Centraal veneuze zuurstof saturatie ($ScvO_2$)

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Inhoud

1. Vragen/ stellingen
2. Zuurstoftransport
3. $ScvO_2$ vs SvO_2
4. $S(c)vO_2$ gerichte therapie
5. Techniek

Vragen/ stellingen

- Wie gebruikt er frequent S(c)vO_2?
- Wat is hoger onder normale omstandigheden? SvO_2 of ScvO_2?
- Wat is hoger in geval van circulatoire shock?
- Is de S(c)vO_2 in de acute fase bij ernstige sepsis/ septische shock meestal verhoogd of verlaagd?

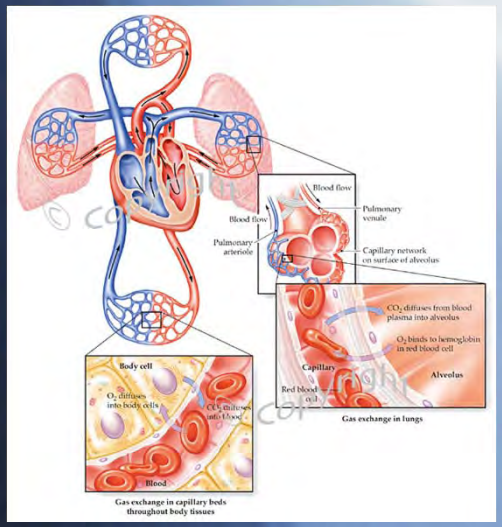
Shock: klinische eindpunten

- Titreren vochttoediening, vasopressie, inotropie, bloedtransfusie
- Eindpunten: MAP, HF, UP, CVD, CO?
  - Normale vitale parameters en toch weefselhypoxie
- Resuscitatie ogv ScvO2?

Foto: F.Muller

Zuurstoftransport

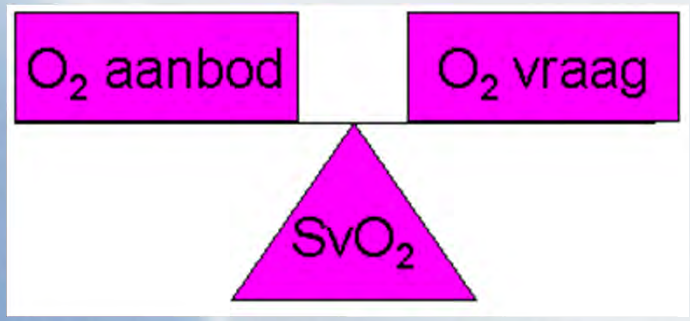
- DO_2= CO x [(1,38 x Hb x SaO_2) + (0,003 x PaO_2)]
- VO_2= CO x [(1,38 x Hb x SaO_2 - SvO_2) + (0,003 x PaO_2)]
- O_2ER= VO_2 / DO_2 = (SaO_2- SvO_2)/ SaO_2



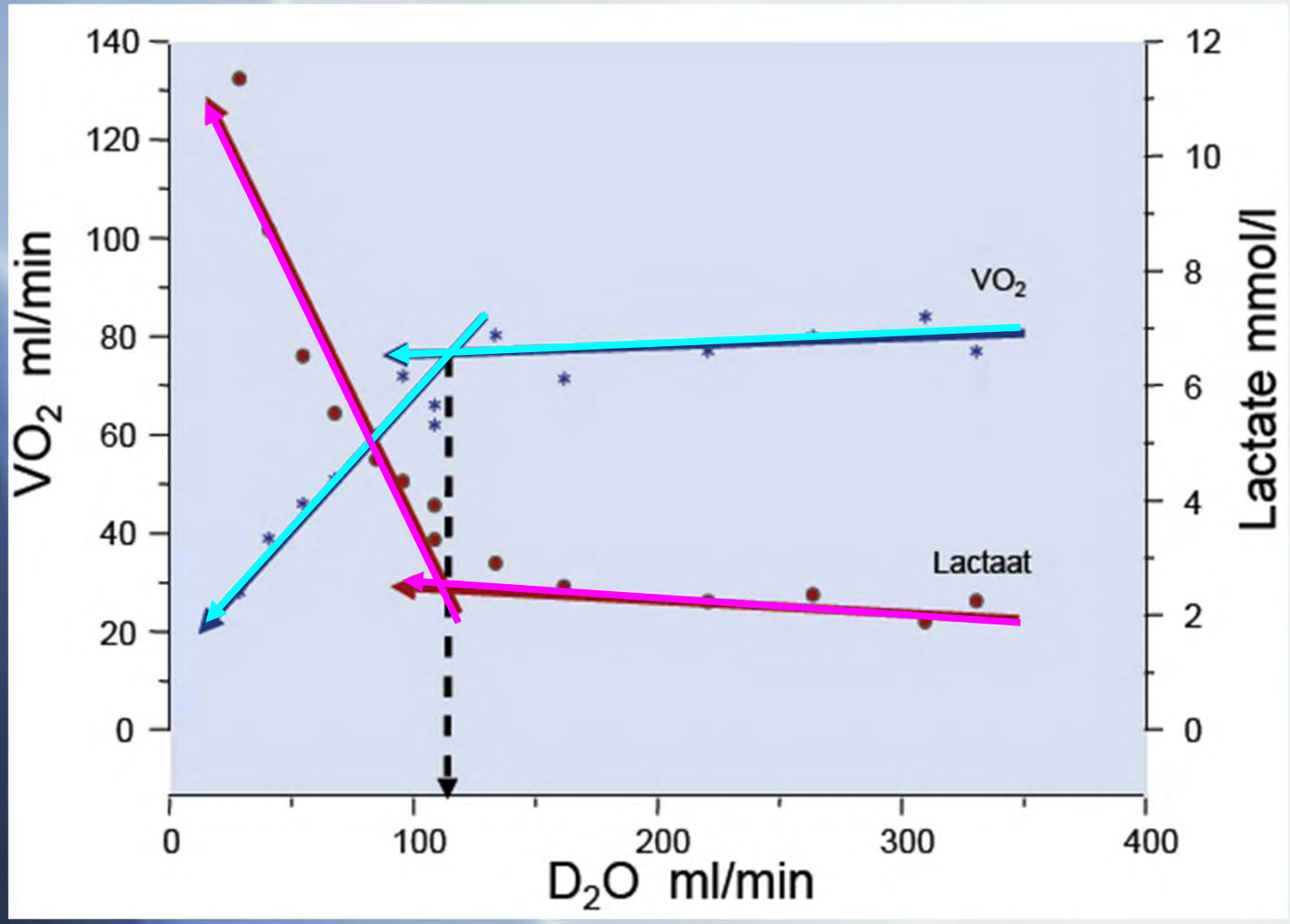
DO_2= zuurstof aanbod
VO_2= zuurstof consumptie
SvO_2 = gemengd veneuze O_2 saturatie
O_2ER= zuurstof extractie ratio

Compensatie mechanisme

- CO primaire compensatie bij ↑VO_2 of ↓Hb/ ↓SaO_2
- ↑O_2 extractie secundair compensatie mechanisme

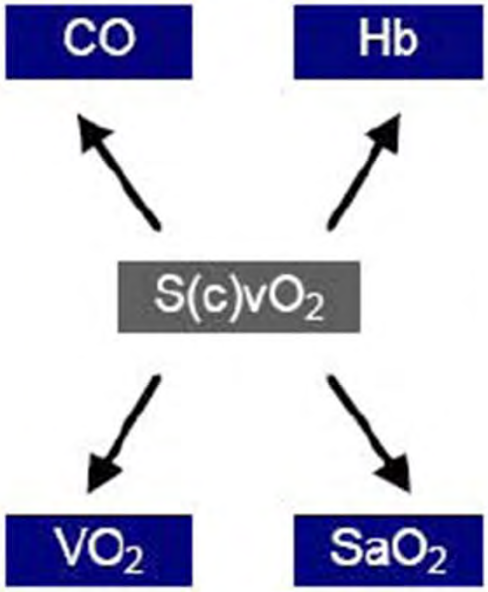


Zuurstofextractie

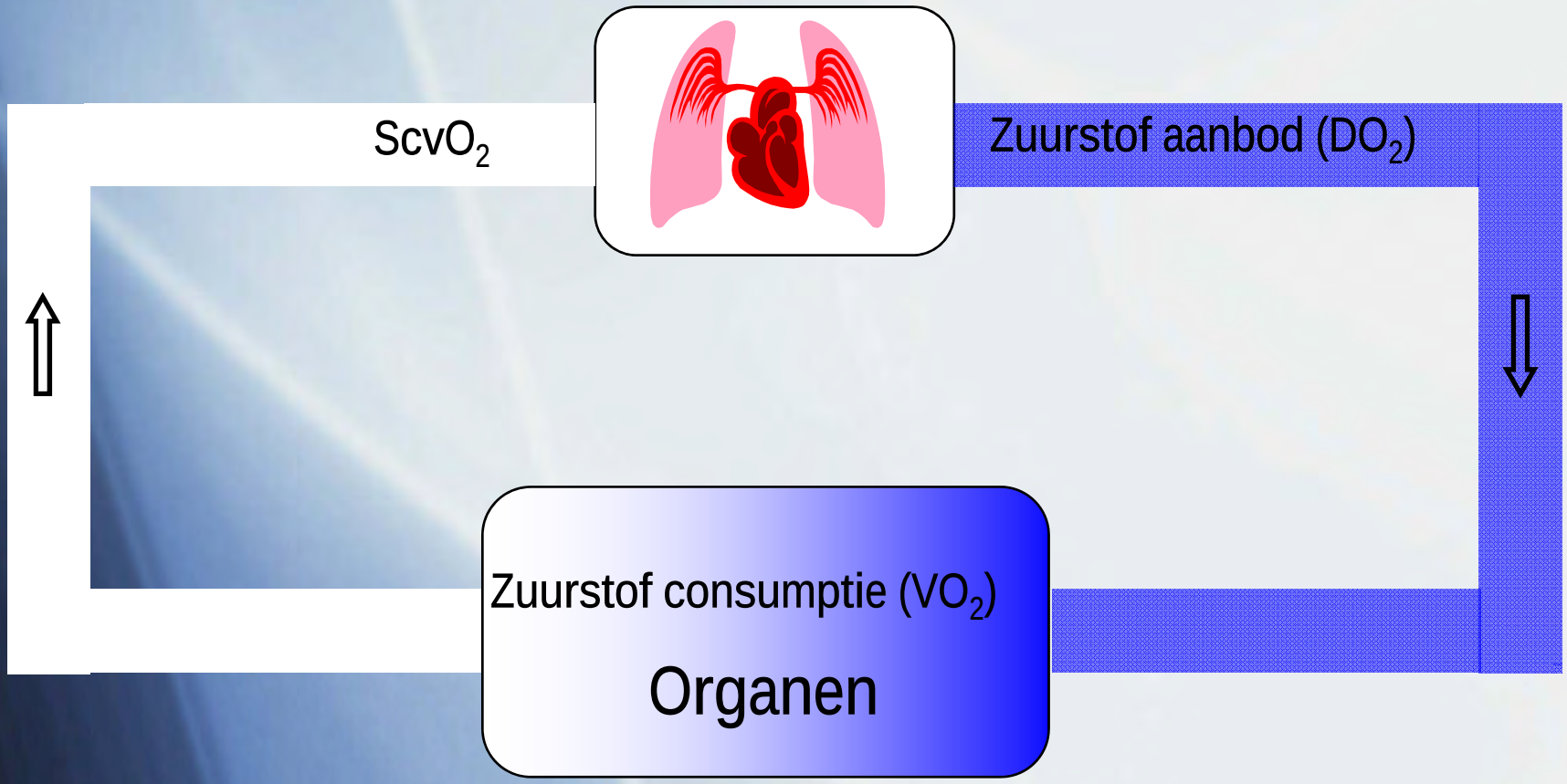


Zhang et al. Amr Rev Respir Dis 1993;148:867-871

Pathofysiologie S(c)vO2



Decrease in $S(c)vO_2$	**O_2 delivery↓** ▪ Anemia/ hemorrhage ▪ Hypoxia ▪ Insufficient cardiac output: myocardial dysfunction/ hypovolemia **O_2 consumption↑** ▪ Agitation ▪ Pain ▪ Fever ▪ Shivering ▪ ↑ metabolic demand (sepsis)
Increase in $S(c)vO_2$	**O_2 delivery↑** ▪ Cardiac output ↑: fluid suppletion/ inotropics ▪ Adequate oxygenation ▪ Blood transfusion **O_2 consumption↓** ▪ Sedation ▪ Analgesia ▪ Hypothermia ▪ Mechanical ventilation **O_2 extraction↓** ▪ Microcirculatory shunting (sepsis) ▪ Cell death


ScvO2
Zuurstof aanbod (DO2)
Zuurstof consumptie (VO2)
Organen

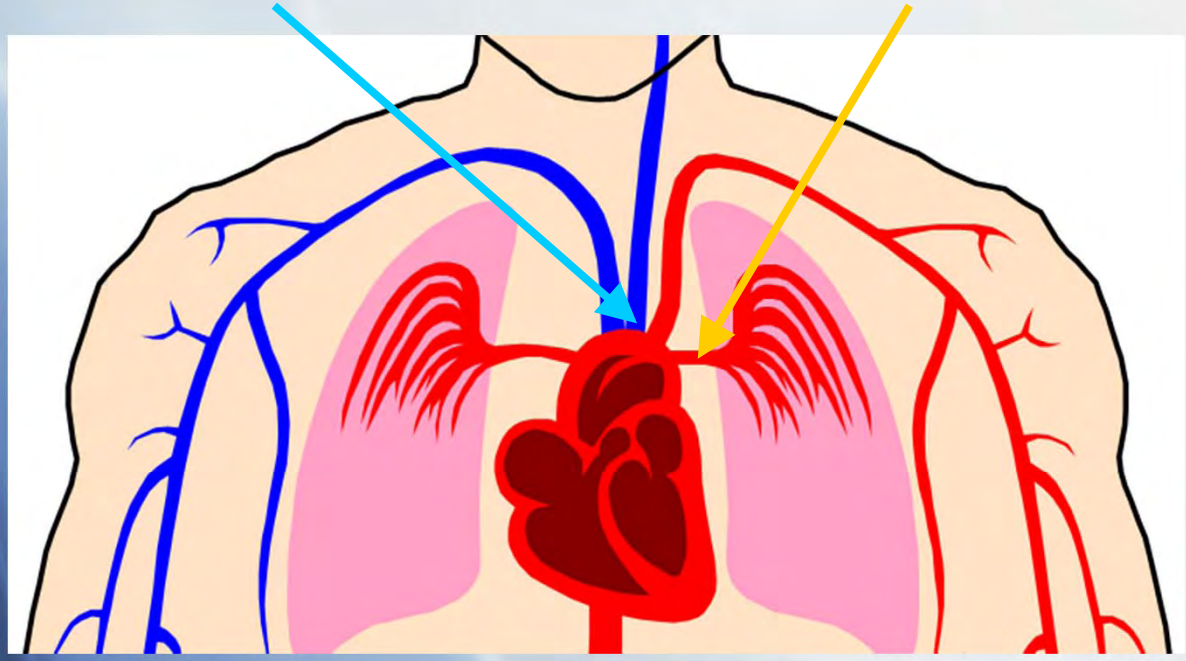
$ScvO_2$ en SvO_2

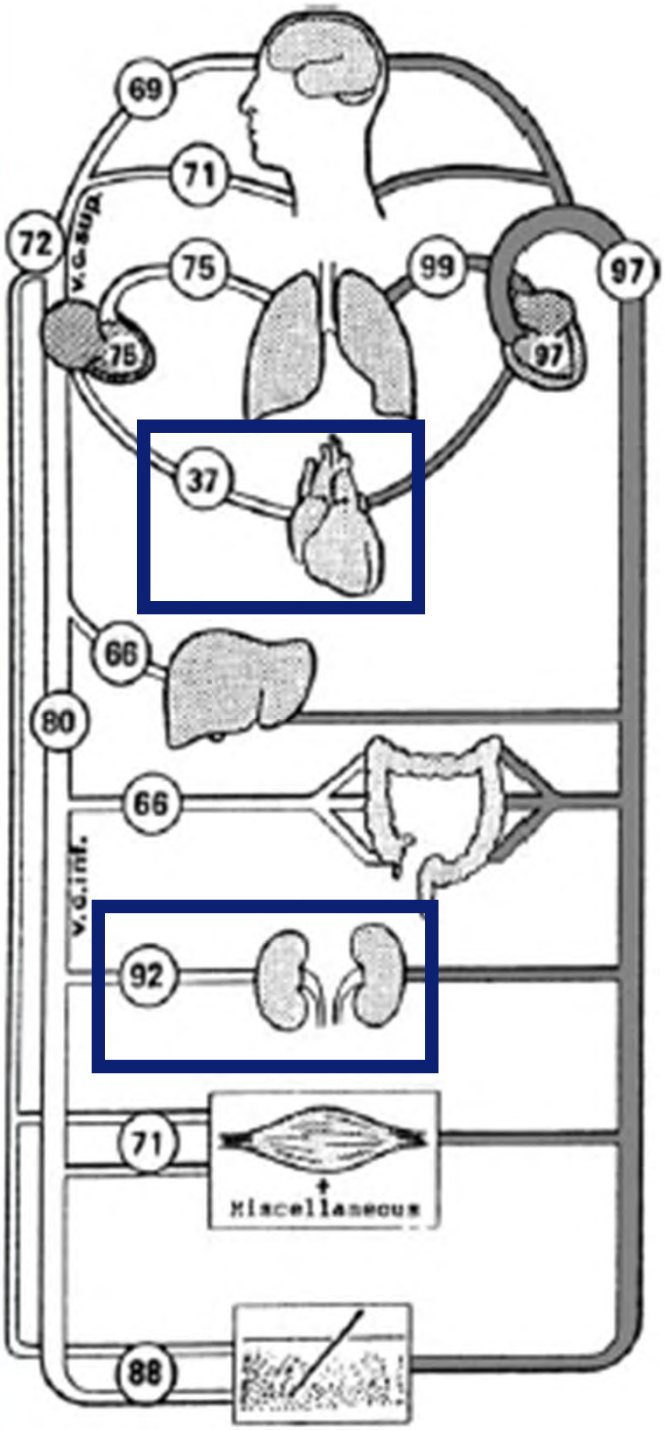
$ScvO_2$ – centraal veneuze zuurstof saturatie

Zuurstof saturatie van hemoglobine in het veneuze bloed in de vena cava superior (10-20% in rechter atrium)

SvO_2 – gemengd veneuze zuurstof saturatie

Zuurstof saturatie van hemoglobine in het bloed in de arterie pulmonalis





Reinhart K (1989) Monitoring O2 transport and tissue oxygenation in critically ill patients. In: Reinhart K, Eyrich K (ed) Clinical aspects of O2 transport and tissue oxygenation. Springer, Berlin Heidelberg New York, pp 195–211

SvO_2 vs $ScvO_2$

Gezond:

$SvO_2 > ScvO_2$ (2%)

- weinig zuurstofextractie in bv. nieren

Shock:

$ScvO_2 > SvO_2$ (5%)

- low flow shock: redistributie van flow en hoge O2 extractie abdomen
- septische shock: toegenomen gastro-intestinale O2 consumptie
- v. cava sup. saturatie blijft relatief lang hoog: cerebrale perfusie blijft gewaarborgd

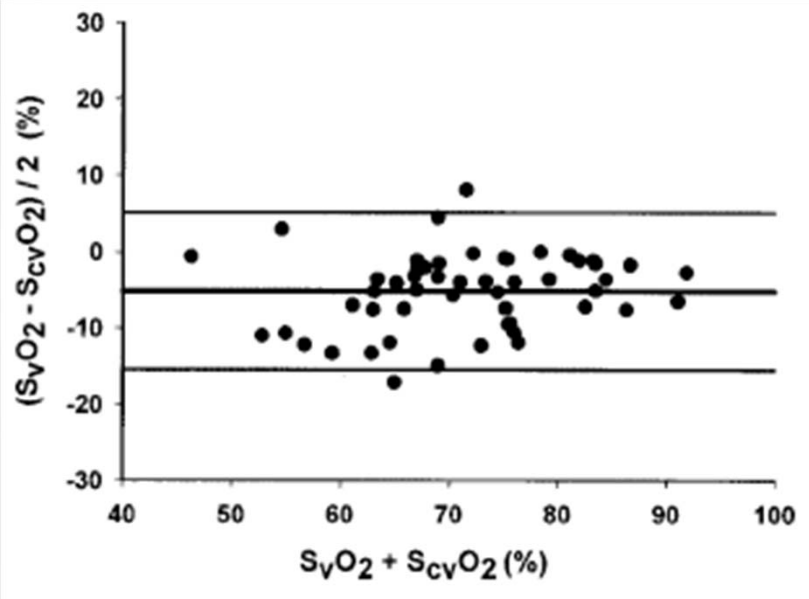
$ScvO_2 = SvO_2$: Pro

- Niet individuele waarde maar trend is belangrijk
- In de lage SvO_2 reeks zal $ScvO_2$ nog lager zijn.
- Inbrengen CVC sneller dan PAC
- Op afdeling cq SEH mogelijk
- Outcome effect van snellere informatie weegt mogelijk op tegen inacuratere meting

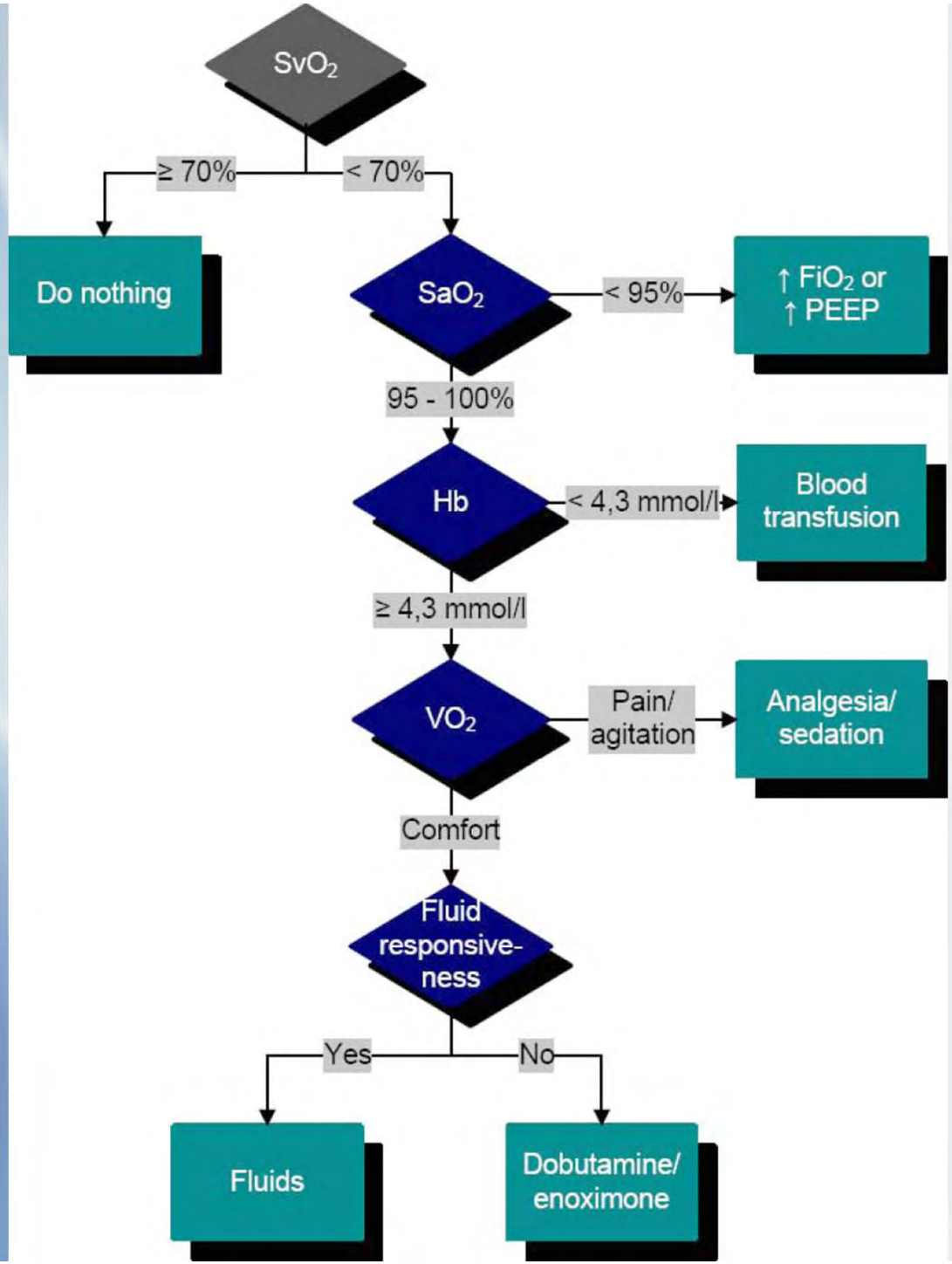
$ScvO_2 = SvO_2$: Con

Lack of Equivalence Between Central and Mixed Venous Oxygen Saturation*

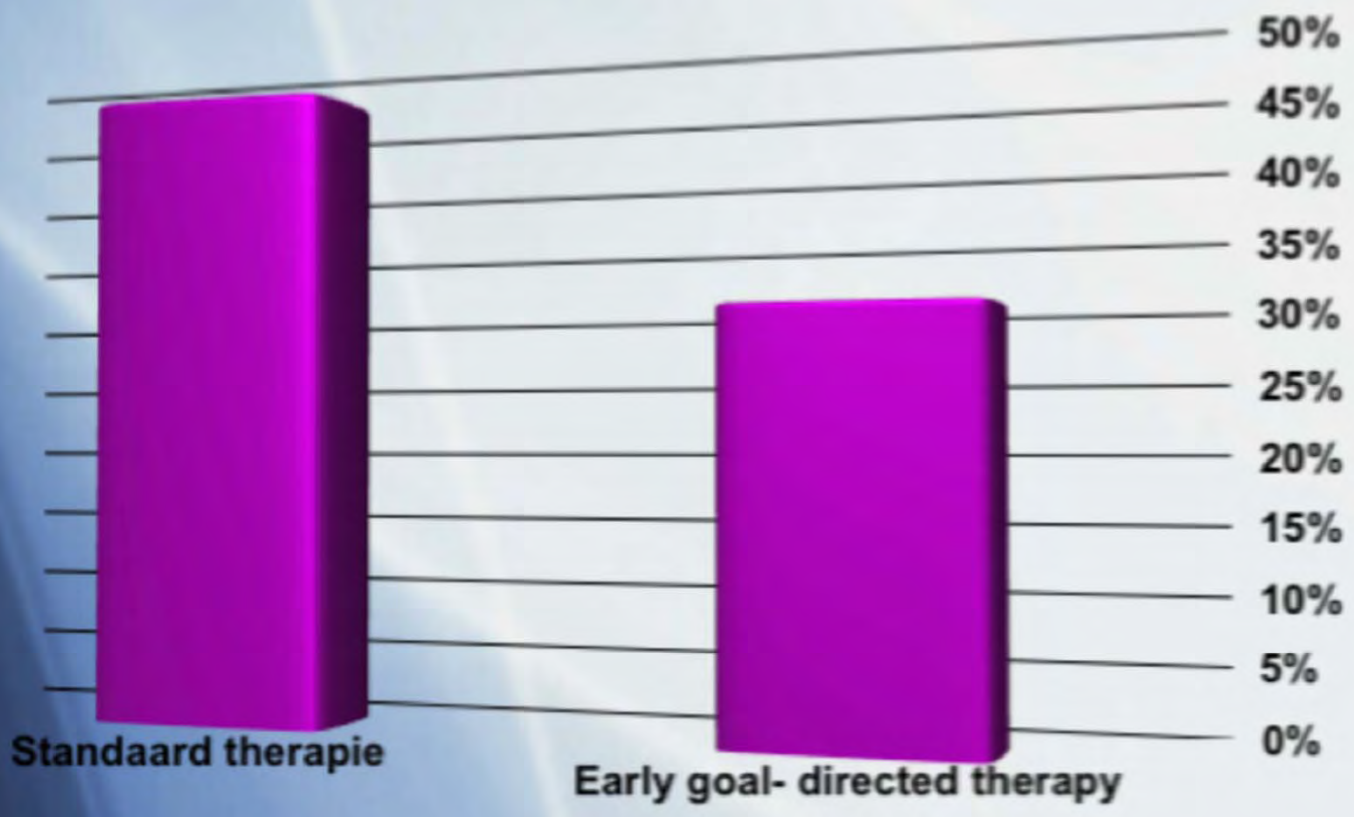
Lakhmir S. Chawla, MD; Hasan Zia, MD; Guillermo Gutierrez, MD, PhD, FCCP; Necin M. Katz, MD; Michael G. Seneff, MD, FCCP; and Muhammed Shah, MD



- Verschil -5%
- 95% CI: 5% tot -16%
- Bij ScvO2 74% ➲ SvO2 79% tot 58%!


SvO_2
≥ 70%
< 70%
Do nothing
SaO_2
< 95%
↑ FiO_2 or ↑ PEEP
95 - 100%
Hb
< 4,3 mmol/l
Blood transfusion
≥ 4,3 mmol/l
VO_2
Pain/ agitation
Analgesia/ sedation
Comfort
Fluid responsive-ness
Yes
No
Fluids
Dobutamine/ enoximone

$ScvO_2$ directed therapy - Rivers studie



SvO_2 directed therapy

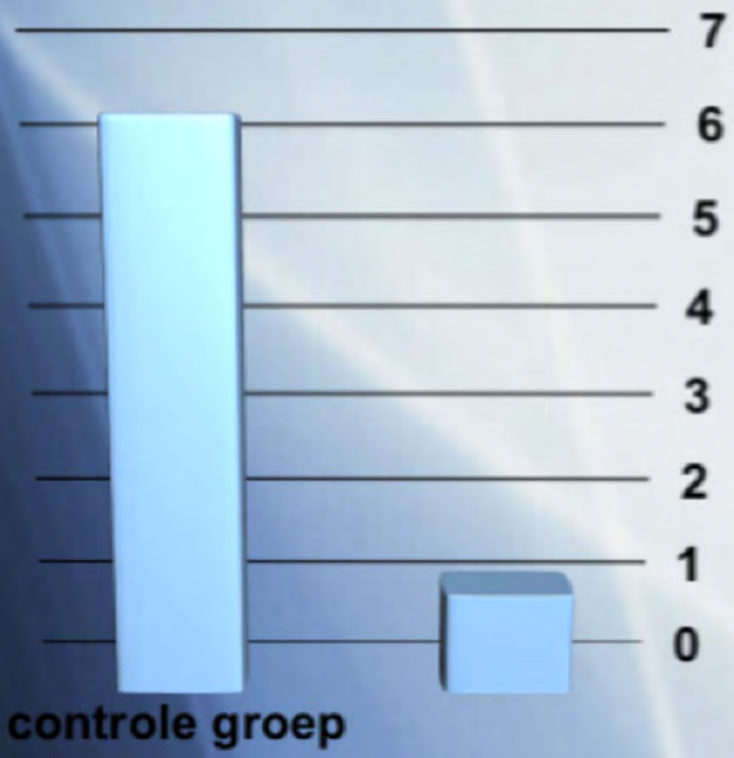
The New England
Journal of Medicine

Volume 333 OCTOBER 19, 1995 Number 16

A TRIAL OF GOAL-ORIENTED HEMODYNAMIC THERAPY IN CRITICALLY ILL PATIENTS

LUCIANO GATTINONI, M.D., LUCA BRAZZI, M.D., PAOLO PELOSI, M.D., ROBERTO LATINI, M.D., GIANNI TOGNONI, M.D., ANTONIO PESENTI, M.D., AND ROBERTO FUMAGALLI, M.D., FOR THE SvO_2 COLLABORATIVE GROUP*

A Prospective, Randomized Study of Goal-Oriented Hemodynamic Therapy in Cardiac Surgical Patients



Klinische eindpunten:
$SvO_2 \geq 70\%$
Lactaat ≤ 2,0 mmol/l

Resultaten:
↓ opnameduur
↓ morbiditeit

Pölönen et al. Anesth Analg 2000;90:1052-1059

Early lactate-guided therapy in ICU patients: a multicenter, open-label, randomized controlled trial

Am J Respir Crit Care Med Vol 182. pp 752–761, 2010

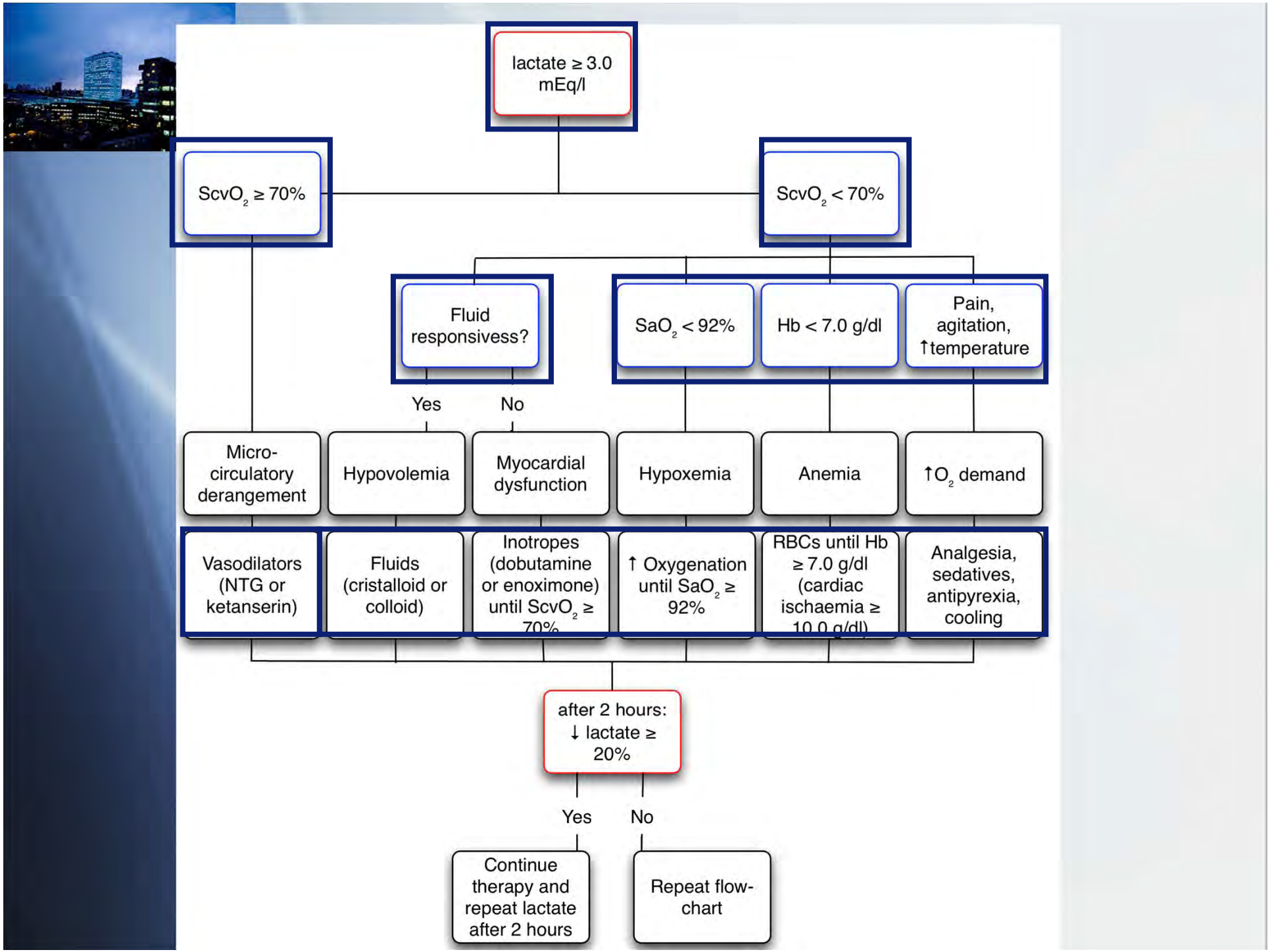
- Tim C. Jansen, MD, Jasper van Bommel, MD PhD, F. Jeanette Schoonderbeek, MD PhD, Steven J. Sleeswijk Visser, MD, Johan M. van der Klooster, MD, Alex P. Lima, MD, Sten P. Willemsen, Jan Bakker, MD PhD; for the LACTATE study group

Erasmus MC University Medical Center Rotterdam

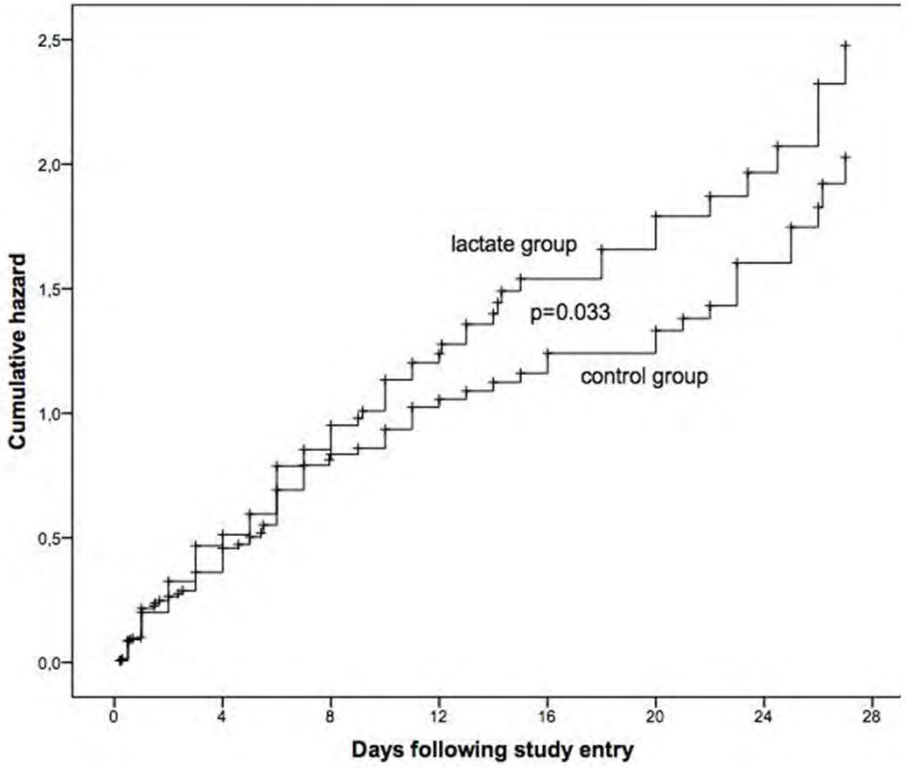
SFG

Reinier de Graaf Groep ziekenhuizen, poliklinieken en medische laboratoria

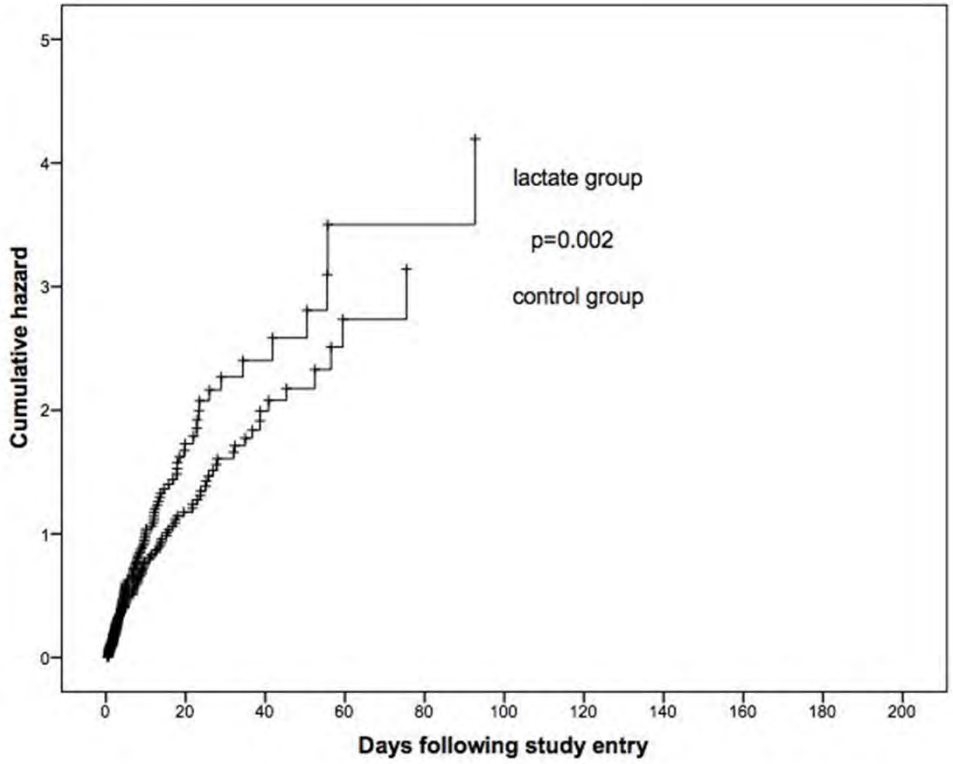
Ikazia ziekenhuis


lactate ≥ 3.0 mEq/l
ScvO2 ≥ 70%
ScvO2 < 70%
Fluid responsivess?
SaO2 < 92%
Hb < 7.0 g/dl
Pain, agitation, ↑temperature
Yes
No
Micro-circulatory derangement
Hypovolemia
Myocardial dysfunction
Hypoxemia
Anemia
↑O2 demand
Vasodilators (NTG or ketanserin)
Fluids (cristalloid or colloid)
Inotropes (dobutamine or enoximone) until ScvO2 ≥ 70%
↑ Oxygenation until SaO2 ≥ 92%
RBCs until Hb ≥ 7.0 g/dl (cardiac ischaemia ≥ 10.0 g/dl)
Analgesia, sedatives, antipyrexia, cooling
after 2 hours: ↓ lactate ≥ 20%
Yes
No
Continue therapy and repeat lactate after 2 hours
Repeat flow-chart

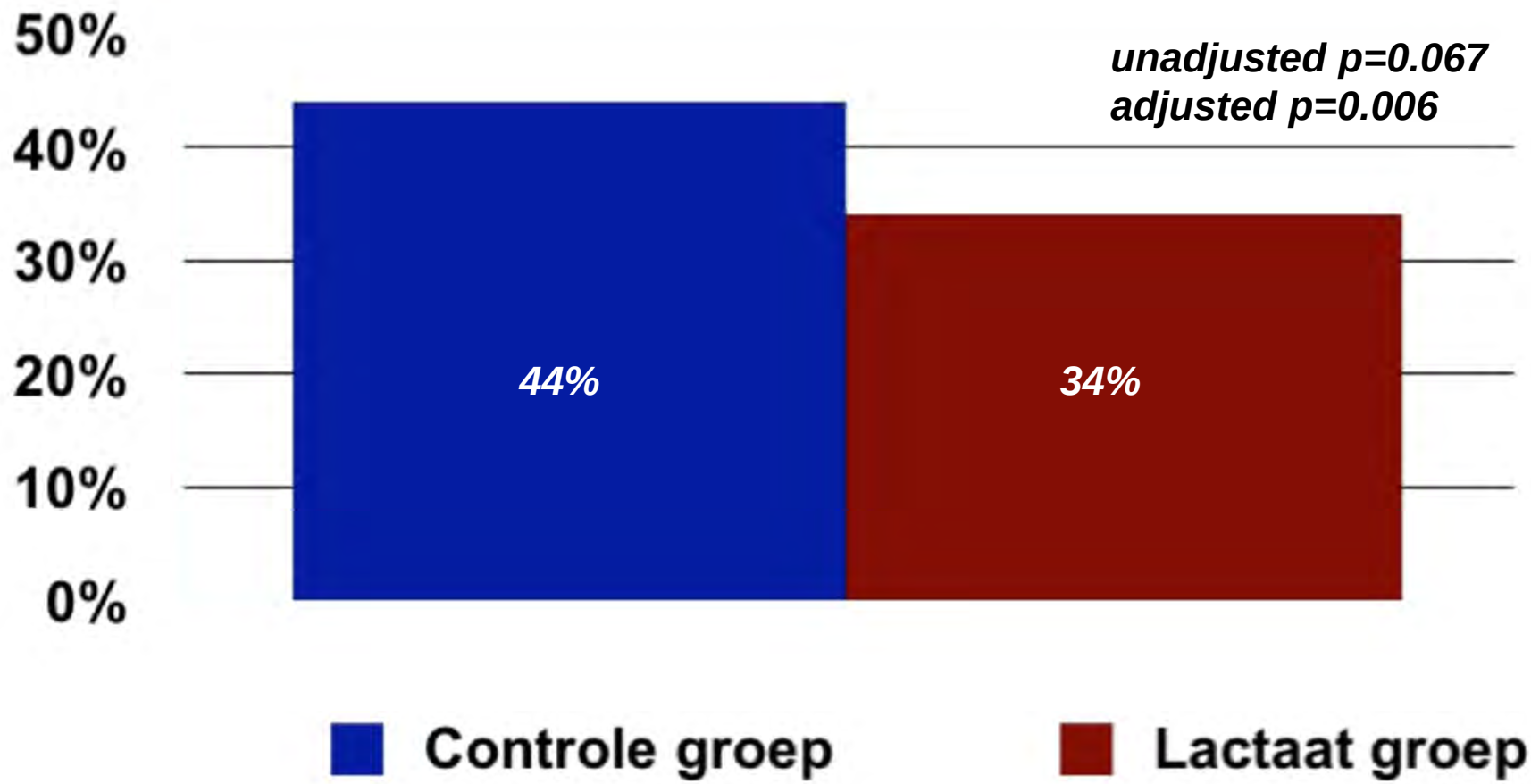
Time-to-weaning from mechanical ventilation



Time-to-discharge from ICU



in-hospital mortality



Am J Respir Crit Care Med Vol 182. pp 752–761, 2010

$ScvO_2$ en sepsis

Variable and Treatment Group	Base Line (0 hr)	Hours after Start of Therapy		
		6	0–6†	7–72‡
Heart rate (beats/min)				
Standard therapy	114±27	105±25	108±23	99±18
EGDT	117±31	103±19	105±19	96±18
P value	0.45	0.12	0.25	0.04
Central venous pressure (mm Hg)				
Standard therapy	6.1±7.7	11.8±6.8	10.5±6.8	11.6±6.1
EGDT	5.3±9.3	13.8±4.4	11.7±5.1	11.9±5.6
P value	0.57	0.007	0.22	0.68
Mean arterial pressure (mm Hg)				
Standard therapy	76±24	81±18	81±16	80±15
EGDT	74±27	95±19	88±16	87±15
P value	0.60	<0.001	<0.001	<0.001
Central venous oxygen saturation (%)				
Standard therapy	49.2±13.3	66.0±15.5	65.4±14.2	65.3±11.4
EGDT	48.6±11.2	77.3±10.0	71.6±10.2	70.4±10.7
P value	0.49	<0.001	<0.001	<0.001

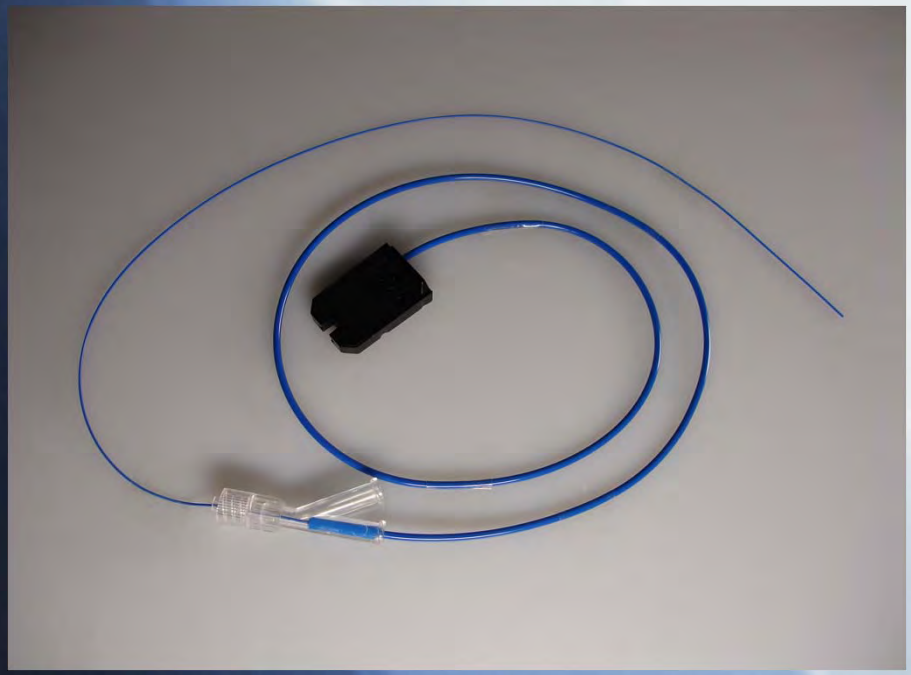
- Rivers studie:
- - $ScvO_2$ 49% bij opname

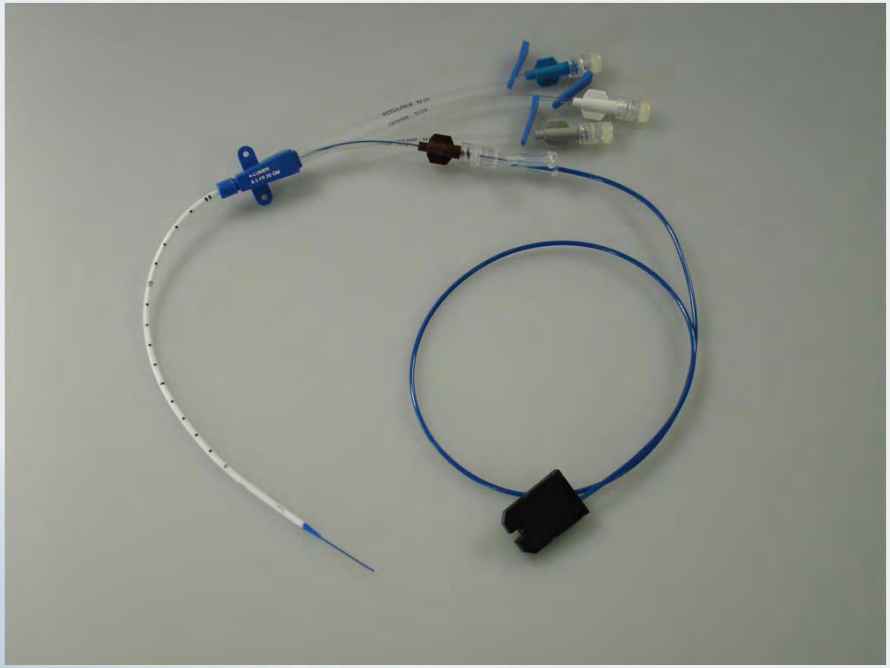
$ScvO_2$ catheter

Edwards
LIFESCIENCES

ScvO2 - probe

PULSION
Medical Systems





Conclusie

- $ScvO_2$ geeft balans tussen zuurstof aanbod en vraag weer
- $ScvO_2$ is belangrijk waarschuwingssignaal op IC
- $ScvO_2$ is bruikbaar als klinisch eindpunt bij behandeling van circulatoire shock in de vroege fase