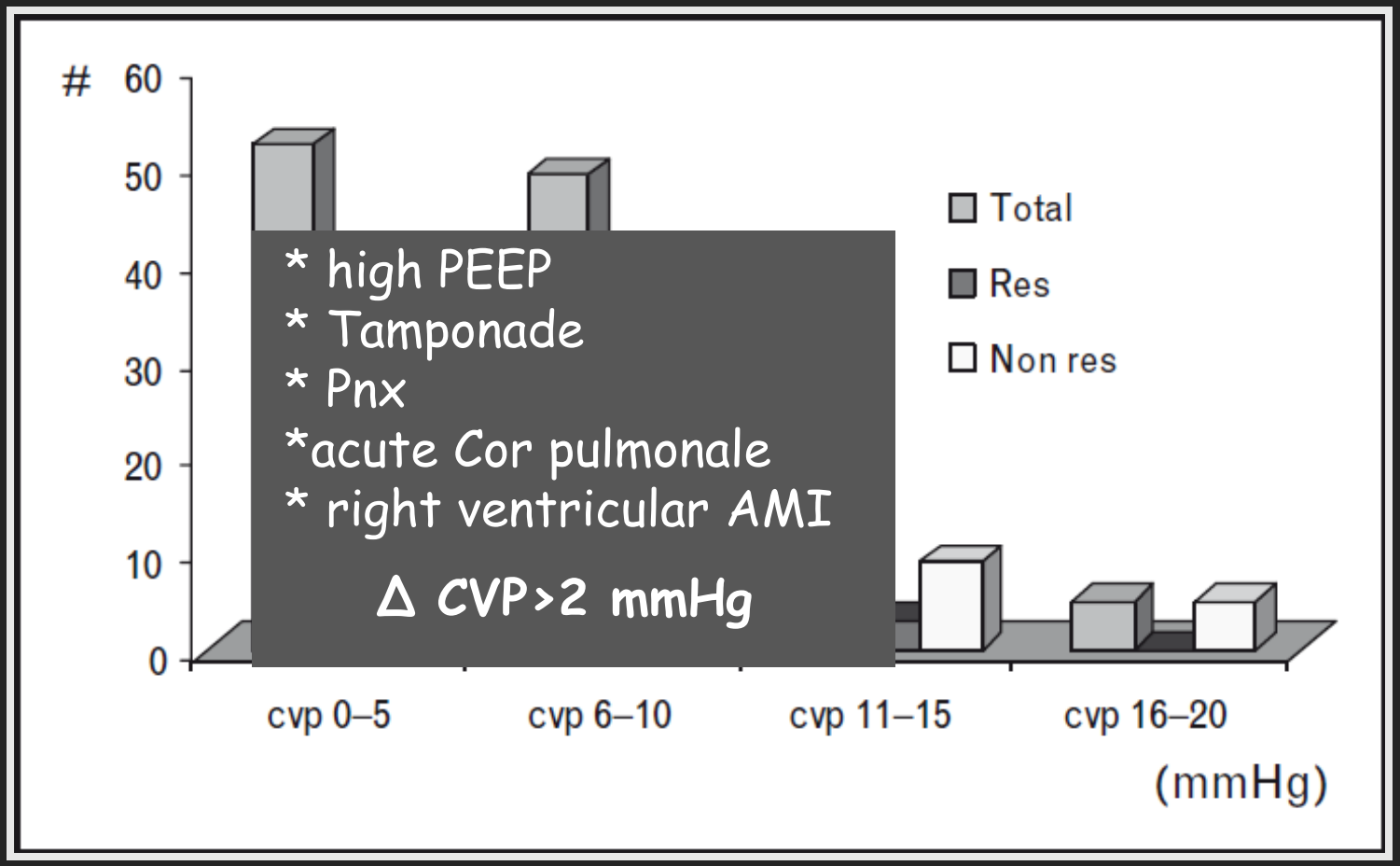
Critical Care 2012

Venous return & cardiac function



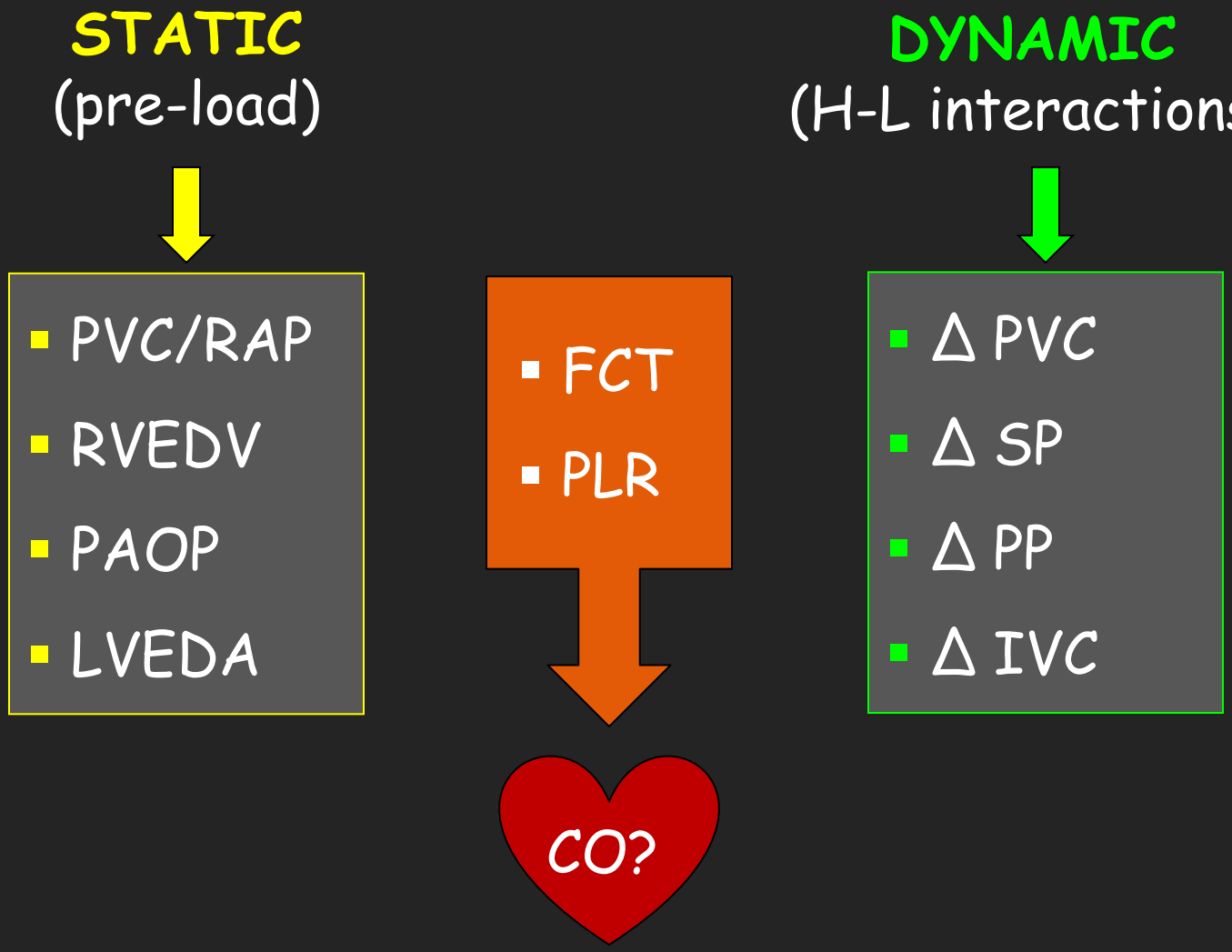
Magder S. Curr Opin Crit Care 2011;17:36—42

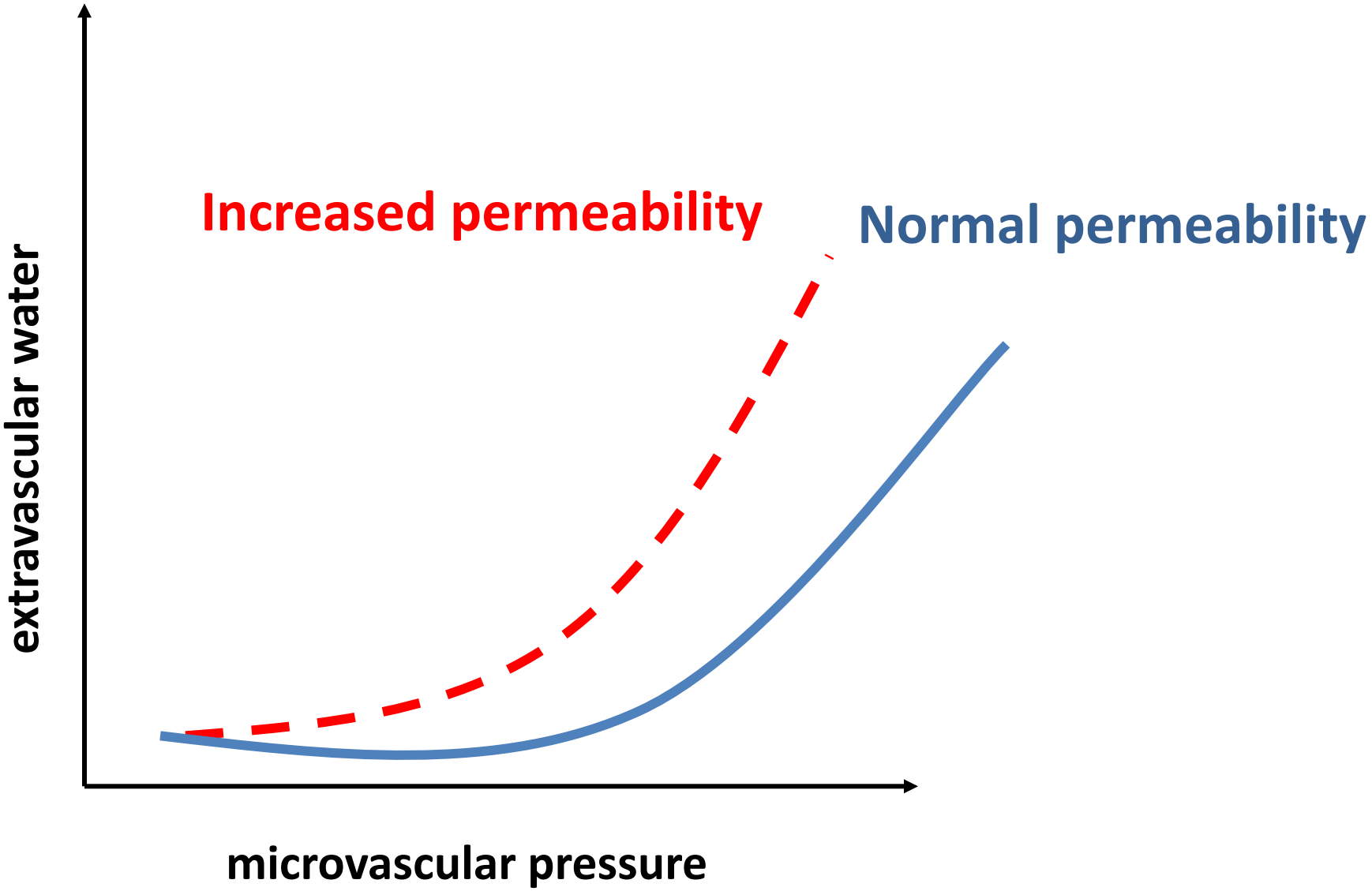
Starting CVP and fluid responsiveness



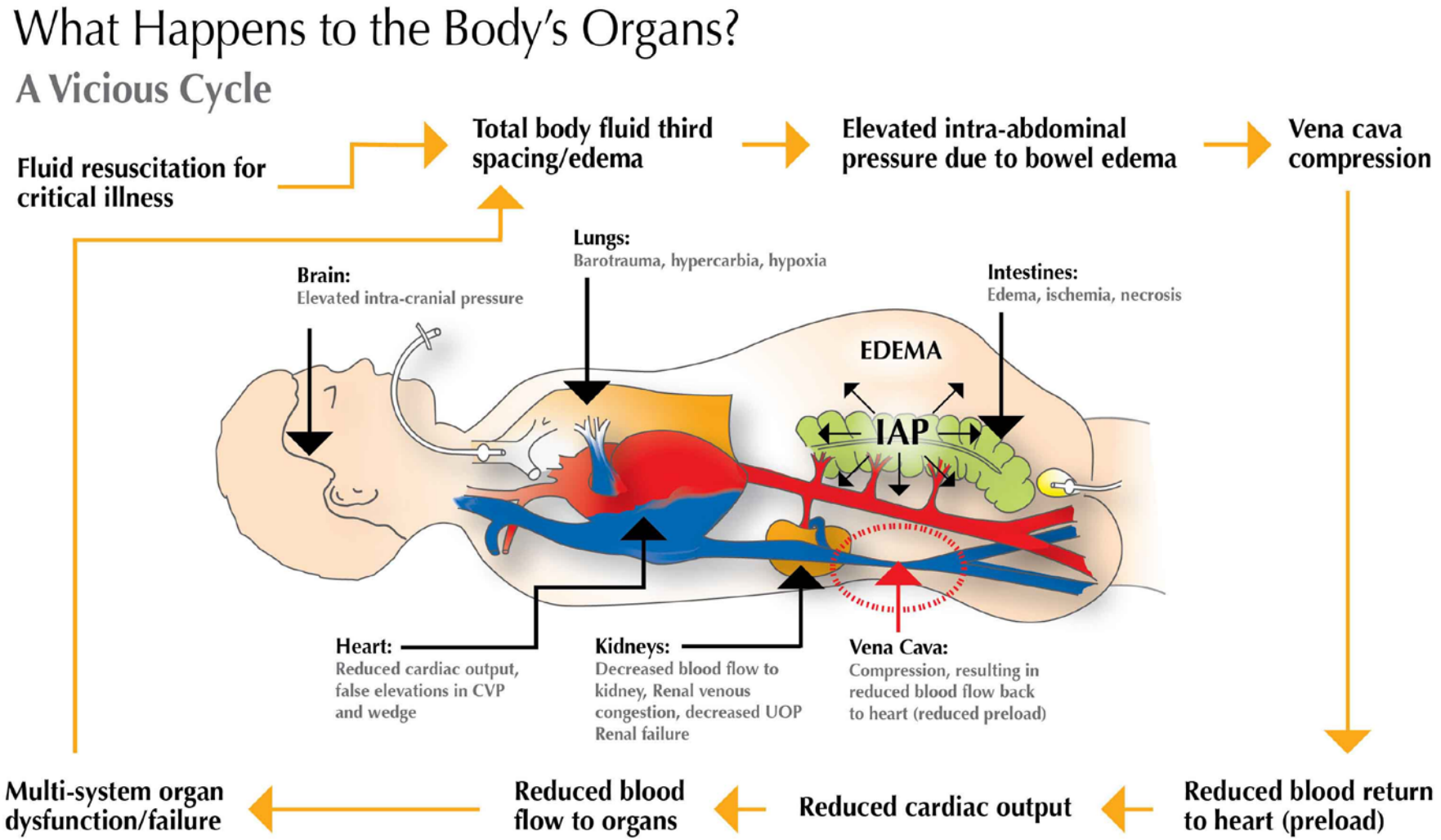
Magder S. Curr Opin Crit Care 2010;16:289—296

PREDICTORS OF FLUID RESPONSIVENESS




Increased permeability
Normal permeability
extravascular water
microvascular pressure

The "messy" cross-talk among organs



O_2 Extration Ratio (OER)

- $VO_2 = CO \times (SaO_2 - ScvO_2)$
- $DO_2 = CO \times SaO_2$
- $OER = VO_2/DO_2 = \dfrac{Sa\,O_2 - ScvO_2}{SaO_2}$

v.n. = 20-25%

Research

Open Access

Incidence of low central venous oxygen saturation during unplanned admissions in a multidisciplinary intensive care unit: an observational study

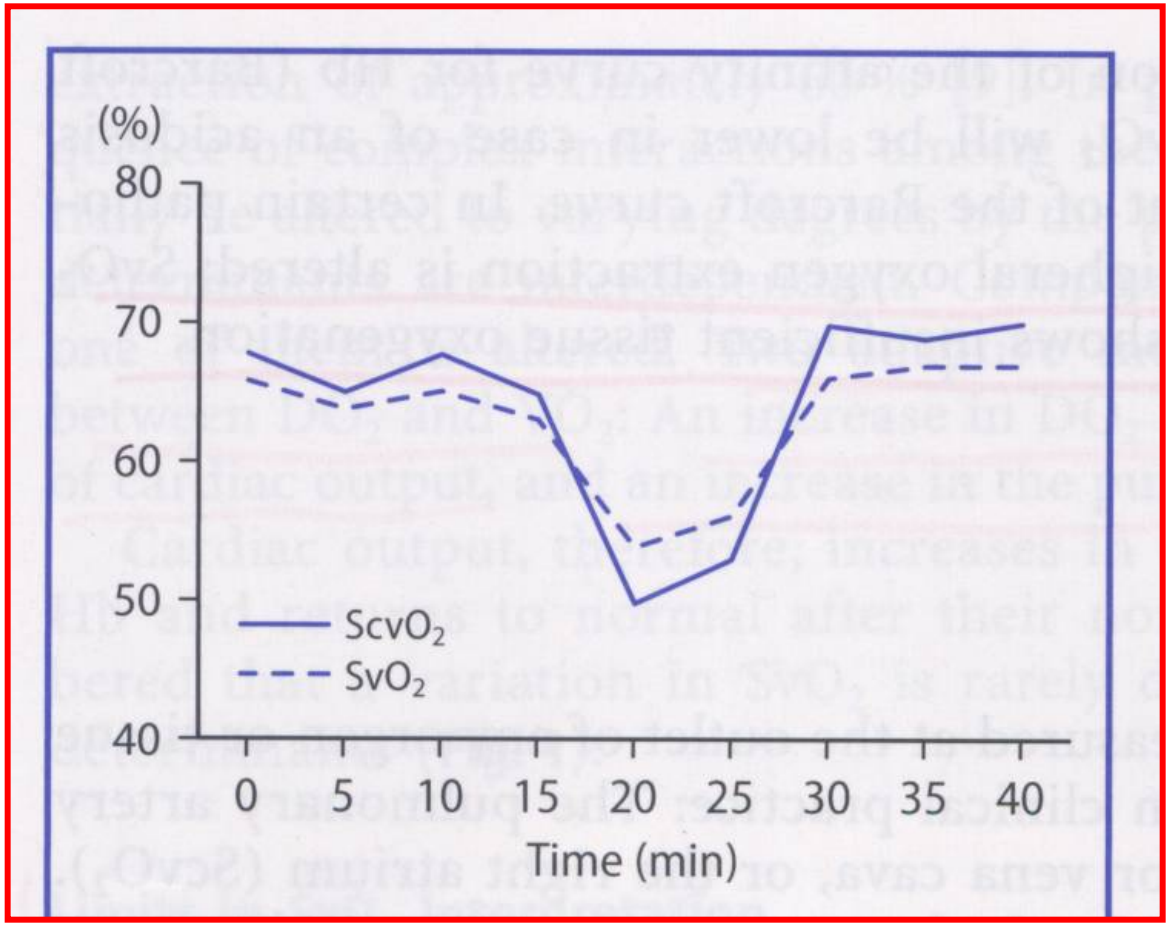
Hendrik Bracht, Matthias Hänggi, Barbara Jeker, Ninja Wegmüller, Francesca Porta, David Tüller, Jukka Takala and Stephan M Jakob

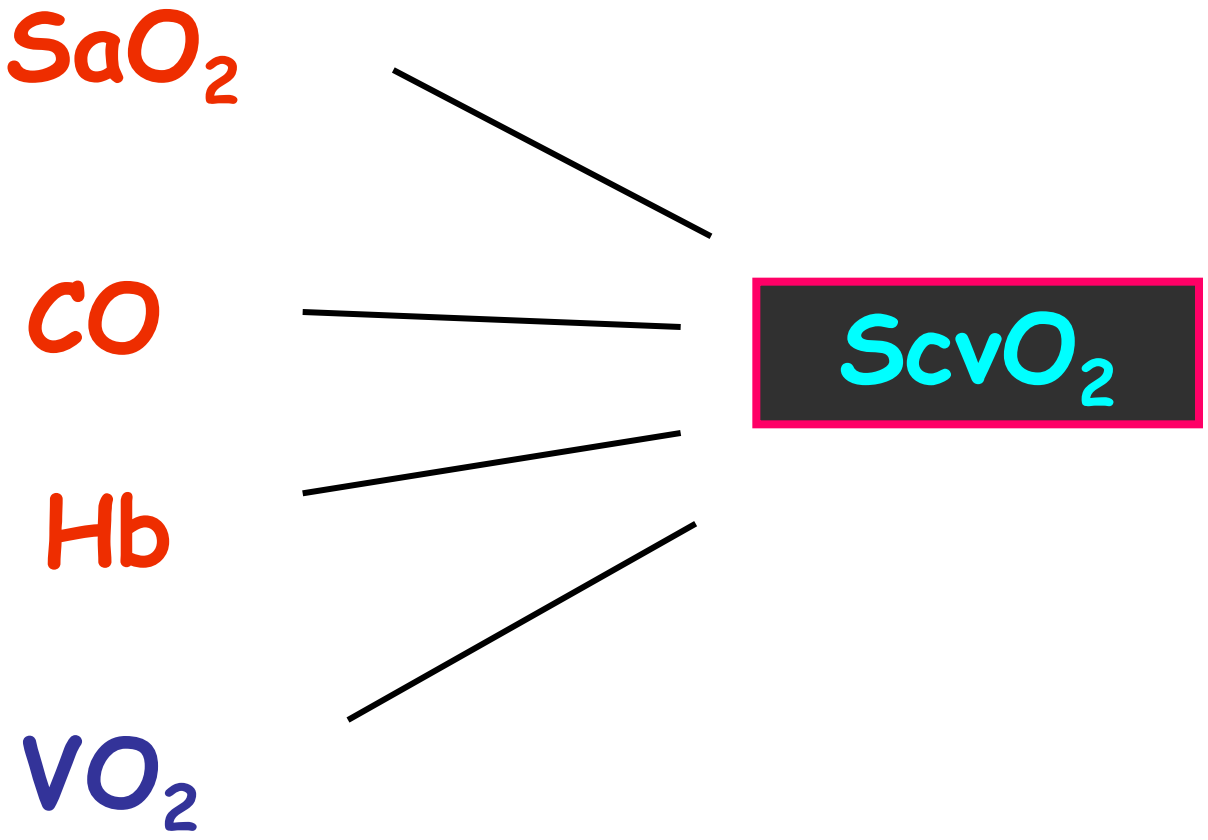
Department of Intensive Care Medicine, University Hospital Bern, University of Bern, Freiburgstrasse, CH-3010 Bern, Switzerland

Corresponding author: Stephan M Jakob, stephan.jakob@insel.ch

Received: 19 May 2006 Revisions requested: 17 Jul 2006 Revisions received: 16 Nov 2006 Accepted: 9 Jan 2007 Published: 9 Jan 2007

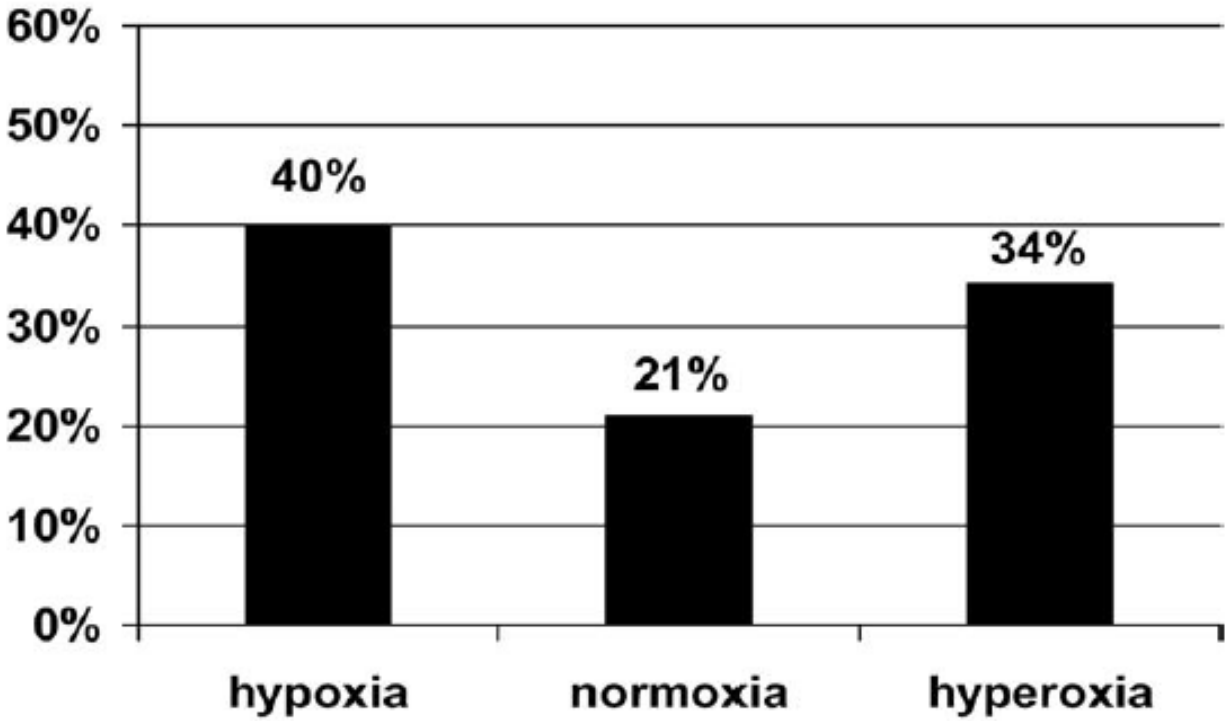
Critical Care 2007, 11:R2 (doi:10.1186/cc5144)




SaO_2
CO
Hb
VO_2
$ScvO_2$

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

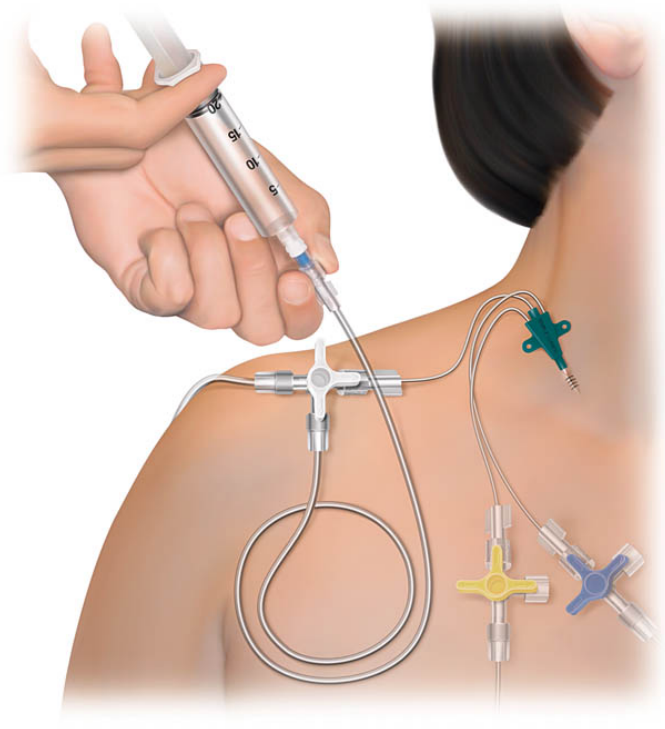
Macrocirculation → **Low $ScvO_2$**

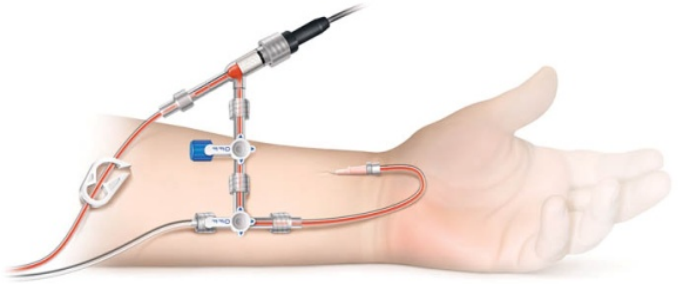
Microcirculation

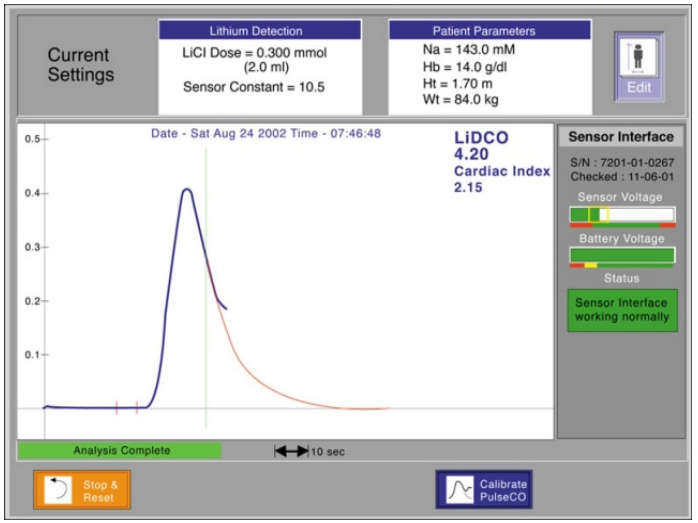
Mitochondria

} **Normal / High $ScvO_2$**

The LiDCO*plus* System™

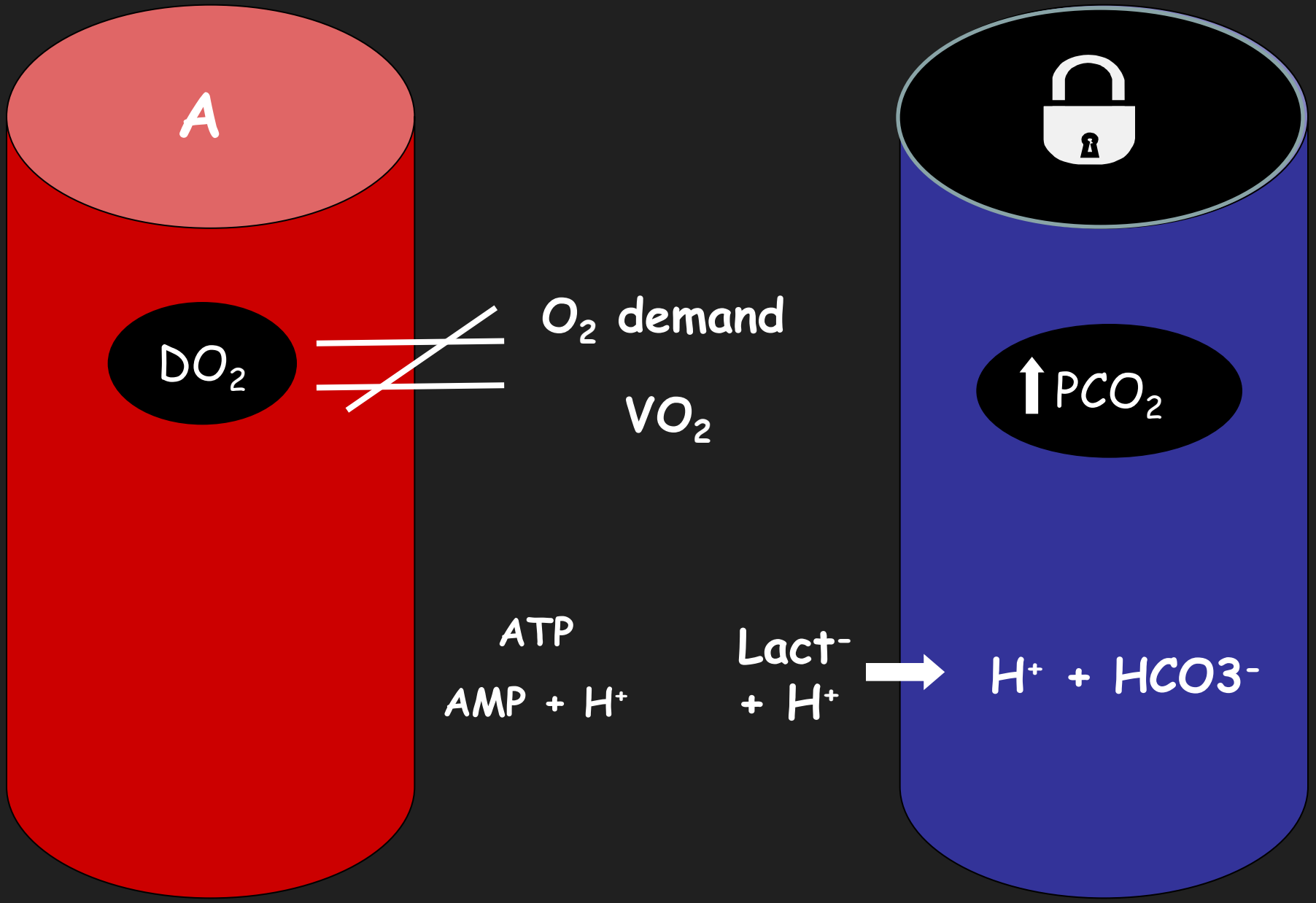




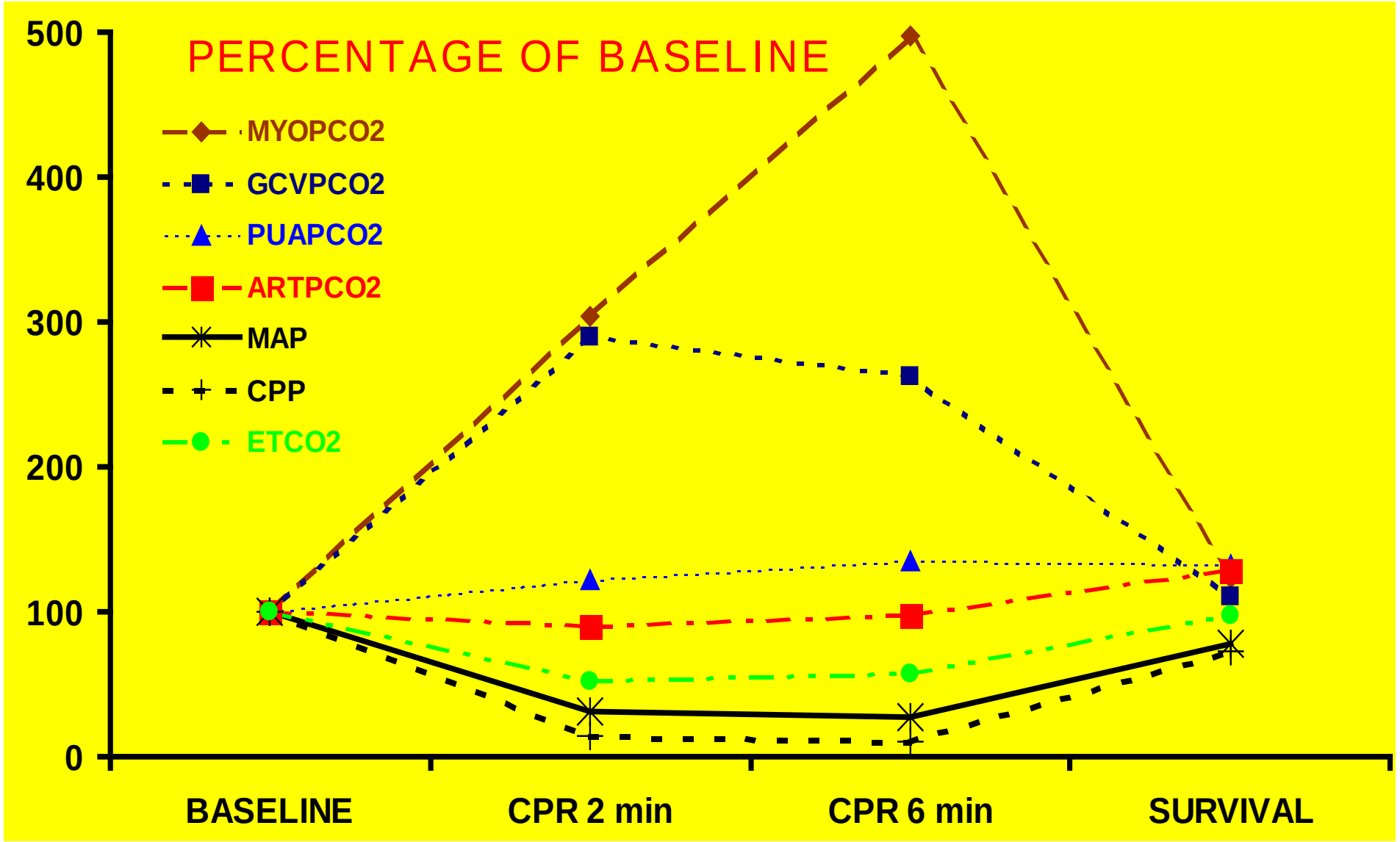



Edwards Lifesciences
2.9
82
Vigileo
FloTrac

The CO_2 lung presentation & low flow

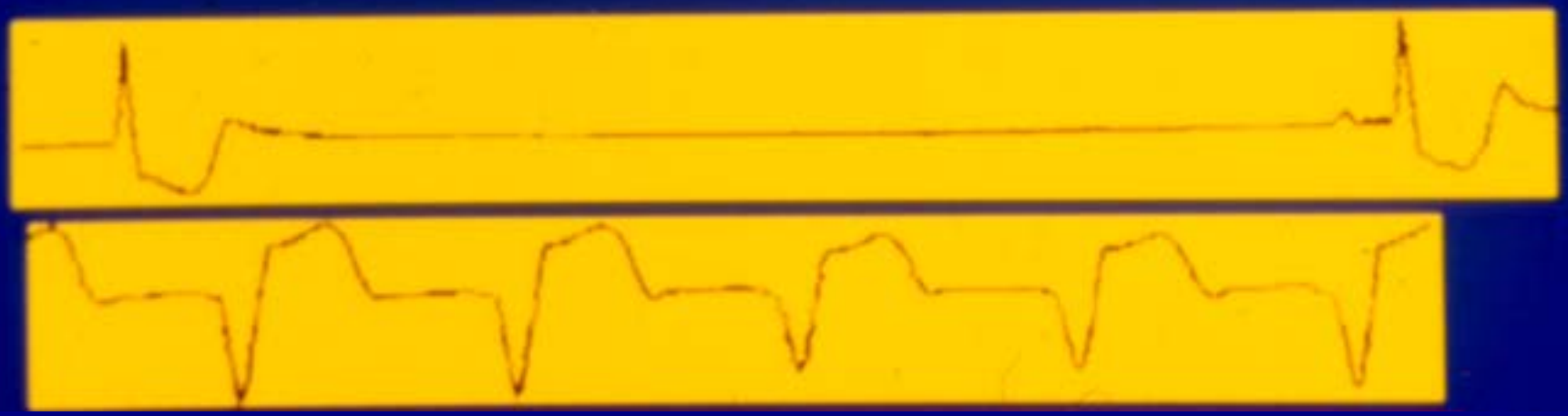


CO_2 AS MONITOR OF PERFUSION



P.R. 69 y.♀ 17th OCt 1992

	h. 12.15 art.	h. 12.15 c.ven.		h. 12.30 art.	h. 12.30 c.ven.	
pH	7.14	7.114		7.440	7.393	
PCO_2	30.9	40.1	ΔCO_2 = 9.2	34.7	40	ΔCO_2 = 5.3
PO_2	199.8	45.3		75.3	31.7	
HCO_3	11.8	12.2		23.3	24	
SAT	99.1	63.2	OER = 36	94.5	61.4	OER = 33.5



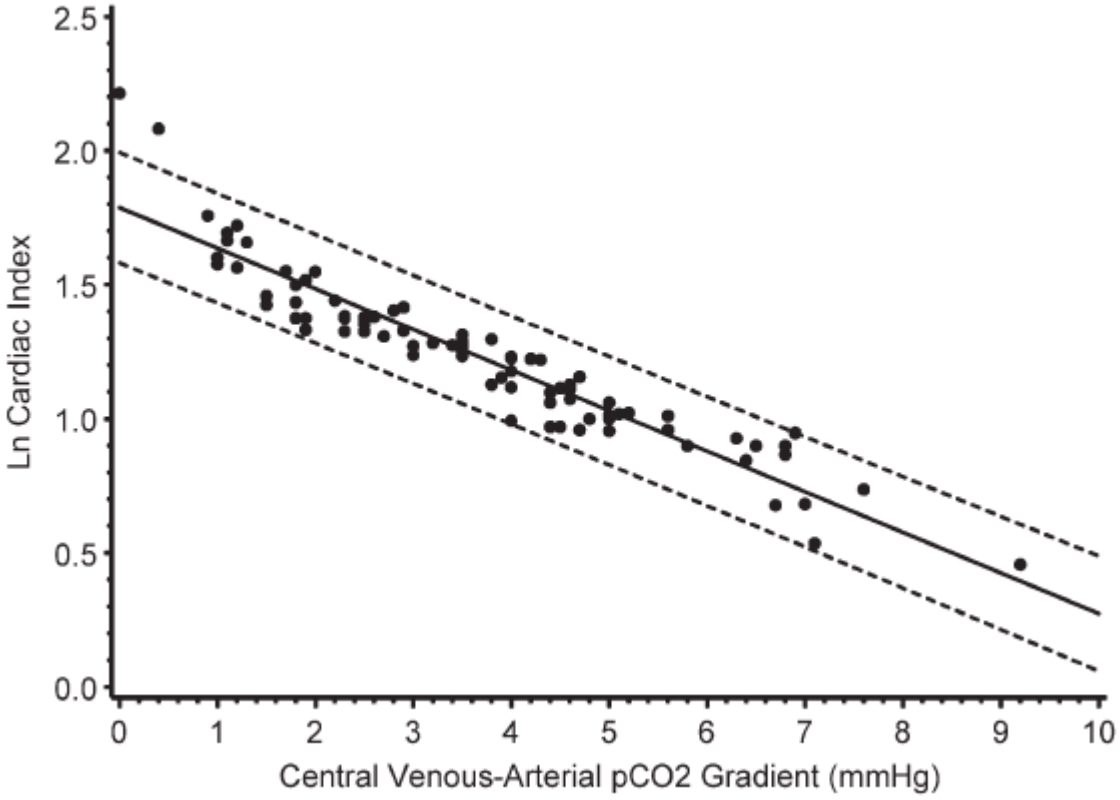
FS 1993

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

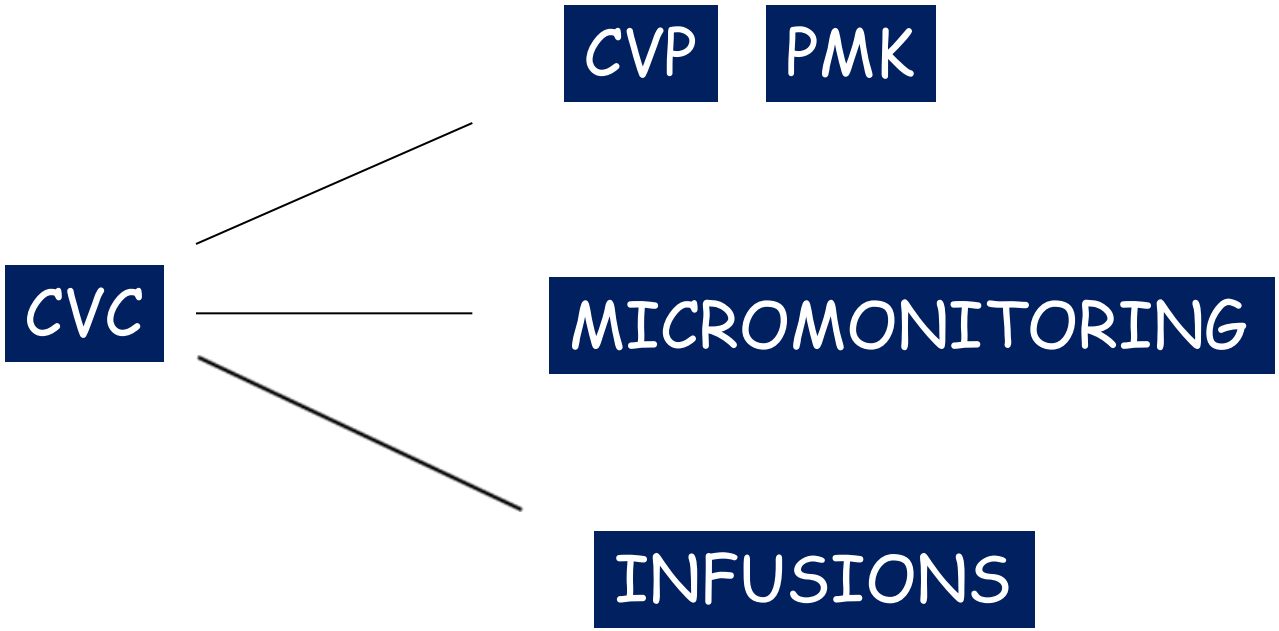
ORIGINAL

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



INTERMEDIATE KEY POINTS



……and almost NO RISKS if US-assisted !!

Do I need a CVC?

1) To give fluids/drug

2) To measure:
- PVC (and then what?)
- $ScvO_2$
- CO (+ arterial waveform)
- EVLW

3) To pace the heart

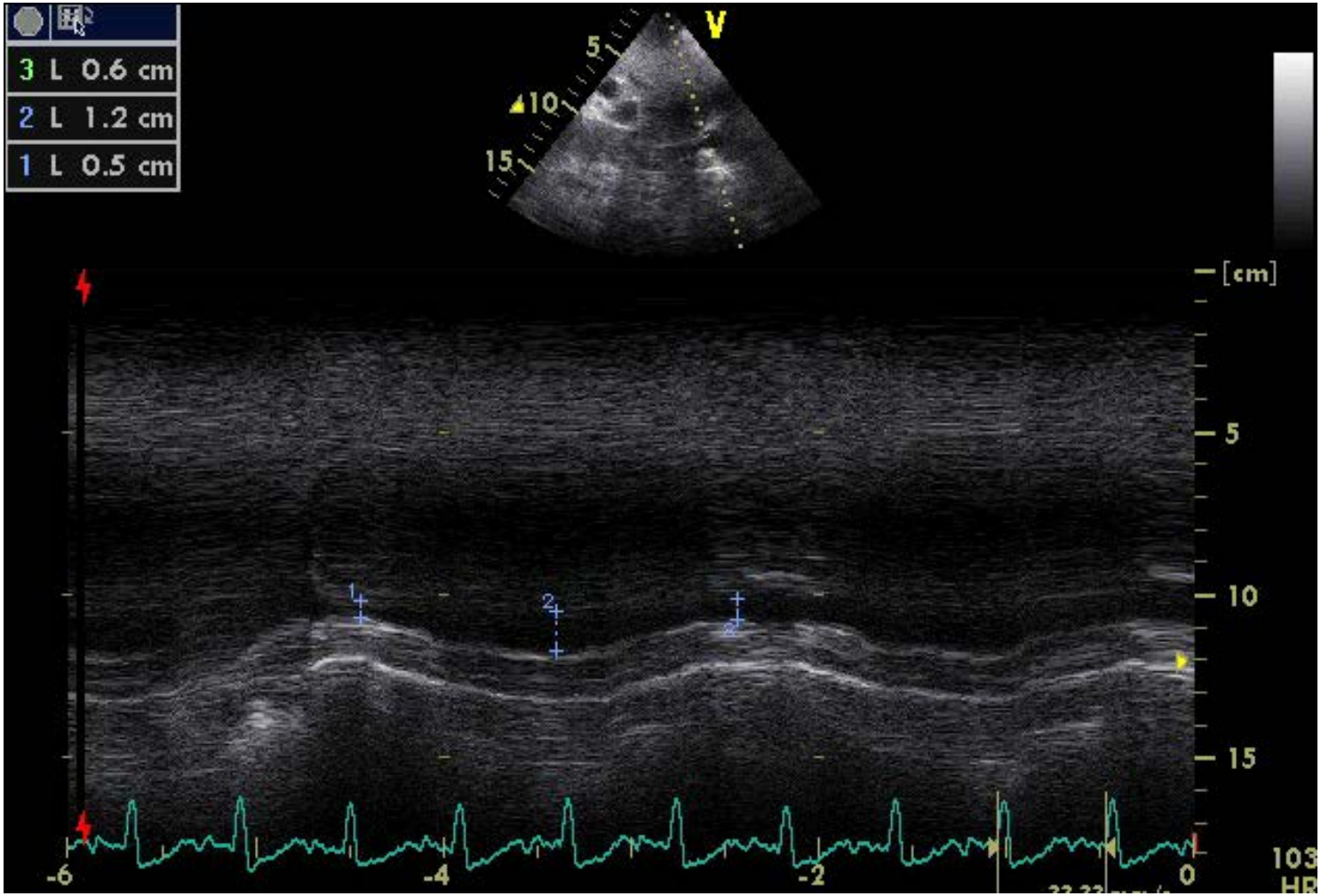
Is it safe ?

To give fluids ?

$$Q = \frac{\Delta P \, \pi \, r^2}{8L \, \eta}$$

Cath size	Fluid rate ml/min	Max Osm mOsm/L
18 G x 30 mm	105	<600 (<800 TPN)
16 G x 30 mm	**220**	"
14 G x 30 mm	295	"
16 G x 200 mm	**60**	> 800

To measure CVP ?



$$\mathbf{CI}_{\mathbf{IVC}} = \frac{\text{Dmax (espiratorio)} - \text{Dmin (inspiratorio)}}{\text{D max \%}}$$

IVC collapsibility and CVP

IVC diameter	Inspiratory variation	RAP
<15 mm	Full collapse	0-5 mmHg
15 - 25 mm	> 50%	5-10 mmHg
>25 mm	<50%	10-15 mmHg
Dilated IVC and supra-hepatic veins	none	>20 mmHg

American Journal of Emergency Medicine (2009) 27, 851–855

ELSEVIER

The American Journal of Emergency Medicine

www.elsevier.com/locate/ajem

Brief Report

Correlation of sonographic measurements of the internal jugular vein with central venous pressure

Sean P. Donahue DO[a,1], Joseph P. Wood MD[a,*], Bhavesh M. Patel MD[b], James V. Quinn MD[c]

Patient supine, at end expiration (SB)

IJV AP diameter:

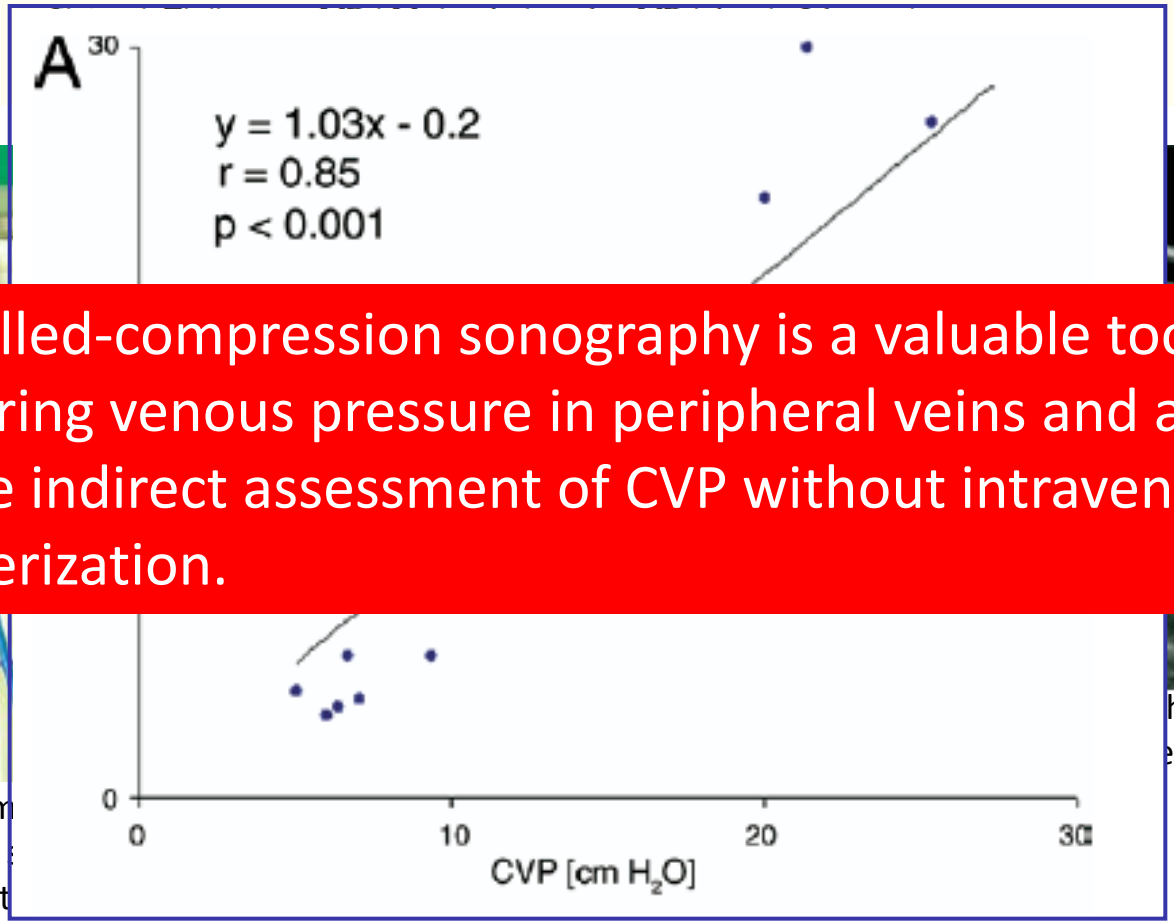
5.7- 8.3 mm → **CVP < 10** cm H_2O

11.2 - 13.8 mm → **CVP > 10** cm H_2O

Journal of the American College of Cardiology
© 2007 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 50, No. 16, 2007
ISSN 0735-1097/07/$32.00
doi:10.1016/j.jacc.2007.07.022

Noninvasive Central Venous Pressure Measurement by Controlled Compression Sonography at the Forearm



Controlled-compression sonography is a valuable tool for measuring venous pressure in peripheral veins and allows reliable indirect assessment of CVP without intravenous catheterization.

hy:
r compression.

(A) Pressure m
(1) translucent
(2) ultrasound t
(3) flexible pressure tubing
(4) pressure meter.

Intensive Care Med (2008) 34:659–663
DOI 10.1007/s00134-008-0994-y

CLINICAL COMMENTARY

Xavier Monnet
Jean-Louis Teboul

Passive leg raising

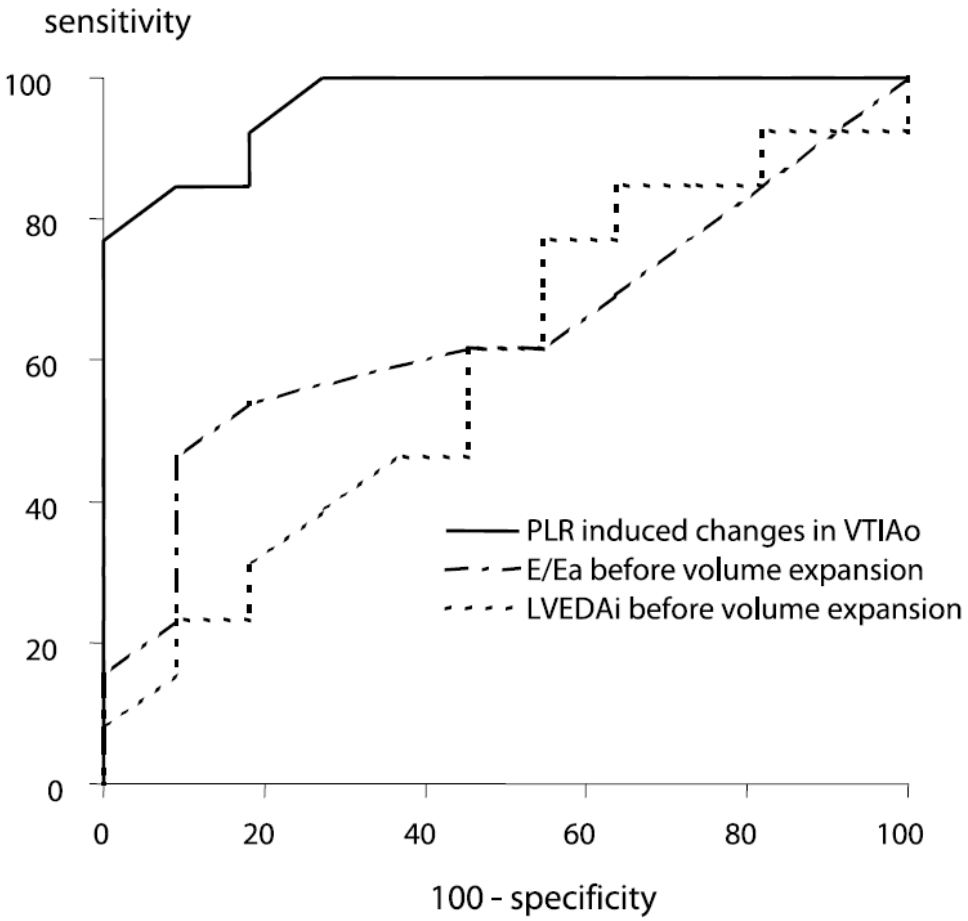
Intensive Care Med (2007) 33:1125–1132
DOI 10.1007/s00134-007-0646-7

ORIGINAL

Bouchra Lamia
Ana Ochagavia
Xavier Monnet
Denis Chemla
Christian Richard
Jean-Louis Teboul

Echocardiographic prediction of volume responsiveness in critically ill patients with spontaneously breathing activity

24 pts (14 SB)
PLR induced increase in **VTIAo >12.5%** predicted an increase in **SV ≥ 15%** after VE (sens 77%; **spec 100%**).



To measure $ScvO_2$?

Lactate Clearance vs Central Venous Oxygen Saturation as Goals of Early Sepsis Therapy

A Randomized Clinical Trial

300 patients with severe sepsis and septic shock

150 pts	150 pts
CVP ≥ 8 mm Hg	**IVC US ?**
MAP ≥ 65 mmHg	MAP ≥ 65 mm Hg
$ScvO_2$ ≥ 70 %	**Lact Clear ≥ 10%**

no difference in in-hospital mortality

Jones AE et al. *JAMA. 2010;303(8):739-746*

To measure CO?

REVIEW

Ultrasonic evaluation of the heart

Daniel De Backer

Table 1. Main hemodynamic variables measured with echocardiography

	Methods	Main interest
Flow measurement	Aortic VTI	Evaluation of cardiac output
		Evaluation of response to therapy
PAOP	Mitral E/Ea	Safety limit during fluid administration
		Cardiogenic component in pulmonary edema
LV systolic function	Ejection fraction	Potential indication for inotropic therapy
	TDSa	
Right ventricle	Right ventricular size and septal motion	Detection of acute cor pulmonale
		Adaptation of ventilatory conditions
	TAPSE	Evaluation of right ventricular systolic function
	Tricuspid regurgitation maximum velocity	Measurement of systolic pulmonary artery pressure
Preload dependency	Respiratory variations in aortic VTI, in superior vena cava, and in inferior vena cava	Prediction of fluid responsiveness

Curr Opin Crit Care 2014, 20:309–314

VOLUME CLAMP TECHNIQUE (NEXFIN) AT THE BEDSIDE

Volume clamp method : photoelectric plethysmography + inflatable finger cuff → brachial arterial waveform → **continuous CO, SVV, PPV**

To measure EVLW ?

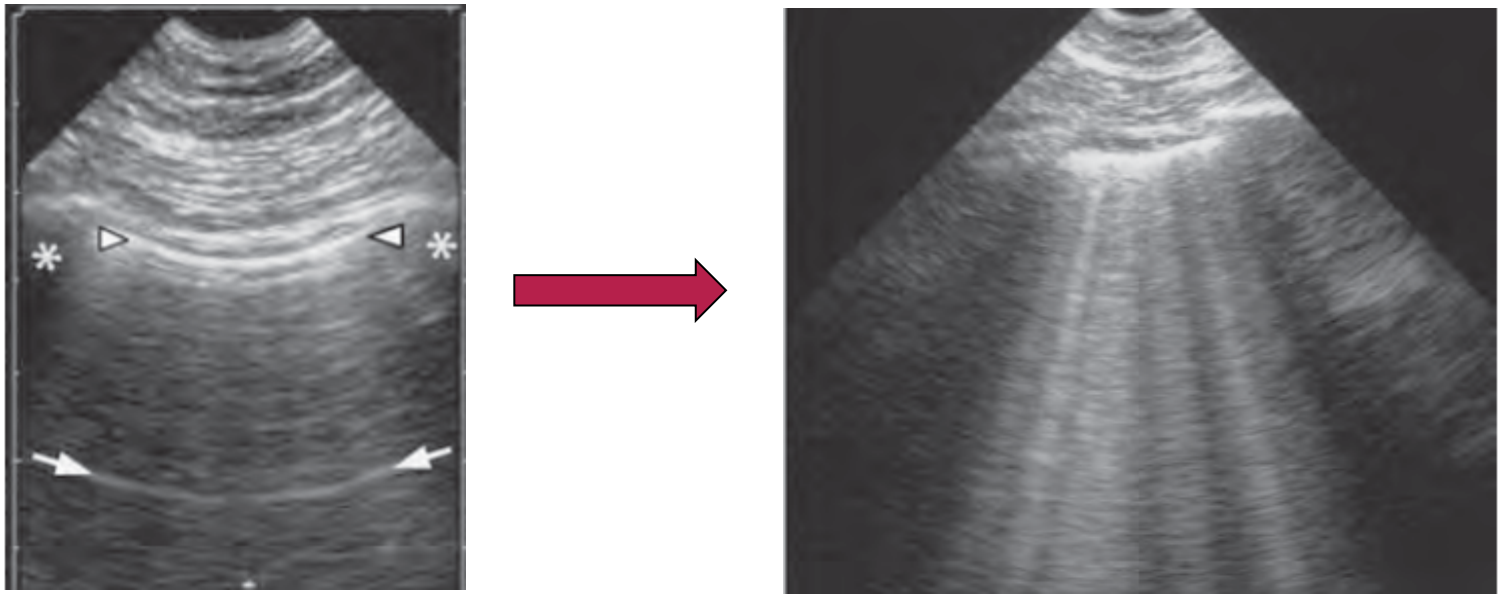
REVIEW

Lung ultrasound in the critically ill

Daniel Lichtenstein

Curr Opin Crit Care 2014, 20:315–322

The Fluid Administration Limited by Lung Sonography (FALLS) protocol



YES

Is CVC safe ?

Catheter -Related Bloodstream Infections (CRBSI):

- Incidence: 0-33% (5%) or 2.8-12.8 episodes/1000 cath days
- femoral > jugular > subclavian site

Clinical Infectious Dsease 2011;52(9):1087-1099

THE FULL PICTURE

CLINICS

US

$$\frac{VO_2}{DO_2} \div ScvO_2 \text{ (If low = } O_2 \text{ debt)}$$

$$\frac{VCO_2}{flow} \div \Delta_{va}PCO_2 \text{ (if high = underperfusion)}$$

↓micro-flow ÷ OPS, StO2, $\Delta_{ta}PCO_2$..


©mitradivshali