The high risk surgical patient

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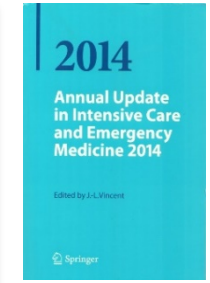
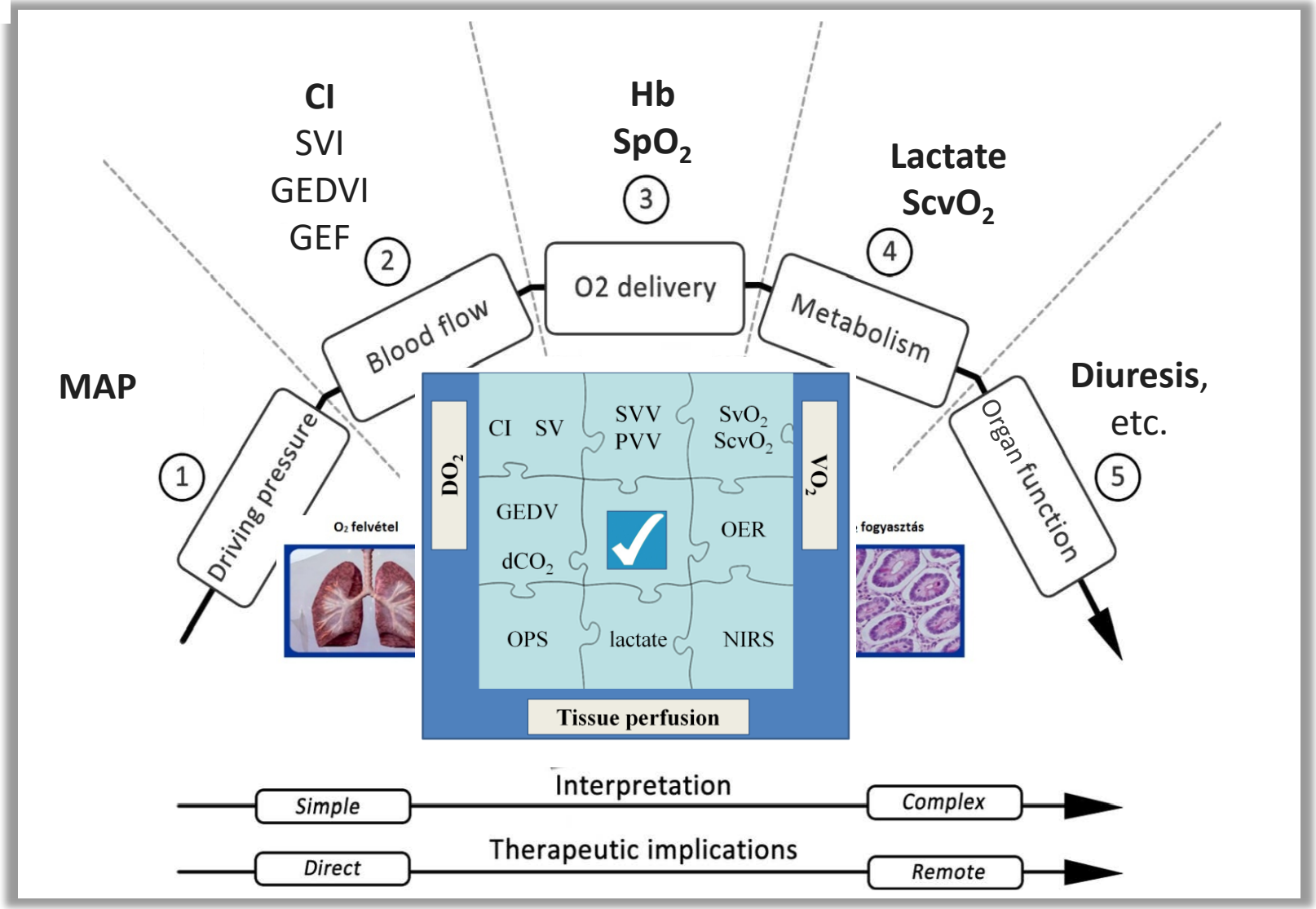
I[ST] INTERNATIONAL INTER-CONGRESS
CONFERENCE OF THE POLISH SOCIETY
OF ANAESTHESIOLOGY AND INTENSIVE THERAPY
PITFALLS IN ANAESTHESIOLOGY
AND INTENSIVE THERAPY
ZAKOPANE, 11–12 December 2015 r.

Multimodal hemodynamic monitoring

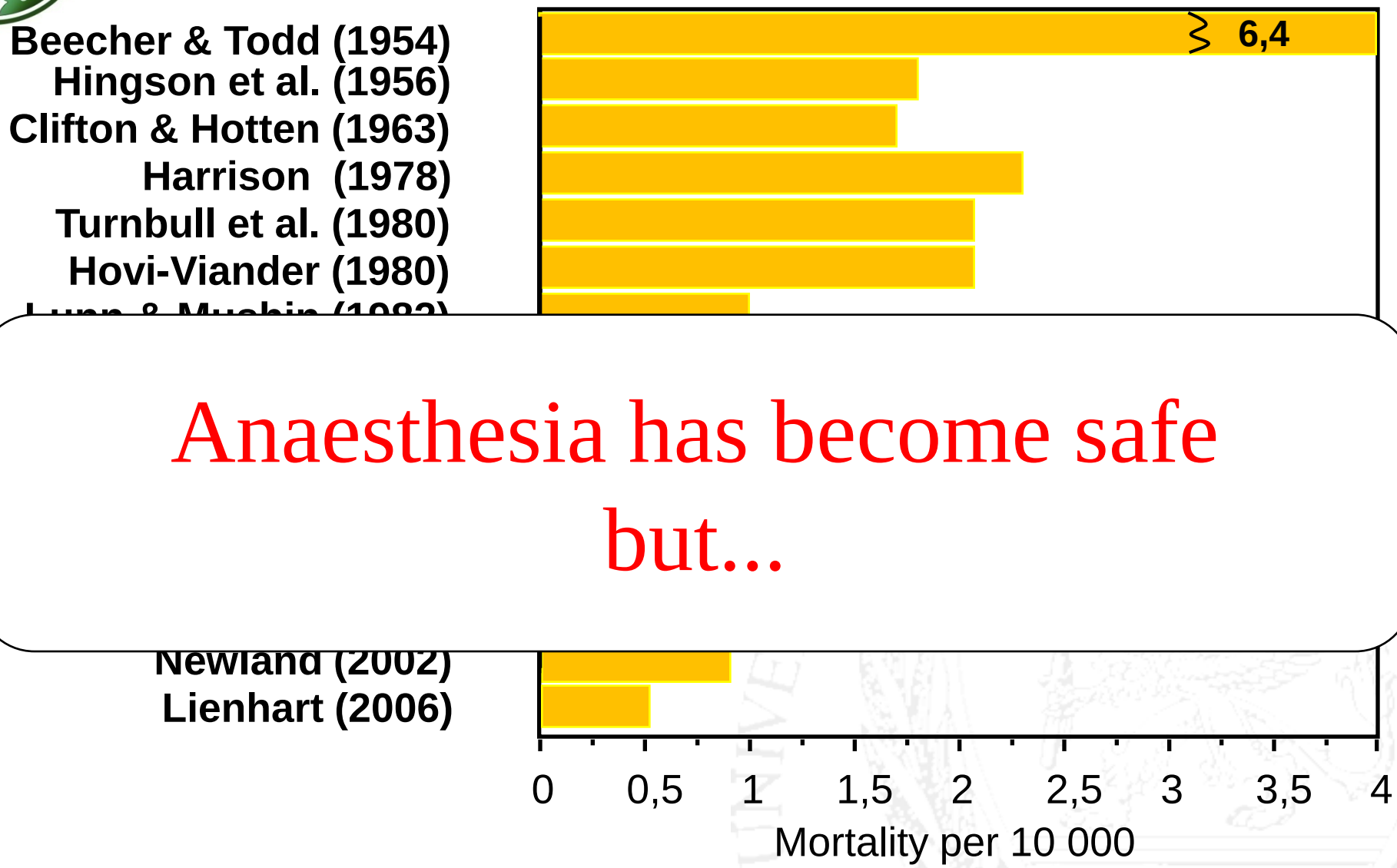
Tánczos K, Németh M, Molnár Z. *Ann. Up. in Int. Care and Em. Med*. 2014, pp:355





Is it important in the perioperative setting?

Mortality and anaesthesia



Anaesthesia has become safe but...

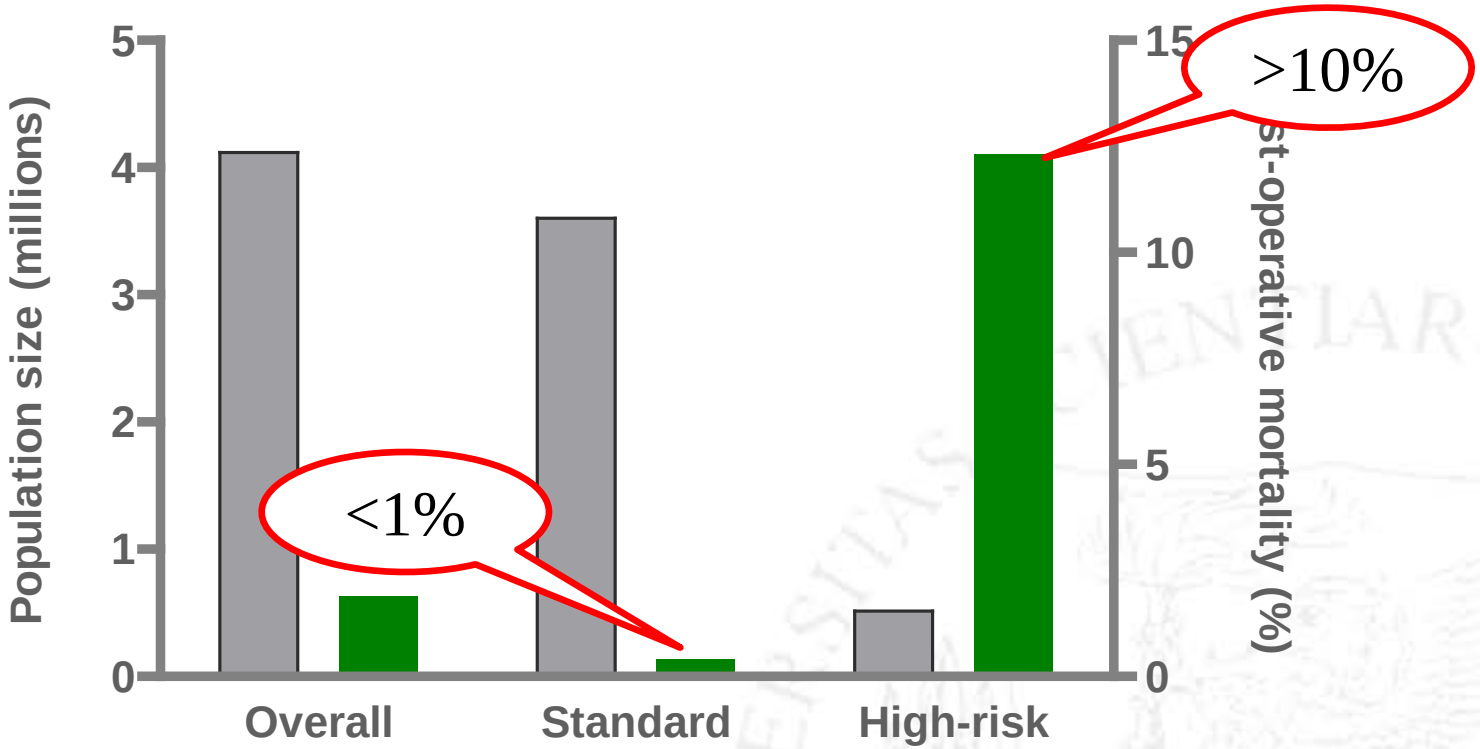
Research

Open Access

Identification and characterisation of the high-risk surgical population in the United Kingdom

Rupert M Pearse[1], David A Harrison[2], Philip James[3], David Watson[1], Charles Hinds[1], Andrew Rhodes[4], R Michael Grounds[4] and E David Bennett[4]

Critical Care 2006, **10**:R81



Higher mortality in high risk patients is hidden by the large number of cases

Mortality after surgery in Europe: a 7 day cohort study

*Rupert M Pearse, Rui P Moreno, Peter Bauer, Paolo Pelosi, Philipp Metnitz, Claudia Spies, Benoit Vallet, Jean-Louis Vincent, Andreas Hoeft, Andrew Rhodes, for the European Surgical Outcomes Study (EuSOS) group for the Trials groups of the European Society of Intensive Care Medicine and the European Society of Anaesthesiology**

Lancet 2012; 380: 1059–65

	Number of patients	Median days in hospital (IQR)	Number admitted to critical care	Percentage admitted to critical care (95% CI)	Number died in hospital	Percentage died in hospital (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p value
Belgium	1486	3·0 (1·0–6·0)	136	9·2% (7·7–10·6)	47	3·2% (2·3–4·1)	0·89 (0·65–1·21)	1·65 (0·81–3·40)	0·17
Croatia	1767	4·0 (2·0–7·0)	166	9·4% (8·0–10·8)	131	7·4% (6·2–8·6)	2·17 (1·77–2·67)	1·89 (0·94–3·80)	0·07
Cyprus	45	1·0 (1·0–3·0)	0	0	1	2·2% (0·0–6·7)	0·62 (0·09–4·48)	0·82 (0·04–16·70)	0·90
Czech Republic	434	4·0 (2·0–9·0)	21	4·8% (2·8–6·9)	10	2·3% (0·9–3·7)	0·64 (0·34–1·21)	1·30 (0·23–7·46)	0·77
Denmark	1000	2·0 (1·0–5·0)	36	3·6% (2·4–4·8)	32	3·2% (2·1–4·3)	0·90 (0·62–1·29)	1·16 (0·52–2·61)	0·72
Estonia	727	3·0 (1·0–6·0)	51	7·0% (5·2–8·9)	11	1·5% (0·6–2·4)	0·42 (0·23–0·76)	0·60 (0·16–2·28)	0·45
Finland	1071	2·0 (1·0–5·0)	43	4·0% (2·8–5·6)	21	2·0% (1·1–2·8)	0·54 (0·35–0·85)	0·44 (0·19–1·05)	0·06
France	2278	3·0 (1·0–6·0)	132	5·8% (4·8–6·8)	73	3·2% (2·5–3·9)	0·90 (0·70–1·16)	1·36 (0·72–2·56)	0·34
Germany	5284	4·0 (2·0–9·0)	611	11·6% (10·7–12·4)	133	2·5% (2·1–2·9)	0·70 (0·57–0·86)	0·85 (0·50–1·43)	0·54
Greece	1803	3·0 (2·0–7·0)	63	3·5% (2·7–4·3)	65	3·6% (2·7–4·5)	1·01 (0·78–1·33)	1·20 (0·66–2·16)	0·55
Hungary	621	4·0 (2·0–7·0)	44	7·1% (5·1–9·1)	20	3·2% (1·8–4·6)	0·90 (0·57–1·43)	1·23 (0·43–3·50)	0·69
Iceland	162	2·0 (1·0–4·0)	15	9·3% (4·8–13·8)	2	1·2% (0·0–3·0)	0·34 (0·08–1·37)	0·47 (0·07–3·41)	0·46
Ireland	856	3·0 (1·0–6·0)	66	7·7% (5·9–9·5)	55	6·4% (4·8–8·1)	1·86 (1·39–2·49)	2·61 (1·30–5·27)	0·007
Italy	2673	3·0 (2·0–7·0)	200	7·5% (6·5–8·5)	141	5·3% (4·4–6·1)	1·51 (1·24–1·84)	1·70 (0·97–2·97)	0·06
Latvia	302	4·0 (2·0–8·0)	19	6·3% (3·5–9·1)	65	21·5% (16·9–26·2)	7·44 (5·55–9·97)	4·98 (1·22–20·29)	0·025
Lithuania	375	3·0 (2·0–5·0)	14	3·7% (1·8–5·7)	10	2·7% (1·0–4·3)	0·74 (0·39–1·40)	1·21 (0·21–6·95)	0·83
Netherlands	1627	3·0 (1·0–6·0)	126	7·7% (6·4–9·0)	32	2·0% (1·3–2·7)	0·55 (0·38–0·78)	0·63 (0·28–1·41)	0·26
Norway	689	3·0 (1·0–6·0)	31	4·5% (3·0–6·1)	10	1·5% (0·6–2·4)	0·40 (0·21–0·75)	0·51 (0·17–1·49)	0·22
Poland	397	5·0 (2·0–7·5)	8	2·0% (0·6–3·4)	71	17·9% (14·1–21·7)	5·91 (4·48–7·79)	6·92 (2·37–20·27)	0·0004
Portugal	1489	3·0 (1·0–7·0)	103	6·9% (5·6–8·2)	61	4·1% (3·1–5·1)	1·16 (0·88–1·53)	1·43 (0·72–2·83)	0·31
Romania	1298	5·0 (3·0–8·0)	209	16·1% (14·1–18·1)	88	6·8% (5·4–8·2)	1·97 (1·55–2·51)	3·19 (1·61–6·29)	0·001
Serbia	85	5·0 (3·0–7·0)	1	1·2% (0·0–3·5)	2	2·4% (0·0–5·6)	0·65 (0·16–2·67)	1·06 (0·11–10·04)	0·96
Slovakia	1156	3·0 (2·0–7·0)	22	1·9% (1·1–2·7)	129	11·2% (9·3–13·0)	3·41 (2·76–4·20)	2·15 (0·91–5·07)	0·08
Slovenia	518	3·0 (1·0–7·0)	13	2·5% (1·2–3·9)	15	2·9% (1·5–4·3)	0·81 (0·48–1·37)	1·12 (0·30–4·22)	0·86
Spain	5433	3·0 (1·0–7·0)	677	12·5% (11·6–13·3)	208	3·8% (3·3–4·3)	1·08 (0·91–1·28)	1·39 (0·89–2·18)	0·15
Sweden	1314	2·0 (1·0–6·0)	42	3·2% (2·2–4·2)	24	1·8% (1·1–2·6)	0·50 (0·33–0·77)	0·58 (0·23–1·49)	0·26
Switzerland	1019	4·0 (2·0–8·0)	79	7·8% (6·1–9·4)	20	2·0% (1·1–2·8)	0·54 (0·35–0·86)	0·86 (0·25–2·97)	0·81
UK	10630	2·0 (1·0–6·0)	671	6·3% (5·9–6·8)	378	3·6% (3·2–3·9)	1·00	..	..

Odds ratios (OR) referenced against the UK and adjusted for age, American Society of Anesthesiologists' score, urgency of surgery, grade of surgery (minor, intermediate, major), surgical specialty, and the presence of either metastatic disease or cirrhosis in a two-level binary logistic regression model (with patient at the first level and hospital at the second).

Table 2: **Relation between country and in-hospital mortality**

Mortality after surgery in Europe: a 7 day cohort study

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Lancet 2012; 380: 1059–65

Interpretation The mortality rate for patients undergoing inpatient non-cardiac surgery was higher than anticipated. Variations in mortality between countries suggest the need for national and international strategies to improve care for this group of patients.

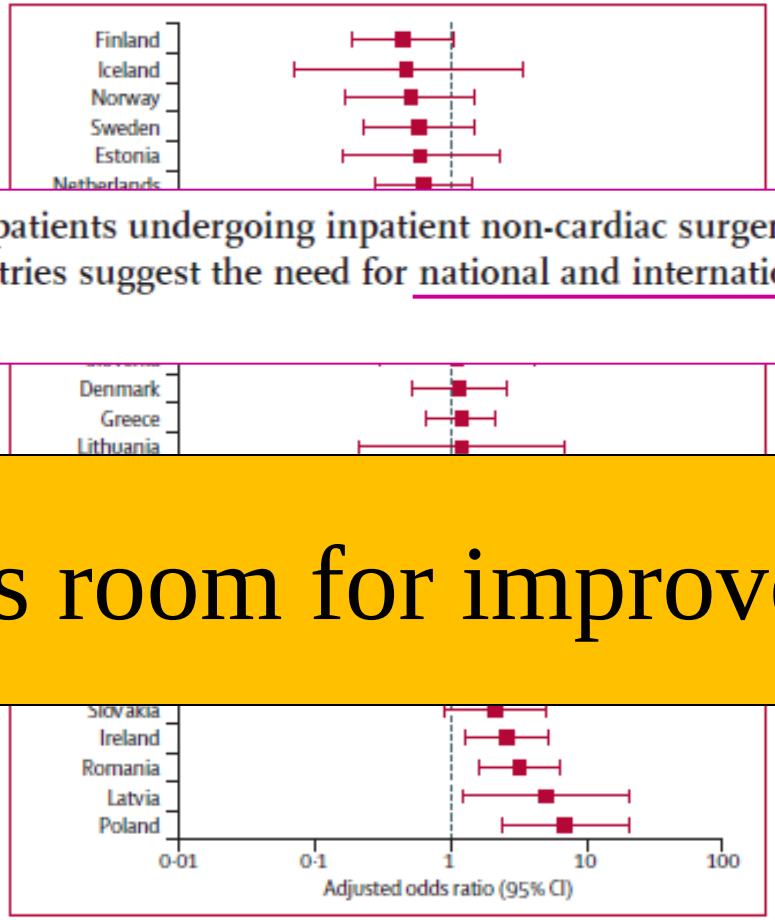
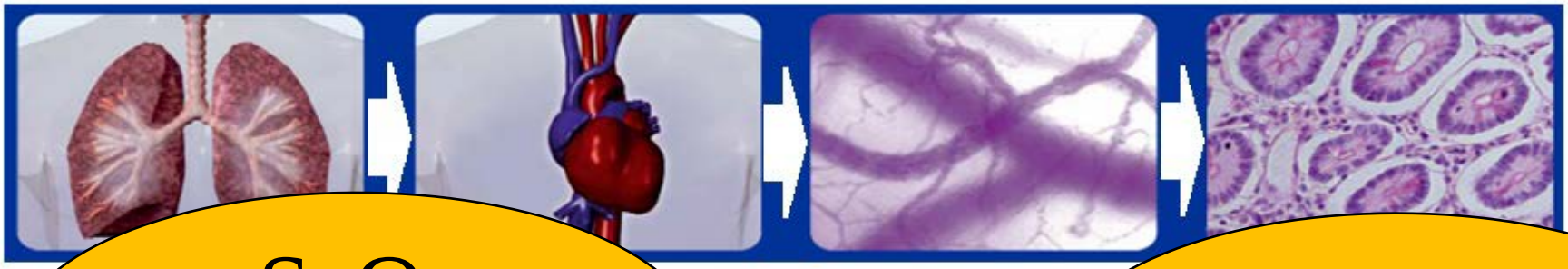


Figure 3: Adjusted odds ratio for death in hospital after surgery for each country

There is room for improvement!

Pathophysiology

Why patients get into trouble?



SaO_2 ~100%

xygen

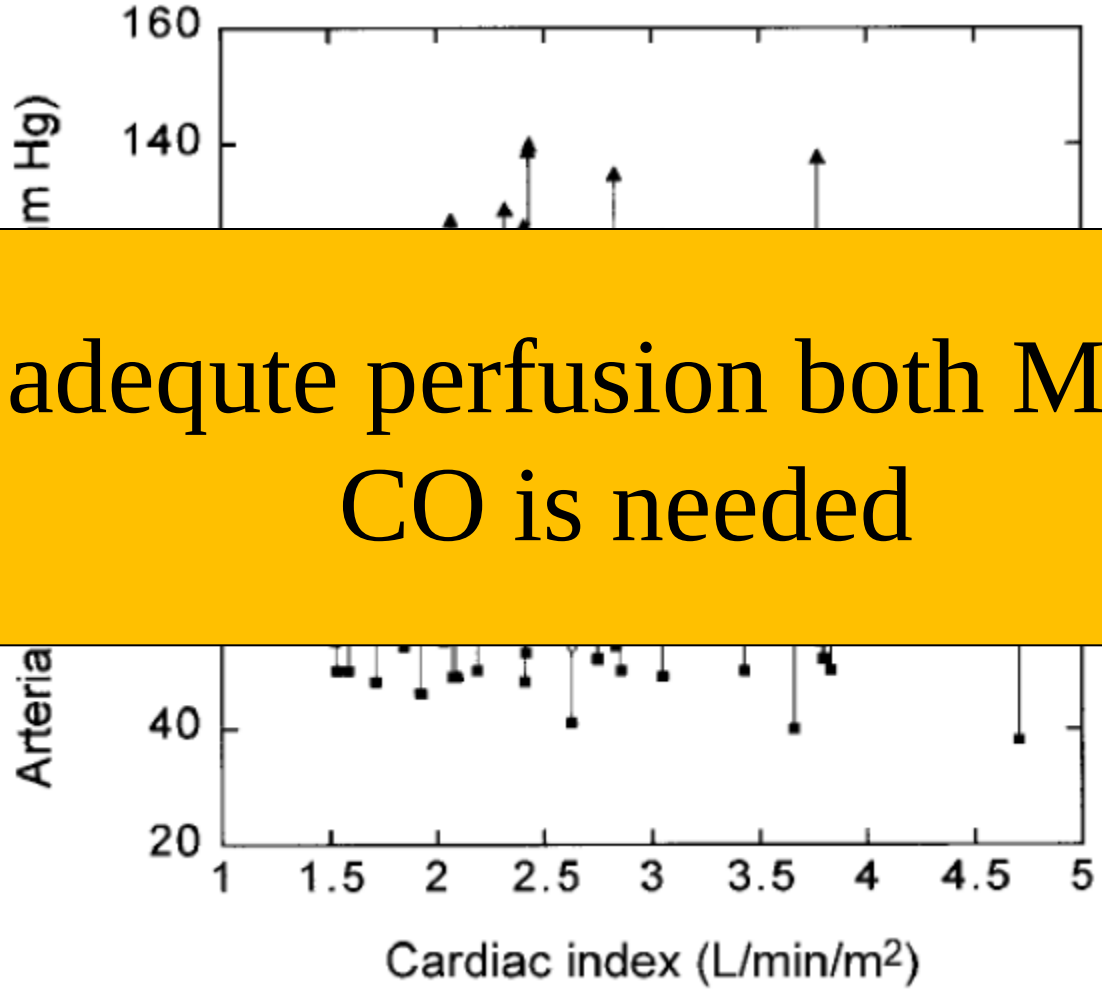
$ScvO_2$ 70%

For adequte assessment
Evaluation of physiology (VO_2/DO_2) is needed

Analgesia, anaesthesia, IPPV

Blood pressure and cardiac output

Linton RA, et al. *J Cardiothorac Vasc Anesth* 2002; 16: 4-7.



For adequte perfusion both MAP and CO is needed

Intensive Care Med
DOI 10.1007/s00134-015-3850-x

SEVEN-DAY PROFILE PUBLICATION

Maurizio Cecconi
Christoph Hofer
Jean-Louis Teboul
Ville Pettila
Erika Wilkman
Zsolt Molnar
Giorgio Della Rocca
Cesar Aldecoa
Antonio Artigas
Sameer Jog
Michael Sander

Fluid challenges in intensive care: the FENICE study

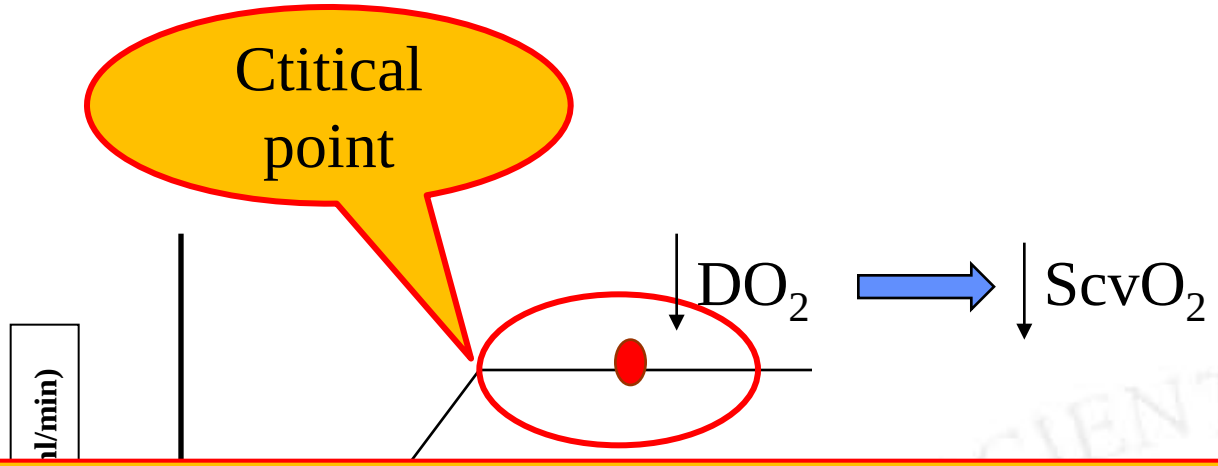
A global inception cohort study

Table 3 Indications and variables used to predict fluid responsiveness ($N = 2213$)

Indication	n (%)
Hypotension	1211 (58.7 [56.7–60.8])
Weaning vasopressor	146 (7.1 [6.0–8.2])
Cardiac output	62 (3.0) [2.3–3.7]
Oliguria	372 (18.0 [16.4–19.6])
Skin mottling	36 (1.7 [1.2–2.2])
Lactate	128 (6.2 [5.2–7.2])
$SvO_2/ScvO_2$	10 (0.5 [0.2–0.8])
SVV/PPV	37 (1.8 [1.3–2.4])
CVP/PAOP	60 (2.9 [2.2–3.6])

59%

Oxygen debt during anaesthesia



Hypothesis:

Intraoperative hypotension – hypovolemia, or anaesthesia caused vasodilatation?

Mikor *et al. BMC Anesthesiology* (2015) 15:82
DOI 10.1186/s12871-015-0064-2

BMC Anesthesiology

RESEARCH ARTICLE Open Access

Continuous central venous oxygen saturation assisted intraoperative hemodynamic management during major abdominal surgery: a randomized, controlled trial

András Mikor[1*], Domonkos Trásy[1], Márton F Németh[1], Angelika Osztroluczki[1], Szilvia Kocsi[2], Ildikó Kovács[1], Gábor Demeter[1] and Zsolt Molnár[1]

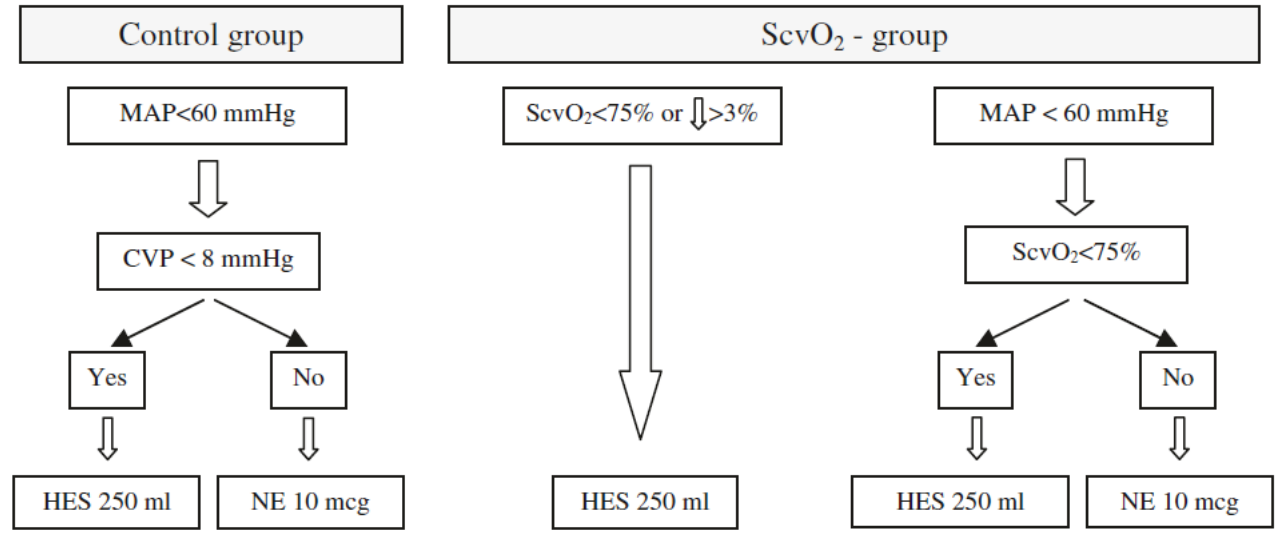


Fig. 1 Flowchart of the study design. MAP: mean arterial pressure, CVP: central venous pressure, $ScvO_2$: central venous oxygen saturation, HES: hydroxyethyl starch, NE: norepinephrine

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Table 2 Intraoperative interventions. Data are shown as mean ± SD or median (interquartile)

	$ScvO_2$ ($n = 38$)	Control ($n = 41$)	p
Crystalloid (ml/h)	1126 ± 471	1049 ± 431	0.46
Colloid (ml/h)	279 (161)	107 (250)	<0.001*
Number of patients needing vasopressor	11	15	0.47
Dose of vasopressor (mcg/h)	37 (107)	18 (73)	0.84
Number of patients receiving blood transfusion	24	15	0.02*
Blood loss during the operation (ml)	973 ± 473	983 ± 574	0.99

*: p<0.05

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		$ScvO_2$ (n=38)	Control (n=41)	p
Number of patients with complications		10	19	0.07
PaO_2/FiO_2	**> 300 Hgmm**	4	3	0.62
	200-300 Hgmm	24	15	0.02*
	100-200 Hgmm	10	22	0.01*
	< 100 Hgmm	0	1	0.52
28 day survival (S/NS)		37/1	33/8	0.018*

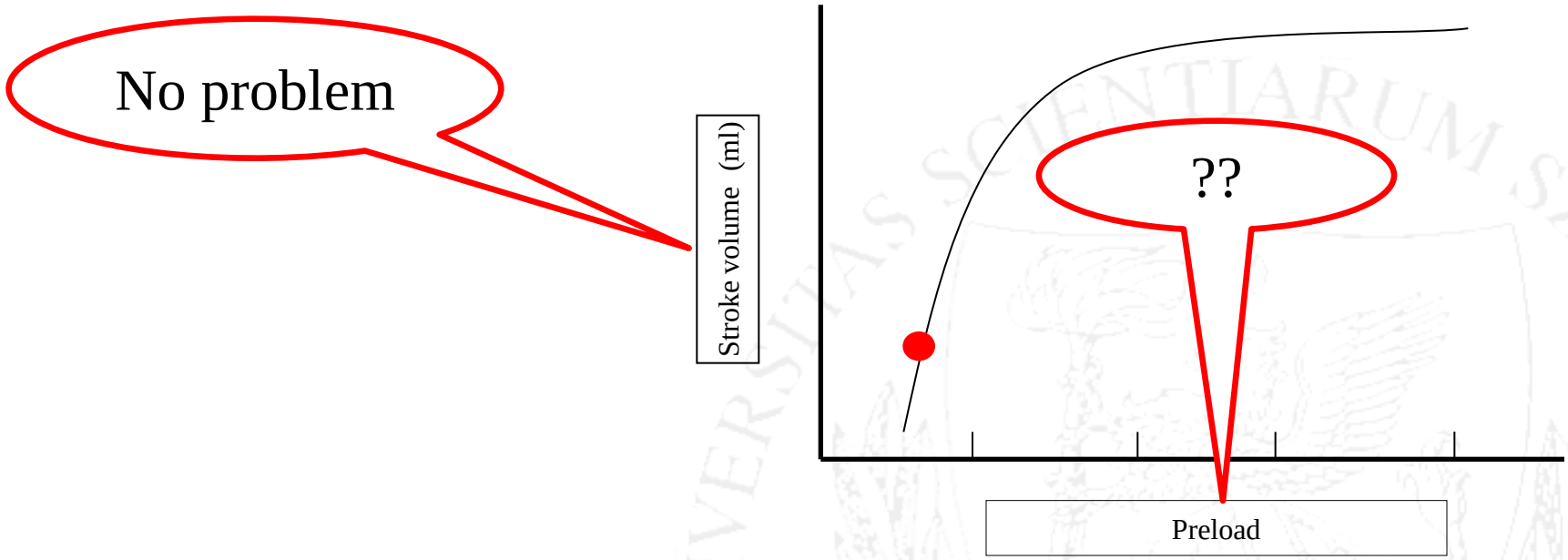
Pioneers

- Otto Frank (1865-1944):
  - Physiologist (Leipzich)
  - Zur Dynamik des Herzmuskels, Z Biol 32 (1895) 370

- Ernest Starling (1866-1927):
  - University College London
  - Starling forces, hormones, etc.

Hemodynamics

- Otto Frank, Ernest Starling – 1914: „Law of the heart”
  - „Within physiological limits, the force of contraction is directly proportional to the initial length of the muscle fiber”

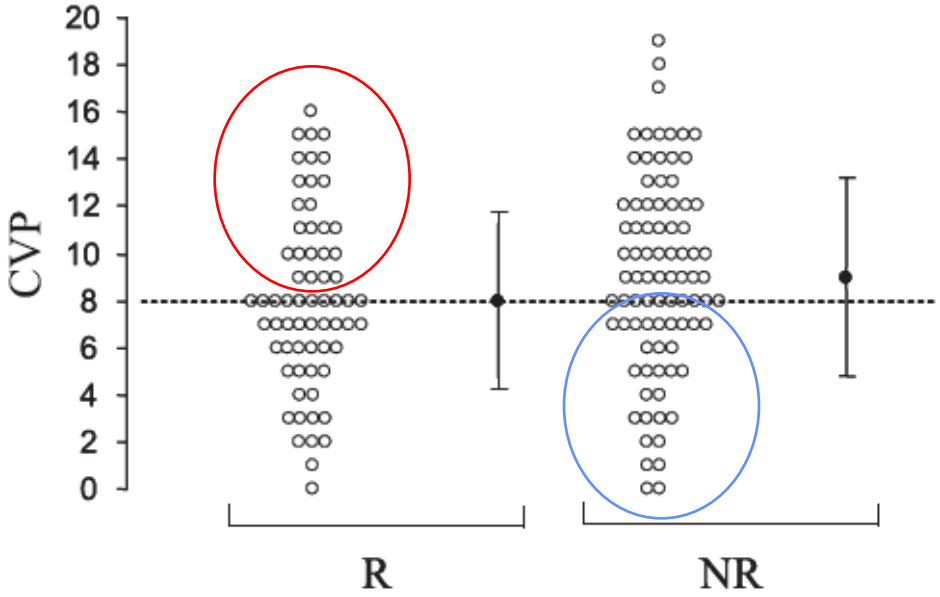


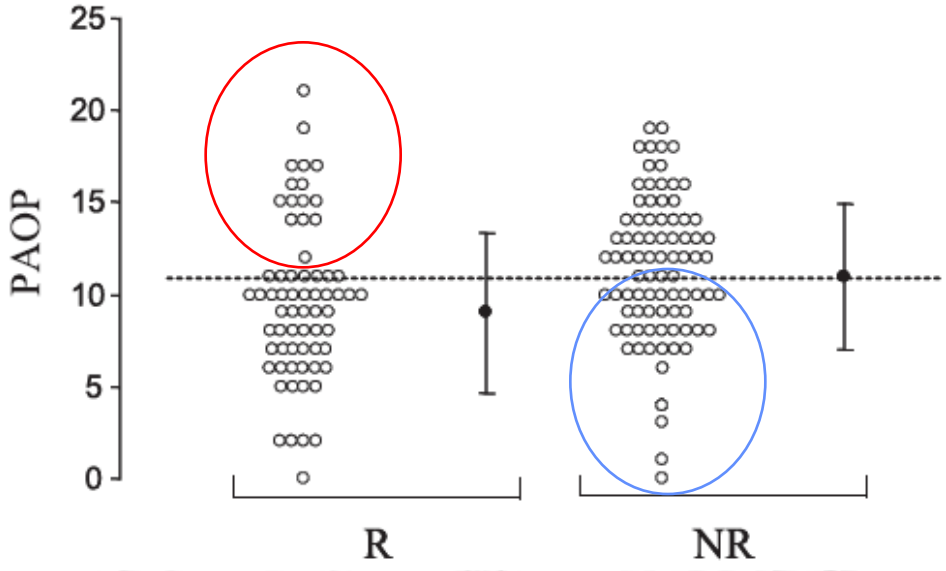
Starling EH. The Linacre Lecture on the Law of the Heart. London; 1918
Starling EH. *J R Army Med Corps*. 1920; 34: 258-262

Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge

Osman D, et al. *Crit Care Med* 2007; 35: 64-8

Pre-infusion values

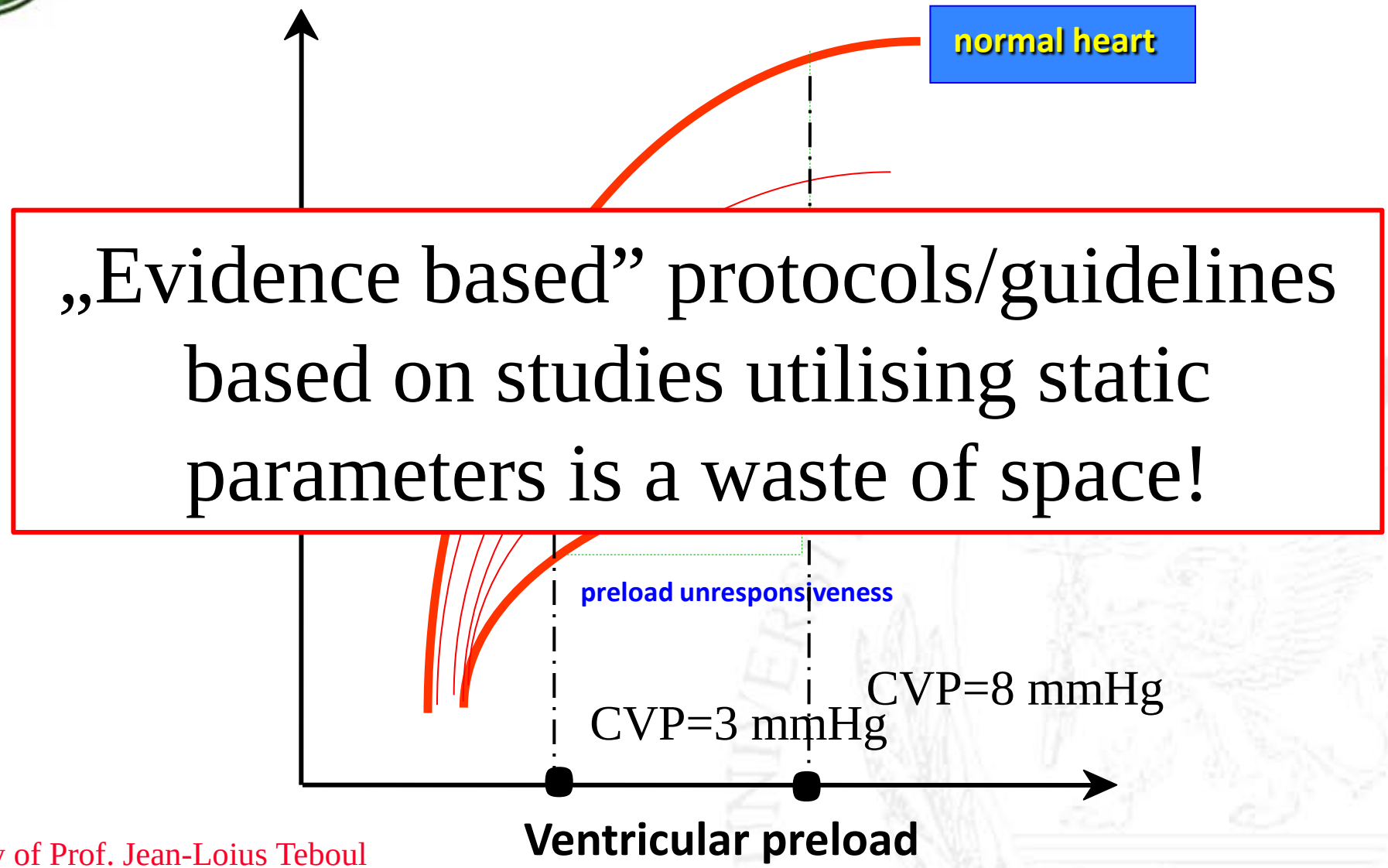




- CVP:
  - Sens: 62% (95% CI, 49–73%)
  - Spec: 54% (95% CI, 43–65%)

- PAOP:
  - Sens: 77% (95% CI, 65–87%)
  - Spec: 51% (95% CI, 40–62%)

„One size does not fit all!”



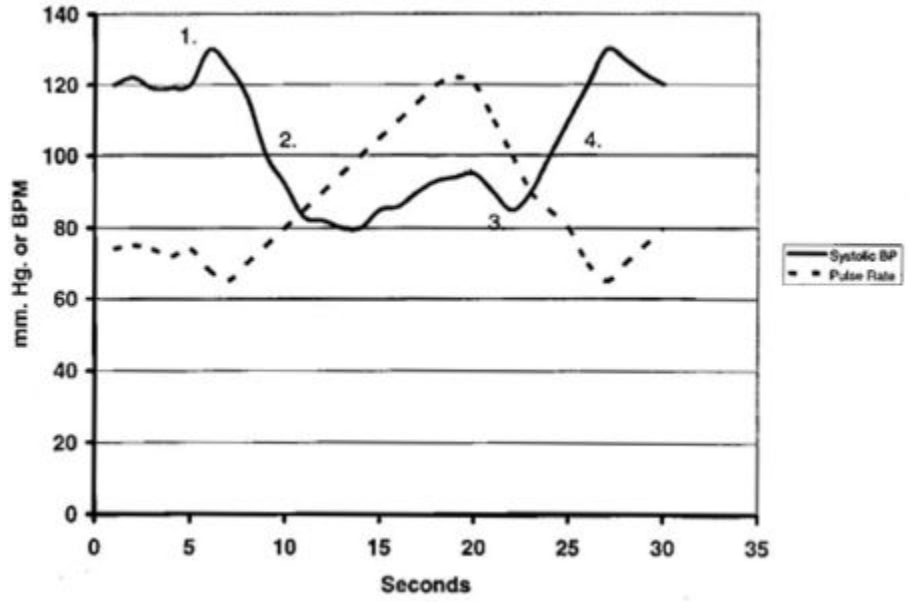
Courtesy of Prof. Jean-Loius Teboul

Applying physiology at the bedside

Heart-lung interactions

- Antonio Maria Valsalva (1666-1723)
  - Physician, phylosopher, artist
  - Anatomy of the ear

- Valsalva maneuvre:

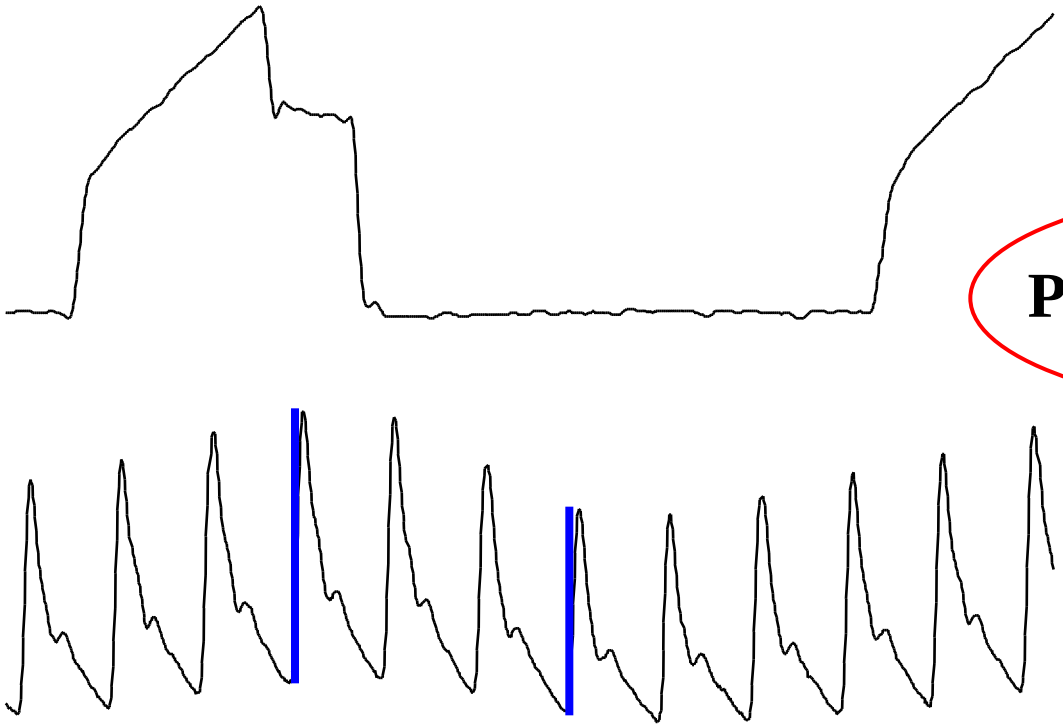


IPPV = series of Valsalva-maneuvers

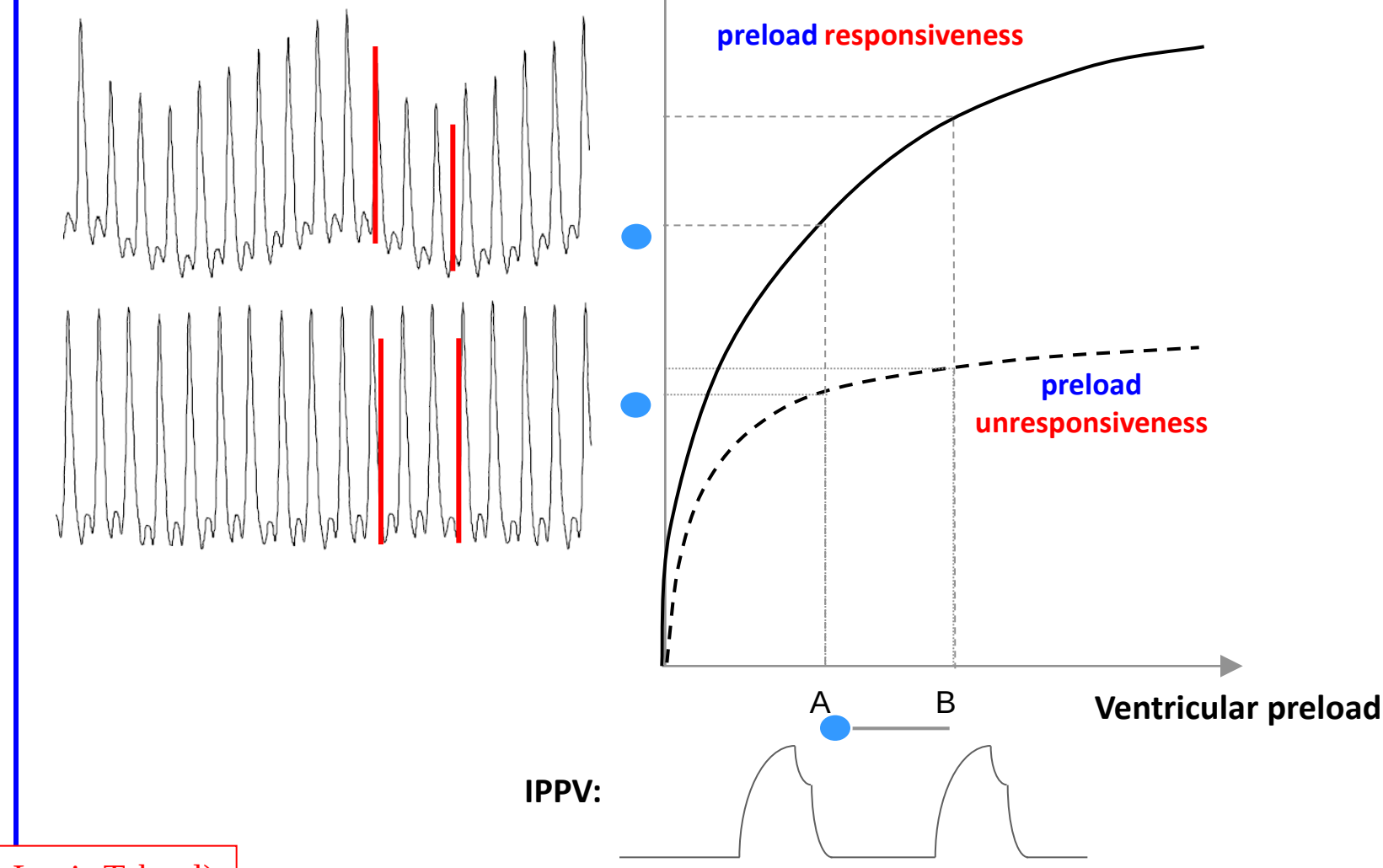
Clinical Use of Respiratory Changes in Arterial Pulse Pressure to Monitor the Hemodynamic Effects of PEEP

FRÉDÉRIC MICHARD, DENIS CHEMLA, CHRISTIAN RICHARD, MARC WYSOCKI, MICHAEL R. PINSKY, YVES LECARPENTIER, and JEAN-LOUIS TEBOUL

AM J RESPIR CRIT CARE MED 1999;159:935–939



$$PPV = \frac{PP_{max} - PP_{min}}{(PP_{max} + PP_{min}) / 2}$$



(Courtesy of Jean-Louis Teboul)

Devices


Edwards Lifesciences
Vigileo
PULSION
Medical Systems
PulsioFlex
178 cm 123 kg
SVV 2
SVRI 1902
dPmx 342

Salzwedel et al. Critical Care 2013, 17:R191
http://ccforum.com/content/17/5/R191

CRITICAL CARE

RESEARCH Open Access

Perioperative goal-directed hemodynamic therapy based on radial arterial pulse pressure variation and continuous cardiac index trending reduces postoperative complications after major abdominal surgery: a multi-center, prospective, randomized study

Cornelie Salzwedel[1†], Jaume Puig[2†], Arne Carstens[3], Berthold Bein[3], Zsolt Molnar[4], Krisztian Kiss[4], Ayyaz Hussain[5], Javier Belda[2], Mikhail Y Kirov[5], Samir G Sakka[6] and Daniel A Reuter[1*]

ProAQT-outcome study

Salzwedel C, et al. *Crit Care* 2013; 17: R191

Figure 1a: Algorithm for initial assessment.

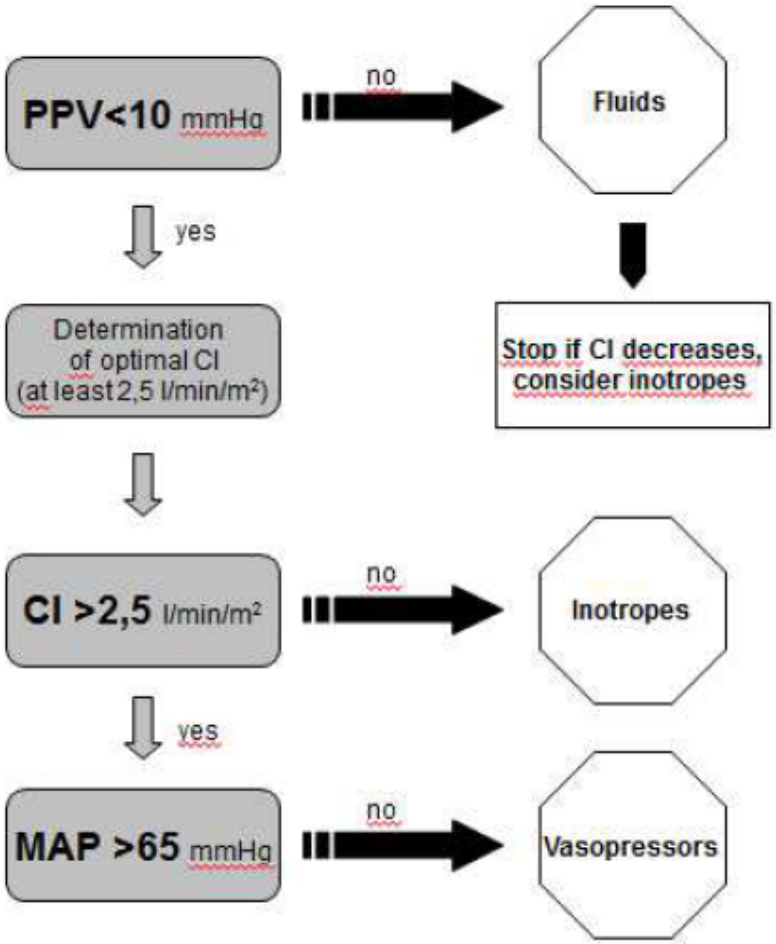
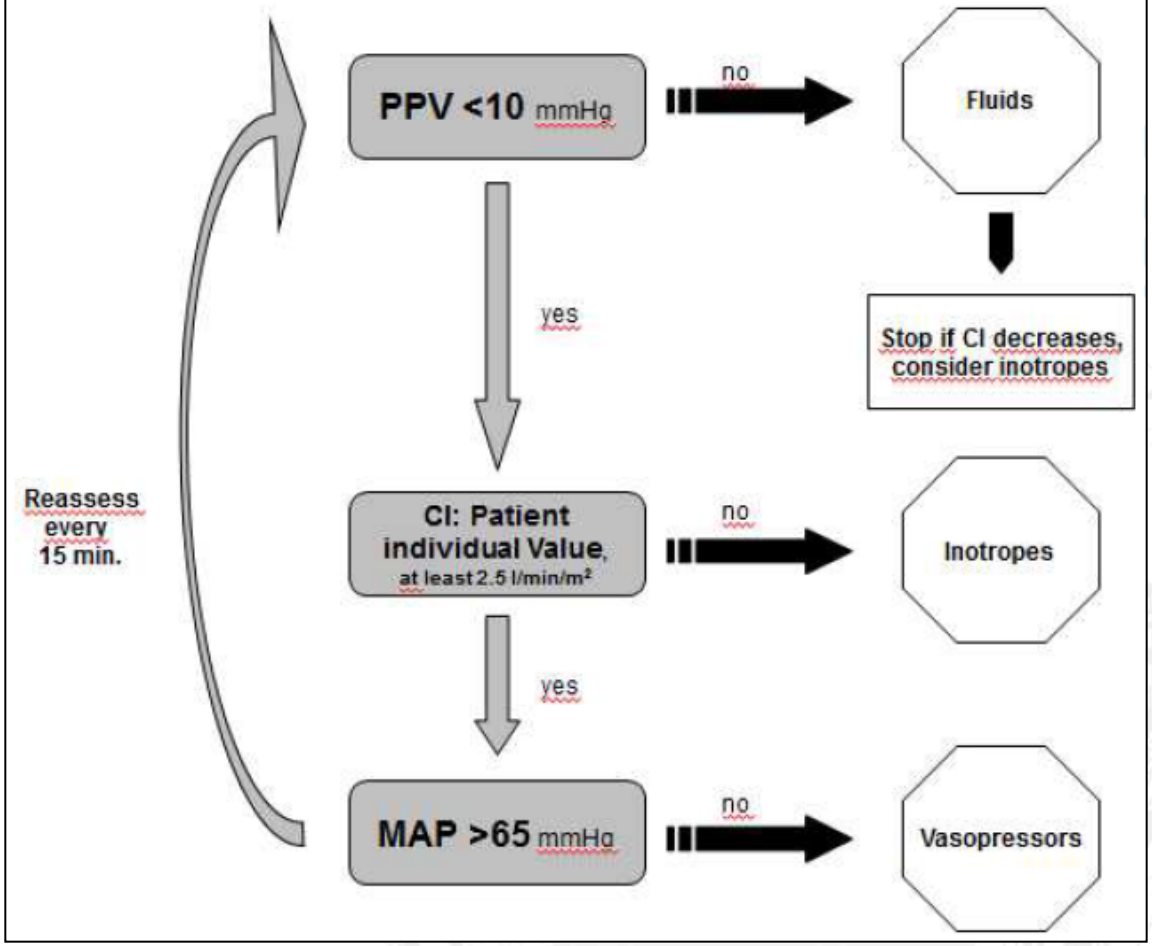
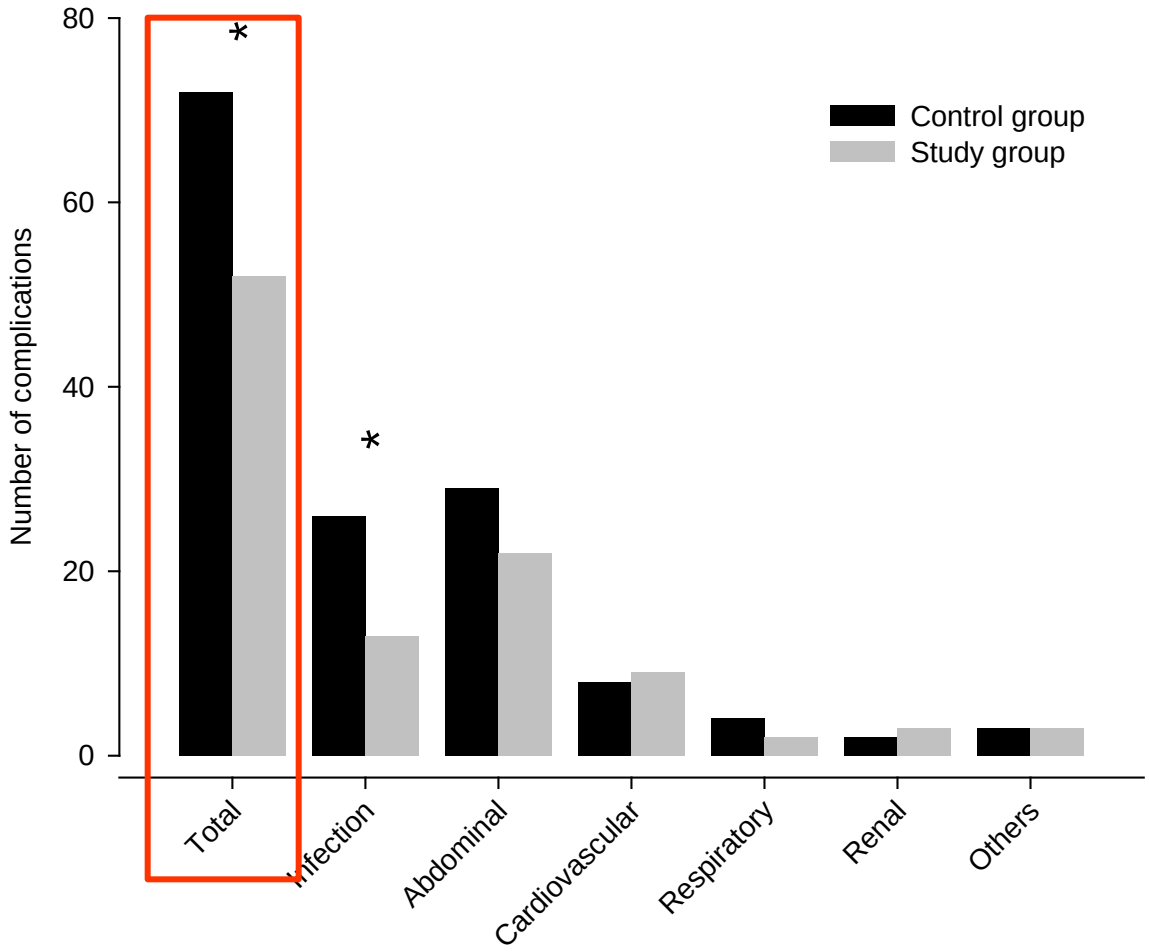


Figure 1b: Algorithm for further evaluation.



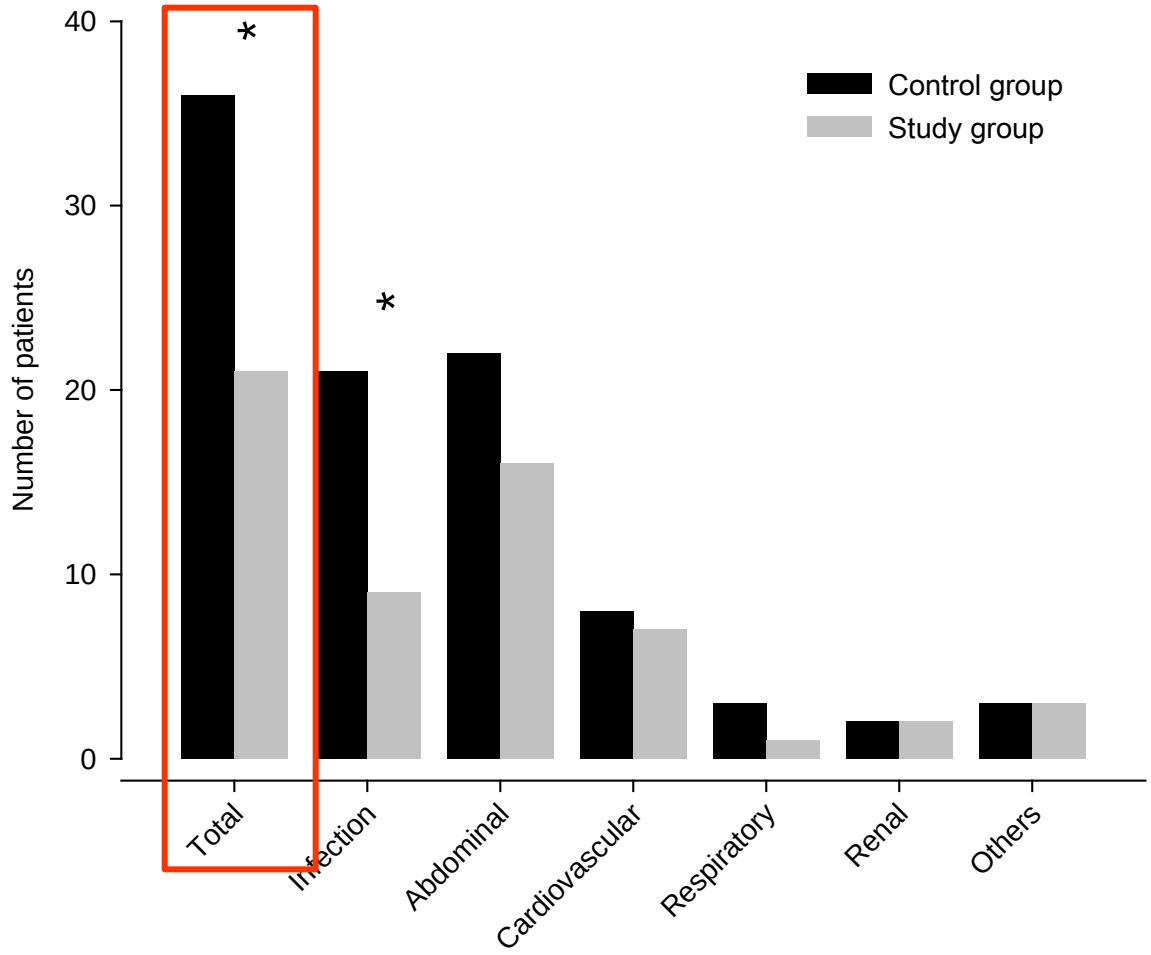
Number of complications

Salzwedel C, et al. *Crit Care* 2013; 17: R191



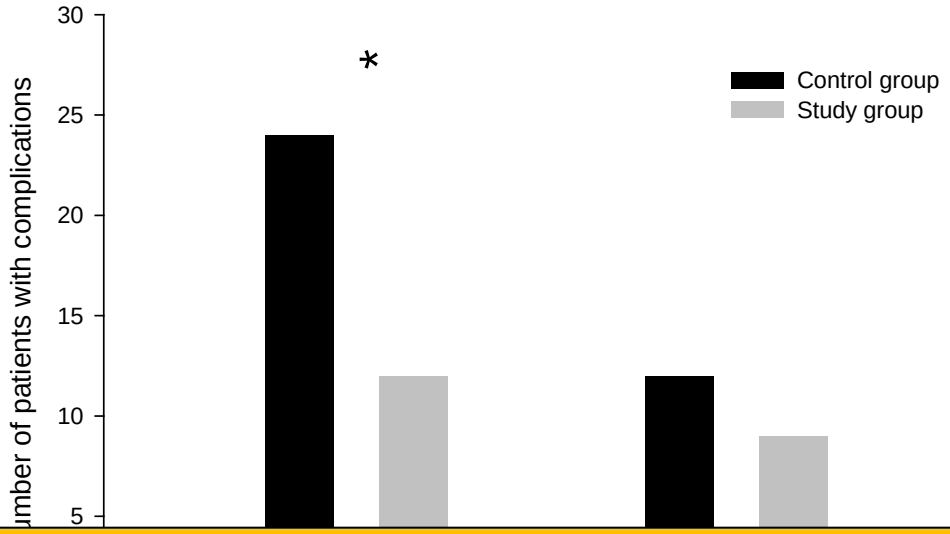
Number of patients with complications

Salzwedel C, et al. *Crit Care* 2013; 17: R191



Number of patients with complications

Salzwedel C, et al. *Crit Care* 2013; 17: R191



Not every patient would benefit from this (i.e.: a certain) approach

Salzwedel et al. Critical Care 2013, 17:R191
http://ccforum.com/content/17/5/R191

CRITICAL CARE

RESEARCH Open Access

Perioperative goal-directed hemodynamic therapy based on radial arterial pulse pressure variation and continuous cardiac index trending reduces postoperative complications after major abdominal surgery: a multi-center, prospective, randomized study

Cornelie Salzwedel[1†], Jaume Puig[2†], Arne Carstens[3], Berthold Bein[3], Zsolt Molnar[4], Krisztian Kiss[4], Ayyaz Hussain[5], Javier Belda[2], Mikhail Y Kirov[5], Samir G Sakka[6] and Daniel A Reuter[1*]

Conclusions: This multi-center study demonstrates that hemodynamic goal-directed therapy using pulse pressure variation, cardiac index trending and mean arterial pressure as the key parameters leads to a decrease in postoperative complications in patients undergoing major abdominal surgery.

Effect of a Perioperative, Cardiac Output–Guided Hemodynamic Therapy Algorithm on Outcomes Following Major Gastrointestinal Surgery

A Randomized Clinical Trial and Systematic Review

Rupert M. Pearse, MD; David A. Harrison, PhD; Neil MacDonald, FRCA; Michael A. Gillies, FRCA; Mark Blunt, FRCA; Gareth Ackland, PhD; Michael P. W. Grocott, MD; Aoife Ahern, BSc; Kathryn Griggs, MSc; Rachael Scott, PhD; Charles Hinds, FRCA; Kathryn Rowan, PhD; for the OPTIMISE Study Group

JAMA. 2014;311(21):2181-2190.

CONCLUSIONS AND R
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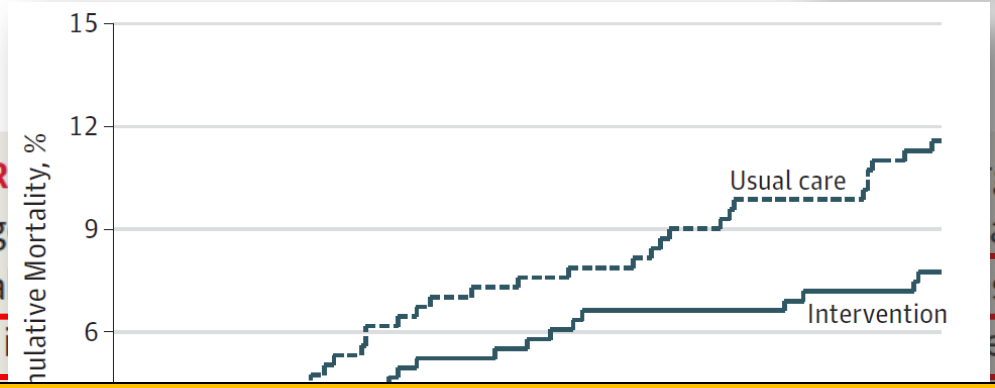


„…although could not show significant reduction in the primary outcome of the complication rate at 30 days in the cardiac output guided group, but there was a measurable treatment effect, and at 180 days there was a non-significant reduction in mortality.”

(Quote from the ESICM interview with Rupert Pearse)

What are we actually using?

Intensive Care Med
DOI 10.1007/s00134-015-3850-x

SEVEN-DAY PROFILE PUBLICATION

Maurizio Cecconi
Christoph Hofer
Jean-Louis Teboul
Ville Pettila
Erika Wilkman
Zsolt Molnar
Giorgio Della Rocca
Cesar Aldecoa
Antonio Artigas
Sameer Jog
Michael Sander

Fluid challenges in intensive care: the FENICE study

A global inception cohort study

Table 3 Indications and variables used to predict fluid responsiveness ($N = 2213$)

Indication	n (%)
Hypotension	1211 (58.7 [56.7–60.8])
Weaning vasopressor	146 (7.1 [6.0–8.2])
Cardiac output	62 (3.0) [2.3–3.7]
Oliguria	372 (18.0 [16.4–19.6])
Skin mottling	36 (1.7 [1.2–2.2])
Lactate	128 (6.2 [5.2–7.2])
$SvO_2/ScvO_2$	10 (0.5 [0.2–0.8])
SVV/PPV	37 (1.8 [1.3–2.4])
CVP/PAOP	60 (2.9 [2.2–3.6])

59%

Hemodynamic variable used to predict fluid responsiveness	n	% Of category	% All
No variable used	945		42.7 [40.6–44.8]
Any variable used	1268		57.3 [55.2–59.4]

43%

Cannesson et al. Critical Care 2011, 15:R197
http://ccforum.com/content/15/4/R197

CRITICAL CARE

RESEARCH Open Access

Hemodynamic monitoring and management in patients undergoing high risk surgery: a survey among North American and European anesthesiologists

Maxime Cannesson[1*], Gunther Pestel[2], Cameron Ricks[1], Andreas Hoeft[3] and Azriel Perel[4]

	ASA respondents (n = 237)	ESA respondents (n = 195)
Answer options	**Response percent**	**Response percent**
Invasive arterial pressure	95.4%	89.7%
Central venous pressure	72.6%	83.6%
Non-invasive arterial pressure	51.9%	53.8%
Cardiac output	35.4%	34.9%
Pulmonary capillary wedge pressure	30.8%	14.4%
Transesophageal echocardiography	28.3%	19.0%
Systolic pressure variation	20.3%	23.6%

Ahmad *et al. Perioperative Medicine* (2015) 4:8
DOI 10.1186/s13741-015-0018-8

Perioperative Medicine

RESEARCH Open Access

Variation in haemodynamic monitoring for major surgery in European nations: secondary analysis of the EuSOS dataset

Tahania Ahmad[1†], Christian M. Beilstein[1†], Cesar Aldecoa[2], Rui P. Moreno[3], Zsolt Molnár[4], Vesna Novak-Jankovic[5], Christoph K. Hofer[6], Michael Sander[7], Andrew Rhodes[8] and Rupert M. Pearse[1,9*]

Conclus… …one in five rec…

Why don't we use it?

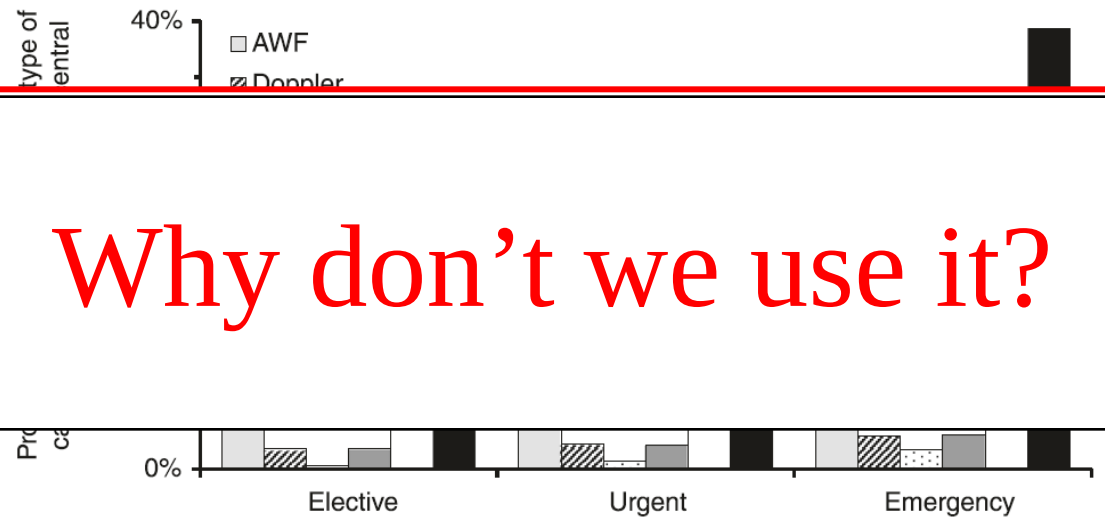
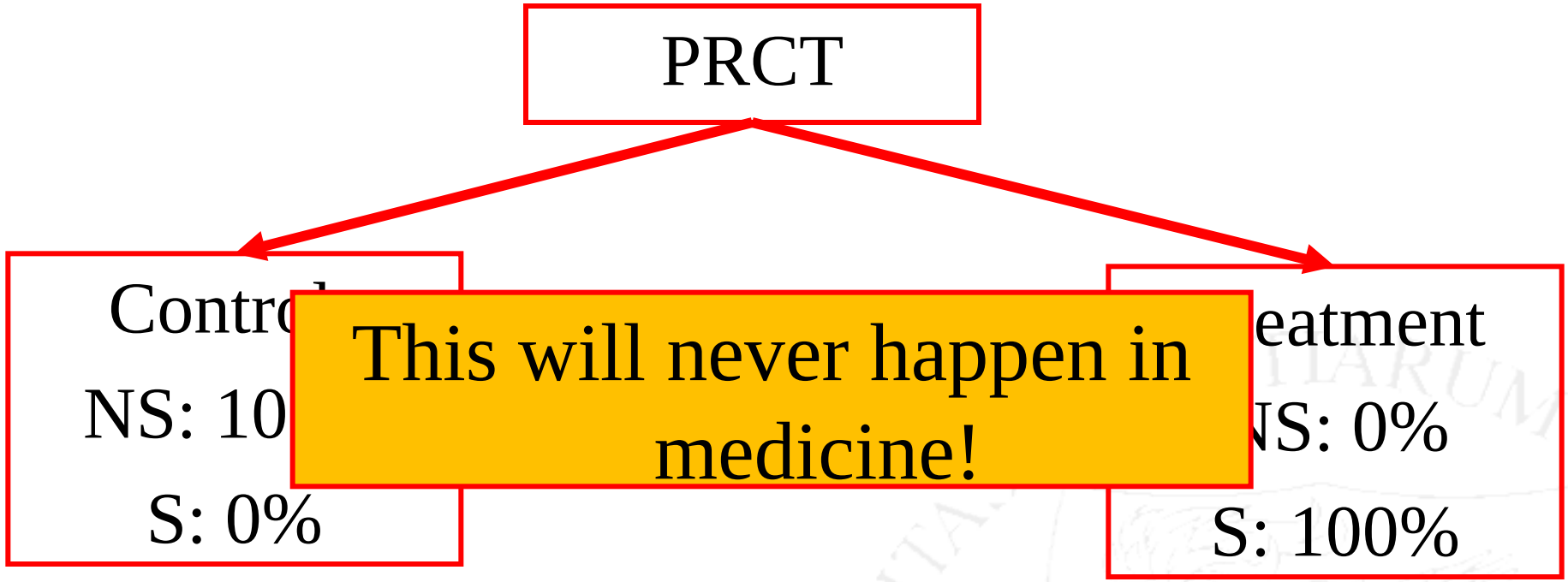


Fig. 1 Use of cardiac output monitoring and central venous catheter per urgency of surgery. Data displayed as percentage per urgency of surgery. *AWF* arterial waveform analysis, *Doppler* Doppler ultrasound, *PAC* pulmonary artery catheter, *COM* cardiac output monitoring, *CVC* central venous catheter

PRCTs and EBM

PRCTs *vs.* the individual patient



- Patients are different (co-moridities, individual response, etc)
- Disease definitions don’t mean homogenious groups
- Practice variations between centers

Multicenter, randomized, controlled trials evaluating mortality in intensive care: Doomed to fail?

Gustavo A. Ospina-Tascón, MD; Gustavo Luiz Büchele, MD; Jean-Louis Vincent, MD, PhD

(Crit Care Med 2008; 36:1311–1322)

- PRCTs till 2006:
  - 72 PRCT with mortality being the primary end-point
  - 10 positive
  - 7 negative
  - 55 no difference

We should abandon randomized controlled trials in the intensive care unit

Jean-Louis Vincent, MD, PhD, FCCM

(Crit Care Med 2010; 38[Suppl.]:S534–S538)

Monocentric *vs*. multicenter

(Courtesy of Prof. J-L Vincent)

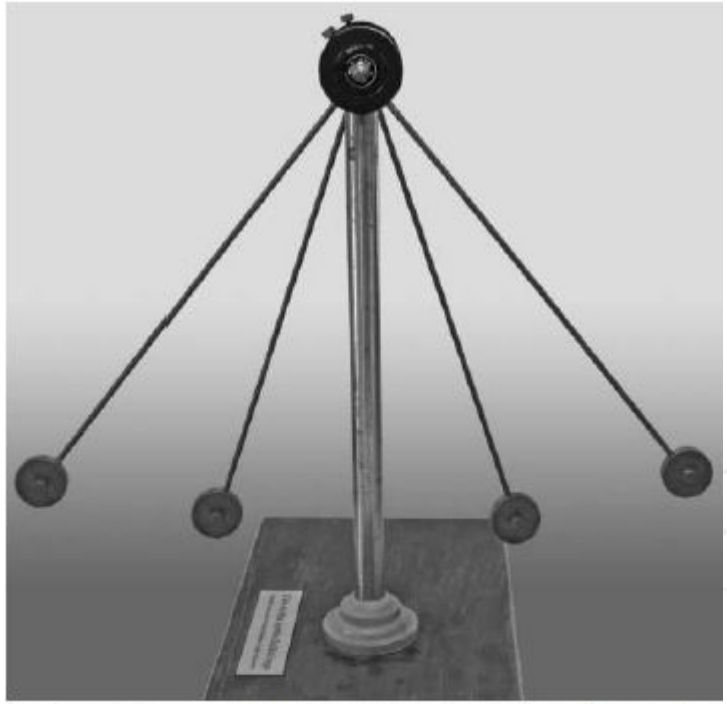
Small study
(monocentric or a few centers)

Unless *all details* (patients&care) are standardised – one center will „kill” the other, hence „non-significant” results are inevitable

Large study
(many centers)

Pendulum effect

Good



3. ábra. A Berzsenyi Dániel Főiskolán készített, továbbfejlesztett Eötvös-féle fizikai inga.

Lóránd Eötvös, 1891

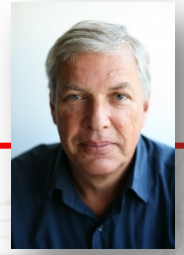
Bad

Pendulum effect

„Critical care medicine and research to a large degree seems more and more like a gigantic pendulum in the center of an insane asylum. Each swing imagined to be something new…and we will continue to clap and druel at each pass of the pendulum insane as that may be…
Reminds me of the old saying "Frequently wrong, but never in doubt"
/Charlie Phillips, 2015/

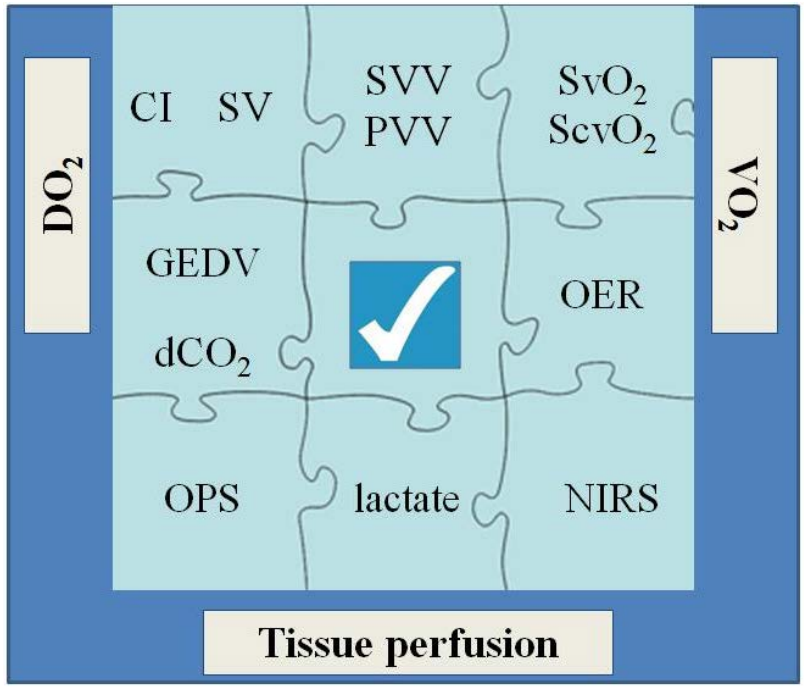
„Sticking to the principles of pathophysiological rationale is the best remedy against the pendulum-induced motion sickness”

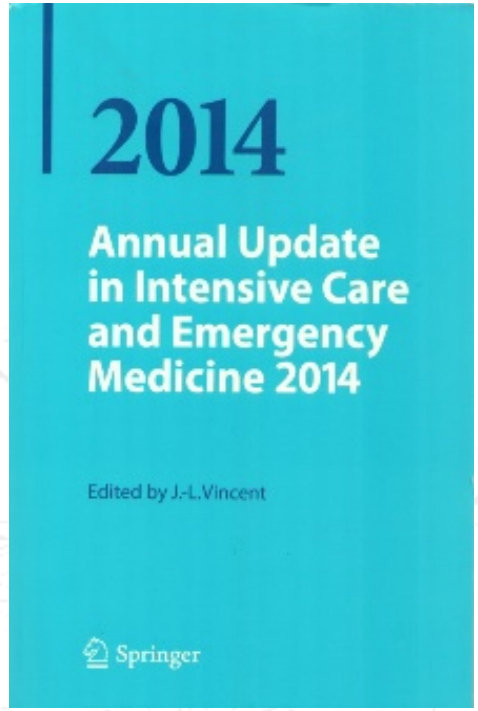
/Azriel Perel, 2015/



Solving the hemodynamic puzzle

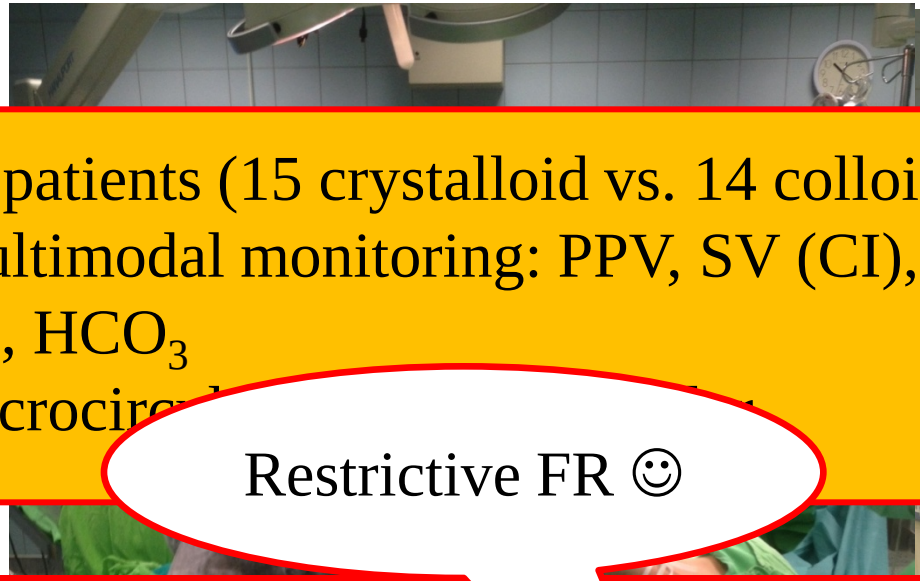
Tánczos K, Németh M, Molnár Z
Ann. Up. in Int. Care and Em. Med. 2014, pp:355

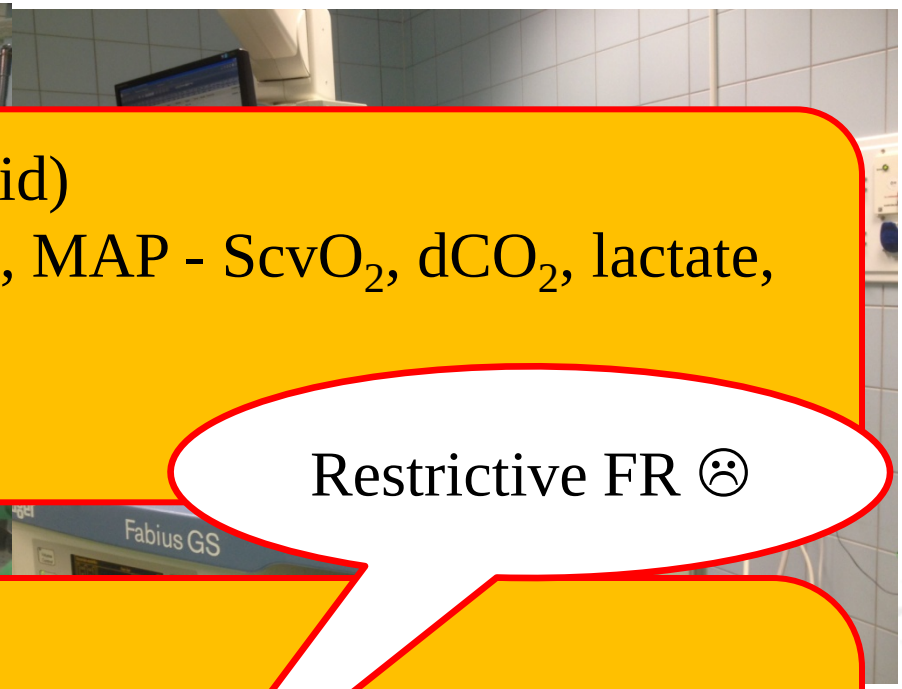




Does it work?

Multimodal monitoring during free-flap surgery: Crystalloid vs. Colloid (PRCT)





- 29 patients (15 crystalloid vs. 14 colloid)
- Multimodal monitoring: PPV, SV (CI), MAP - $ScvO_2$, dCO_2, lactate, pH, HCO_3
- Microcirc

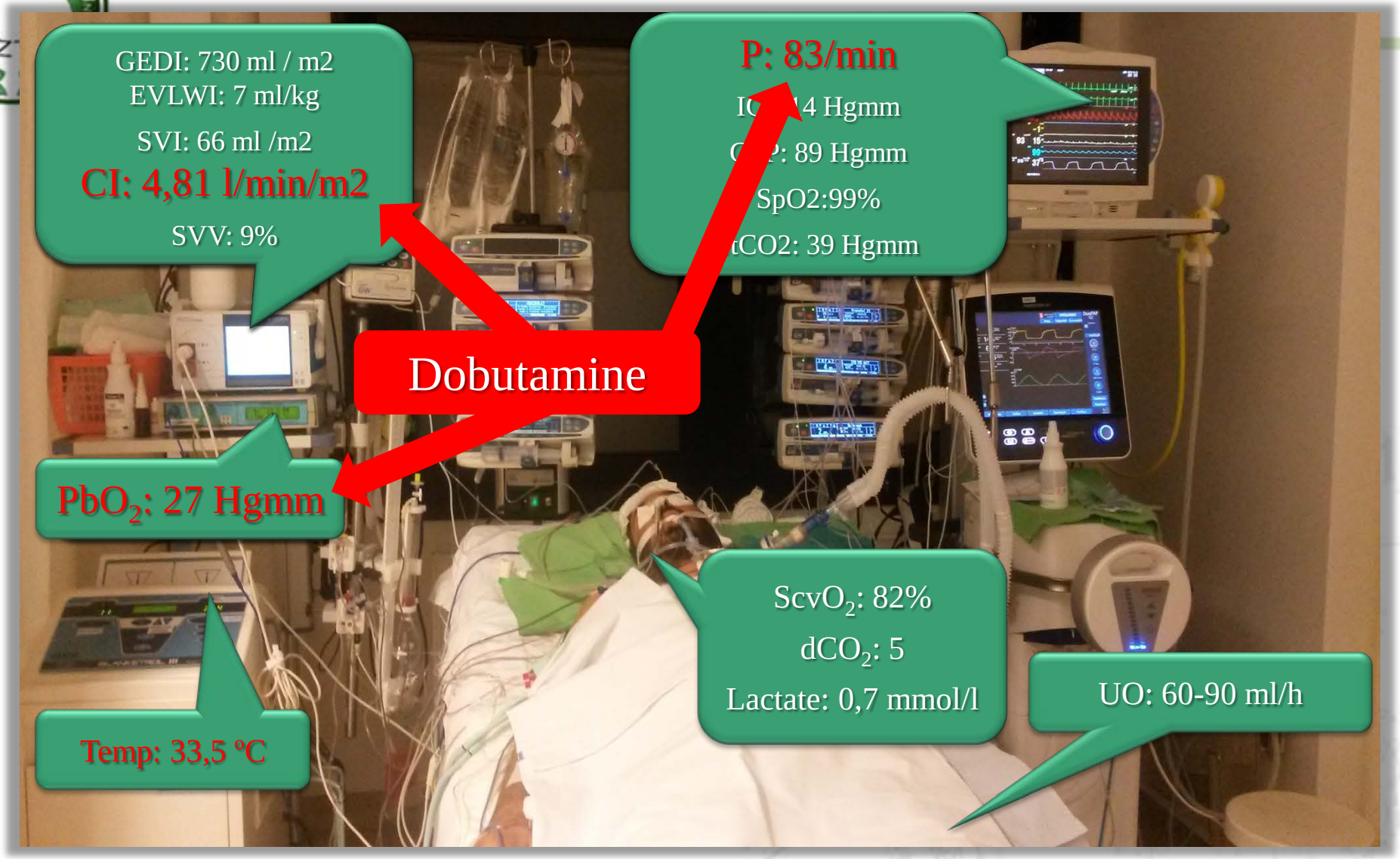
Restrictive FR ☺

Restrictive FR ☹

Length of surgery (mean): hours
Maintenance fluid: 1 ml/kg/h
Boluses:
- Crystalloid group: 1600 ml (min=500, max=5000 ml)
- Coloid group: 560 ml (min=450, max=1500 ml)

No difference in outcome variables

Multimodal monitoring on the ICU



Instead of protocolized management:

frontiers in
PUBLIC HEALTH

MINI REVIEW ARTICLE
published: 30 April 2014
doi: 10.3389/fpubh.2014.00034

The multimodal concept of hemodynamic stabilization

Krisztián Tánczos, Márton Németh and Zsolt Molnár*

Department of Anaesthesiology and Intensive Therapy, University of Szeged, Szeged, Hungary

frontiers in
MEDICINE

SPECIALTY GRAND CHALLENGE ARTICLE
published: 08 April 2015
doi: 10.3389/fmed.2015.00022

Individualized goal directed perioperative care – the way to go!

Zsolt Molnár*

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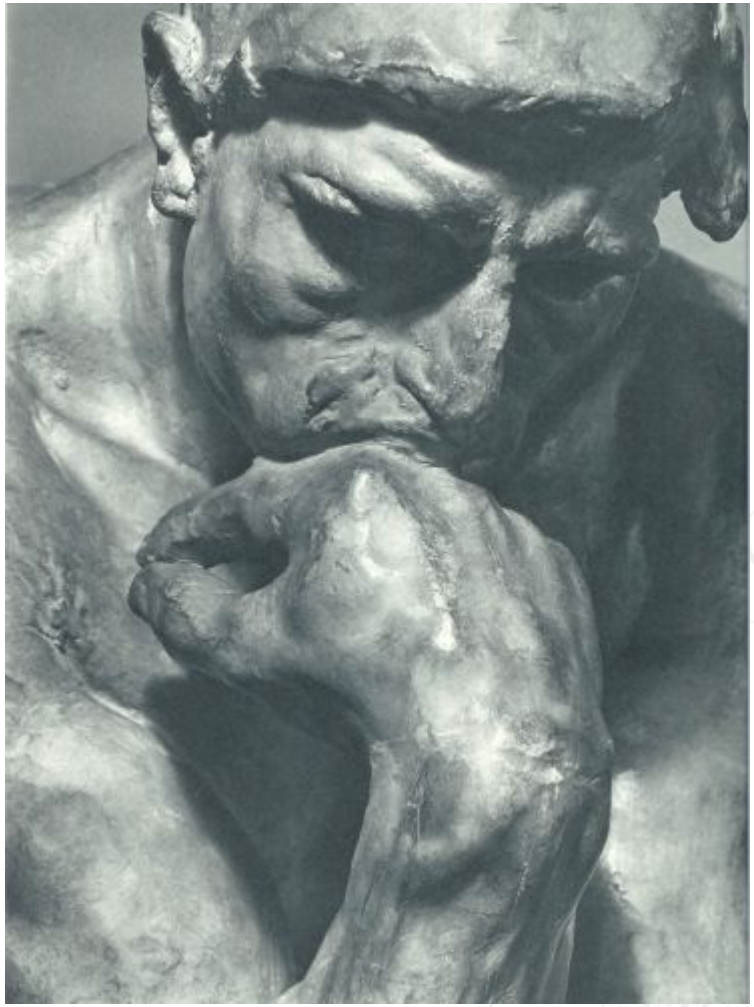
**Correspondence: zsoltmolna@gmail.com*

Thinking has no alternative!



Auguste Rodin: The Thinker, 1880


SepsEast 2014
Free for junior doctors (<29)!
www.sepseast.eu
Budapest, 9-11 November 2016
SepsEast 2016
3rd Central and Eastern European Sepsis Forum