The crystalloid-colloid controversy

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Fluid is important

Fluid improves outcome

The New England Journal of Medicine

EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

EMANUEL RIVERS, M.D., M.P.H., BRYANT NGUYEN, M.D., SUZANNE HAVSTAD, M.A., JULIE RESSLER, B.S., ALEXANDRIA MUZZIN, B.S., BERNHARD KNOBLICH, M.D., EDWARD PETERSON, PH.D., AND MICHAEL TOMLANOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP*

2001;345:1368-77.

TREATMENT	HOURS AFTER THE START OF THERAPY		
	0–6	7–72	0–72
Total fluids (ml)			
Standard therapy	3499±2438	10,602±6,216	13,358±7,729
EGDT	4981±2984	8,625±5,162	13,443±6,390
P value	<0.001	0.01	0.73

Mortality: 46.5 vs. 30.5% (p=0.009)

Maybe harmful: SOAP study

Vincent JL, et al. *Crit Care Med* 2006; 34: 344–353

Table 7. Multivariate, forward stepwise logistic regression analysis in sepsis patients (n = 1177), with intensive care unit mortality as the dependent factor

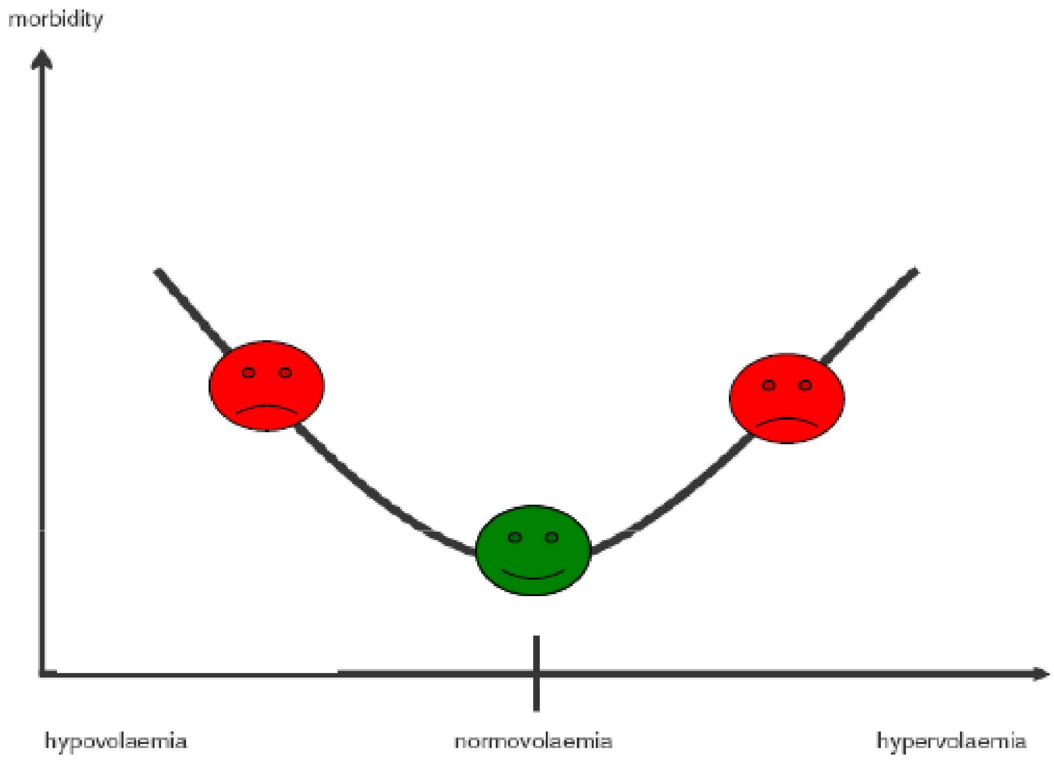
	OR (95% CI)	*p* Value
SAPS II score[a] (per point increase)	1.0 (1.0–1.1)	<.001
Cumulative fluid balance[b] (per liter increase)	1.1 (1.0–1.1)	.001
Age (per year increase)	1.0 (1.0–1.0)	.001
Initial SOFA score (per point increase)	1.1 (1.0–1.1)	.002
Blood stream infection	1.7 (1.2–2.4)	.004
Cirrhosis	2.4 (1.3–4.5)	.008
Pseudomonas infection	1.6 (1.1–2.4)	.017
Medical admission	1.4 (1.0–1.8)	.049
Female gender	1.4 (1.0–1.8)	.044

OR, odds ratio; CI, confidence interval; SAPA, Simplified Acute Physiology Score; SOFA, Sequential Organ Failure Assessment.

[a]At admission; [b]within the first 72 hrs of onset of sepsis.

Give as much as needed

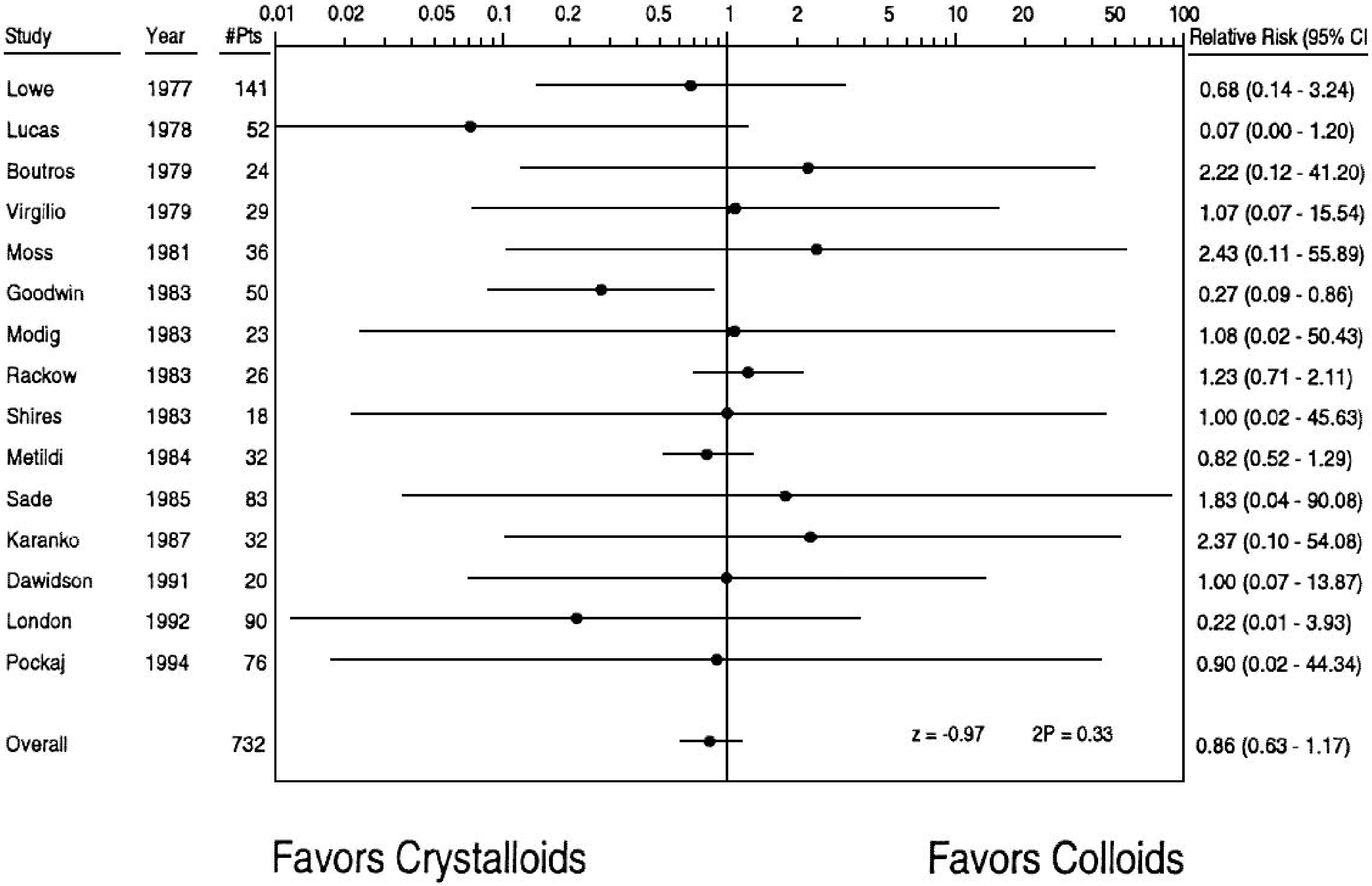
Bungaard-Nielsen M, et al. *ACTA Anaesthesiol Scand* 2009; 53: 843-51



Crystalloid *vs*. Colloid
Which is the killer?

Meta-analysis on mortality

Choi PT et al. *Crit Care Med* 1999; 27: 200



SAFE

Table 3. Primary and Secondary Outcomes.*

Outcome	Albumin Group	Saline Group	Relative Risk (95% CI)	Absolute Difference (95% CI)	P Value
Status at 28 days — no./total no. (%)					
Dead	726/3473 (20.9)	729/3460 (21.1)	0.99 (0.91 to 1.09)		0.87
Alive in ICU	111/34[illegible] (3.2)	87/3460 (2.5)	1.27 (0.96 to 1.68)		0.09
Alive in hospital†	793/[illegible]73 (22.8)	848/3460 (24.5)	[illegible].93 (0.86 to 1.01)		0.10
Length of stay in ICU — days	[illegible]6.5±6.6	6.2±6.2		0.24 (−0.06 to 0.54)	0.44
Length of stay in hospital — days†	15.3±9.6	15.6±9.6		−0.24 (−0.70 to 0.21)	0.30
Duration of mechanical ventilation — days	4.5±6.1	4.3±5.7		0.19 (−0.08 to 0.47)	0.74
Duration of renal-replacement t[illegible] — days	0.48±2.28	0.39±2.0		0.09 (−0.0 to 0.19)	0.41
New organ f[illegible]					0.85§
N[illegible]	1397 (52.7)	1424 (53.3)			
[illegible]	795 (30.0)	796 (29.8)			
[illegible]	369 (13.9)	361 (13.5)			
3 or[illegible]	68 (2.6)	75 (2.8)			
4 organs	18 (0.7)	17 (0.6)			
5 organs	2 (0.1)	0			
Death within 28 days according to subgroup — no./total no. (%)					
Patients with trauma	81/596 (13.6)	59/590 (10.0)	1.36 (0.99 to 1.86)		0.06
Patients with severe sepsis	185/603 (30.7)	217/615 (35.3)	0.87 (0.74 to 1.02)		0.09
Patients with acute respiratory distress syndrome	24/61 (39.3)	28/66 (42.4)	0.93 (0.61 to 1.41)		0.72

20.9%

21.1%

* Plus–minus values are means ±SD. CI denotes confidence interval, and ICU intensive care unit.
† The data include the numbers of patients in the ICU or the length of stay in the ICU.
‡ Data were available for 2649 patients in the albumin group and 2673 patients in the saline group. New organ failure was defined as a Sequential Organ-Failure Assessment score[13] of 0, 1, or 2 in any individual organ system at baseline, followed by an increase in the score to 3 or 4 in the same system.
§ The P value pertains to the comparison between the albumin and saline groups in the numbers of patients who had no new organ failure or new failure of one, two, three, four, or five organs.

Finfer S et al. SAFE study. *N Eng J Med* 2004; 350: 2247

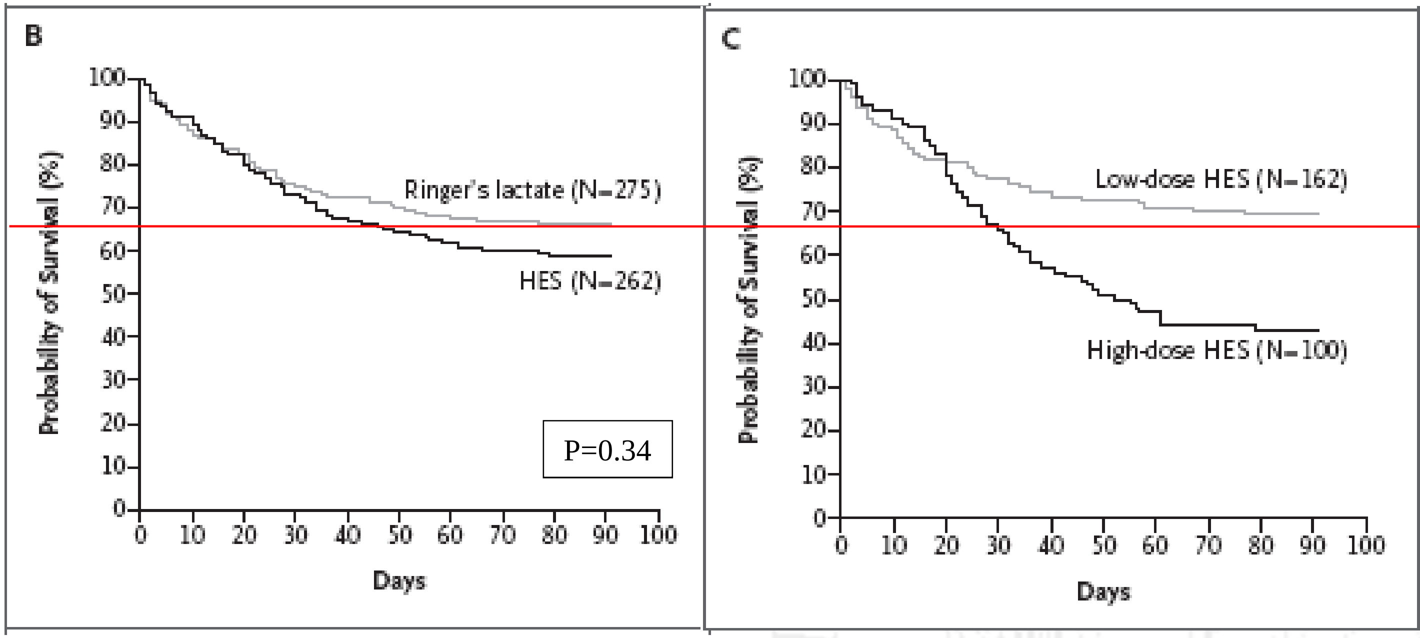
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Intensive Insulin Therapy and Pentastarch Resuscitation in Severe Sepsis

Frank M. Brunkhorst, M.D., Christoph Engel, M.D., Frank Bloos, M.D., Ph.D.,

N Engl J Med 2008;358:125-39.



<22 ml/kg

48 (22-96) ml/kg

Acute Renal Failure: HES-34.9% vs RL-22.8%, p=0.002

HES is bad for you…

The NEW ENGLAND JOURNAL *of* MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch 130/0.4 versus Ringer's Acetate in Severe Sepsis

Perner A et al. 2012; DOI: 10.1056/NEJMoa1204242

- Patients with severe sepsis assigned to fluid resuscitation with HES 130/0.4 had an increased risk of death at day 90 and were more likely to require renal-replacement therapy, as compared with those receiving Ringer's acetate.

The NEW ENGLAND JOURNAL *of* MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

Myburh JA et al. 2012; DOI: 10.1056/NEJMoa1209759

- In patients in the ICU, there was no significant difference in 90-day mortality between patients resuscitated with 6% HES (130/0.4) or saline. However, more patients who received resuscitation with HES were treated with renal-replacement therapy.

Verdict on HES in 2012

Dellinger RP et al. *Intensive Care Med* 39. doi: 10.1007/s00134-012-2769-8

TABLE 6. Recommendations: Hemodynamic Support and Adjunctive Therapy

G. Fluid Therapy of Severe Sepsis

1. Crystalloids as the initial fluid of choice in the resuscitation of severe sepsis and septic shock (grade 1B).
2. Against the use of hydroxyethyl starches for fluid resuscitation of severe sepsis and septic shock (grade 1B).
3. Albumin in the fluid resuscitation of severe sepsis and septic shock when patients require substantial amounts of crystalloids (grade 2C).
4. Initial fluid challenge in patients with sepsis-induced tissue hypoperfusion with suspicion of hypovolemia to achieve a minimum of 30 mL/kg of crystalloids (a portion of this may be albumin equivalent). More rapid administration and greater amounts of fluid may be needed in some patients (grade 1C).
5. Fluid challenge techn ... namic improvement either based on dynamic (e ... eart rate) variables (UG).

End of the synthetic colloid story?

MINERVA ANESTESIOLOGICA

OFFICIAL JOURNAL OF ITALIAN SOCIETY OF ANESTHESIOLOGY, ANALGESIA, RESUSCITATION AND INTENSIVE CARE (SIAARTI)

SIAARTI
PRO VITA CONTRA DOLOREM SEMPER

VOLUME 79 · No. 10 · OCTOBER 2013

EDITORIAL

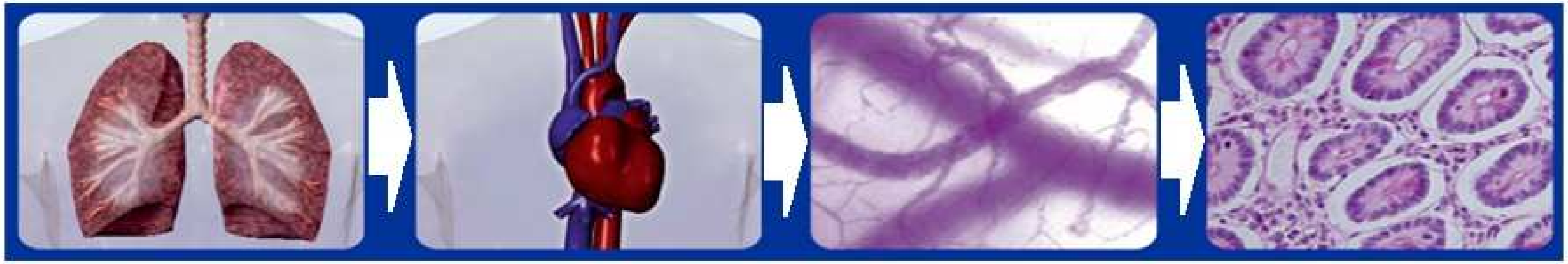
Do no harm: use starches?

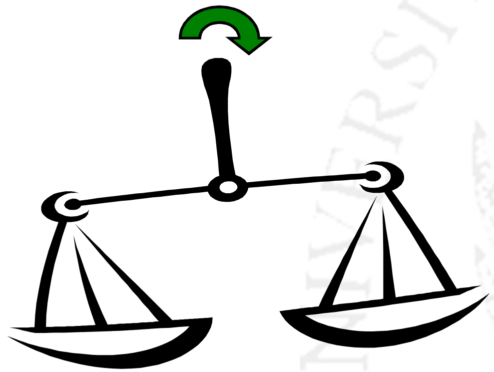
K. TÁNCZOS [1], Z. MOLNÁR [2]

There is only one reason why you give fluid…

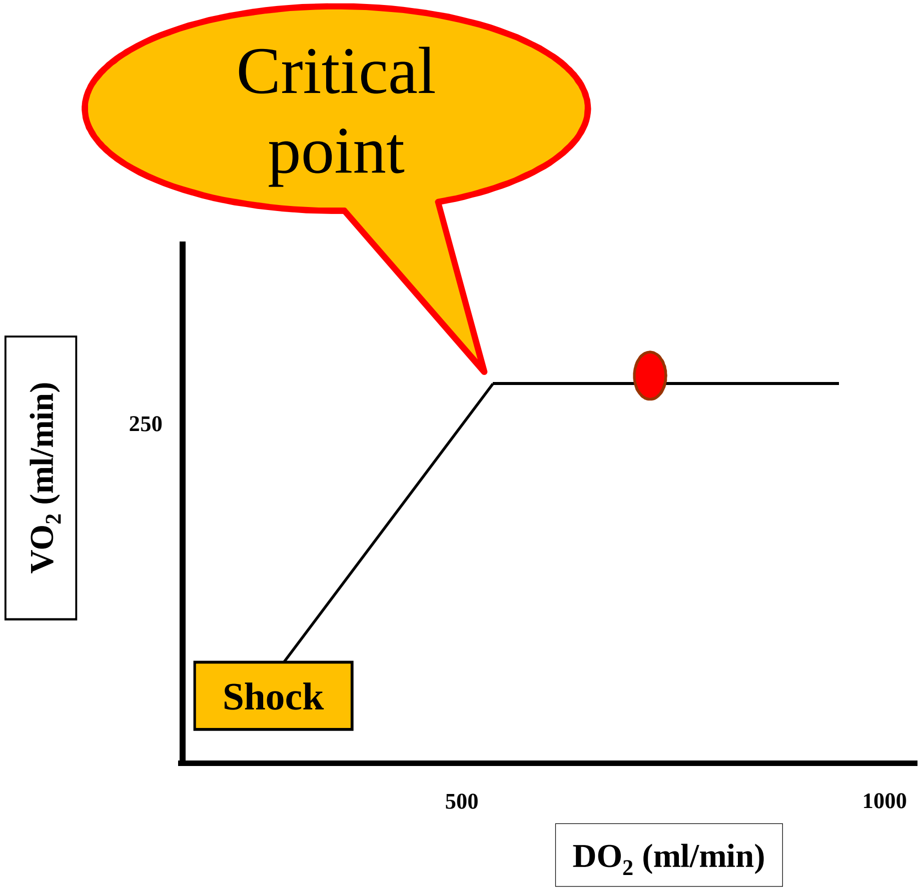
…to avoid oxygen debt

- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2}$ ~ 1000ml/m (SaO_2=100%)
- $VO_2 = CO \bullet (CaO_2 - CvO_2)$ ~ 250 ml/min ($ScvO_2$~70-75%)



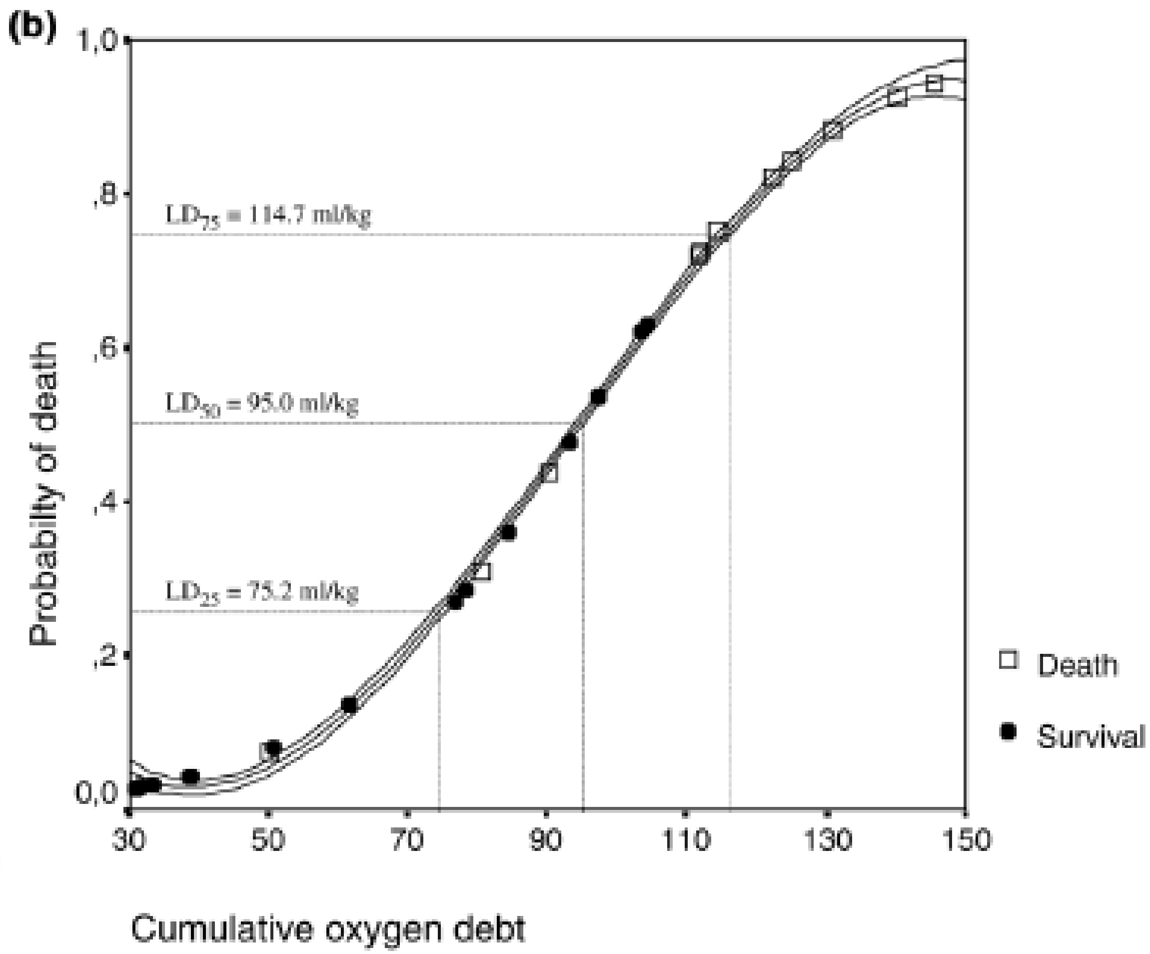
DO_2 ⬇  VO_2 ⬆

Compensatory mechanisms



Oxygen debt and mortality

Rixen D, et al. *Shock* 2001, 16:239-244



What shall we give?

Milestones

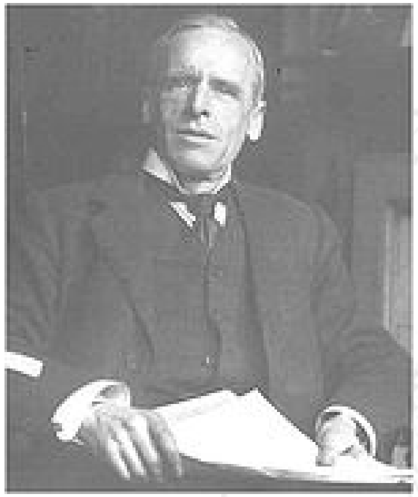
- Crystalloids:
  - Robert Lewins – 1832
    - INJECTION OF SALINE SOLUTIONS IN EXTRAORDINARY QUANTITIES I THE VEINS IN CASES OF MALIGN CHOLERA
  - Sydney Ringer - 1885
  - Alexis Hartmann (1898-1964)
- Albumin
  - Pearl Harbor - 1941

The semipermeable membranes

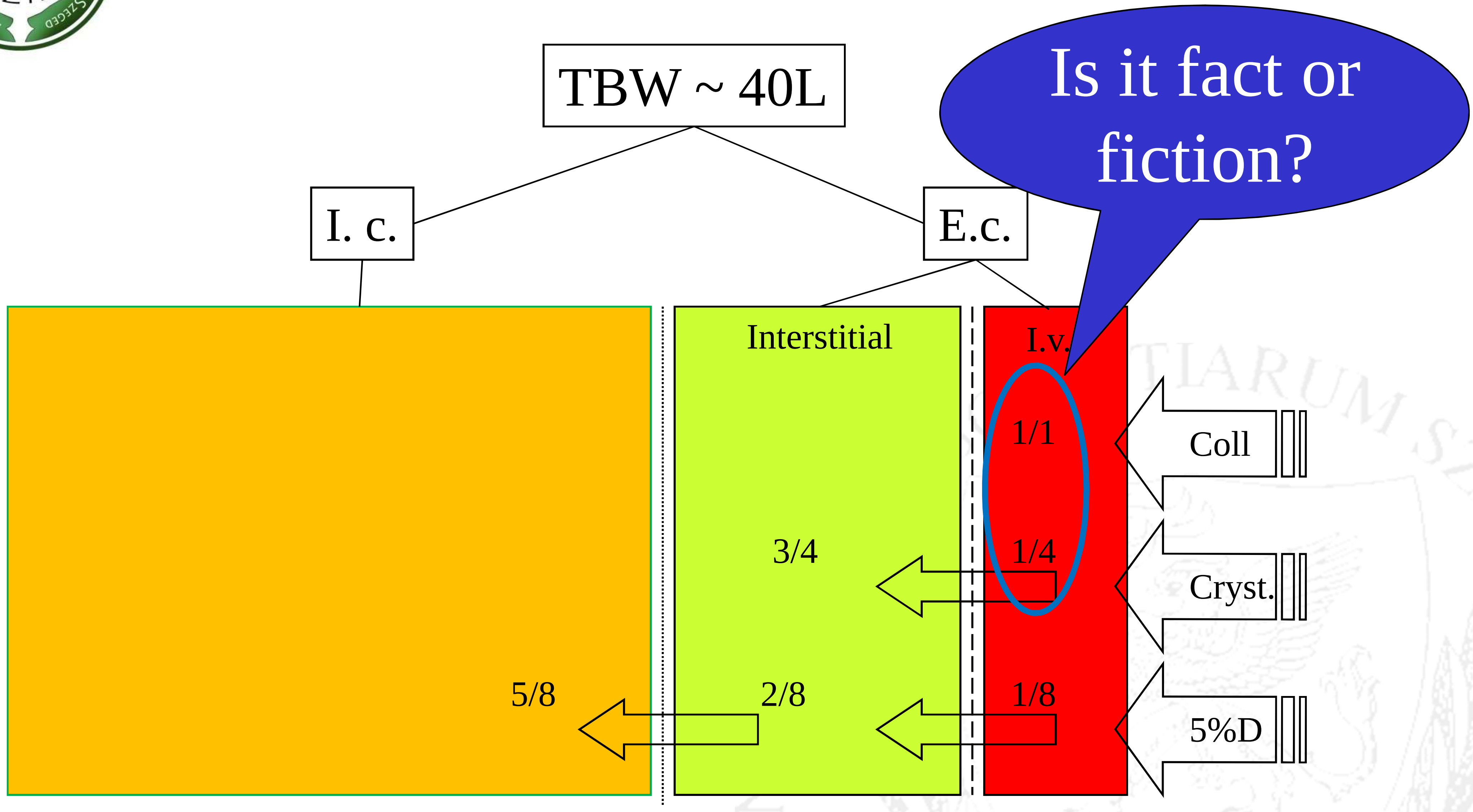
ON THE ABSORPTION OF FLUIDS FROM THE CONNECTIVE TISSUE SPACES. BY ERNEST H. STARLING. (Two Figures in Text.)

(From the Physiological Laboratory, Guy's Hospital.)

J Physiol May 5, 1896 19 (4) 312-326



Distribution of fluids – the compartment model



How does physiology work in critically ill patients?

SAFE

Table 2. Fluids Administered and Physiological Effects of Treatment.*

Variable	Albumin Group		Saline Group		P Value†
	No. of Patients	Value	No. of Patients	Value	
Study fluid (ml)					
Day 1	3410	1183.9±973.6	3418	1565.3±1536.1	<0.001
Day 2	3059	602.7±892.7	3068	[illegible]	<0.001
Day 3	2210	268.0±554.5	2202	[illegible]	0.03
Day 4	1686	192.3±427.0	1664	[illegible]	0.57
Nonstudy fluid (ml)					
Day 1	[illegible]	1459.4±1183.2	3405	[illegible]	0.30
Day 2	[illegible]	2615.9±1372.5	3057	[illegible]	0.009
Day 3	[illegible]	2618.5±1346.5	2191	[illegible]	0.15
Day 4	[illegible]	2691.5±1228.7	1656	[illegible]	0.36
Packed red cells (ml)					
Day 1	3411	97.8±360.7	3415	[illegible]	<0.001
Day 2	3066	106.5±321.4	3074	[illegible]	<0.001
Day 3	2217	59.8±225.5	2210	[illegible]	0.30
Day 4	1692	43.6±167.5	1668	[illegible]	[illegible]
Net[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Day[illegible]	1671	[illegible]	1649	[illegible]	[illegible]
Mean arterial pres[illegible]					
Day 1	3406	81.4±14.4	3408	80.9±14.5	0.14
Day 2	3068	84.4±15.1	3075	84.2±15.7	0.49
Day 3	2215	87.2±15.3	2209	86.9±16.1	0.62
Day 4	1688	88.3±15.9	1666	88.4±16.3	0.87
Heart rate (beats/min)					
Day 1	3398	88.0±20.2	3406	89.7±20.8	<0.001
Day 3	3071	88.5±19.5	3075	89.5±19.2	0.06
Day 3	2216	88.8±19.1	2213	89.7±18.8	0.10
Day 4	1691	89.5±18.9	1668	89.9±18.5	0.52
Central venous pressure (mm Hg)					
Day 1	2204	11.2±4.8	2270	10.0±4.5	<0.001
Day 2	2095	11.6±4.9	2135	10.4±4.3	<0.001
Day 3	1531	11.4±4.8	1589	10.7±4.4	<0.001
Day 4	1221	11.1±4.8	1230	10.5±4.4	<0.001
Serum albumin (g/liter)					
Day 1	2081	28.7±7.0	2061	24.7±6.5	<0.001
Day 2	2708	30.8±6.4	2703	24.5±5.9	<0.001
Day 3	1921	30.0±6.4	1905	23.6±5.6	<0.001
Day 4	1498	29.0±6.2	1478	23.1±5.5	<0.001

* Plus–minus values are means ±SD.
† P values are for the comparison between the two means for each variable at each time point.

Alb: 1184 ml

25%<

Saline: 1565 ml

Finfer S et al. SAFE study. *N Eng J Med* 2004; 350: 2247

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch 130/0.4 versus Ringer's Acetate in Severe Sepsis

Perner A et al. 2012; DOI: 10.1056/NEJMoa1204242

Table 2. Fluid Therapy before and after Randomization.*

	HES 130/0.4 (N=398)			Ringer's Acetate (N=400)			
	Patients	Volume		Patients	Volume Receive		
		median	interquartile range		median	interqu	
	no./total no.§	ml		no./total no.§			
Trial fluid							
Day 1¶	374/397	1500	1000–1500	375/400	1500	1000–2000	0.09
Day 2	288/379	1500	1000–2000	307/380	1500	950–2000	0.50
Day 3	176/330	1000	500–1500	170/326	1000	500–1500	0.78
Open-label trial							
Day 1¶							0.21
Day 2							0.13
Day 3							0.69

HES: 1500 ml

NS<

RA: 1500 ml

„Trial fluid…was used when ICU clinician judged [it] was needed"

The NEW ENGLAND JOURNAL of MEDICINE

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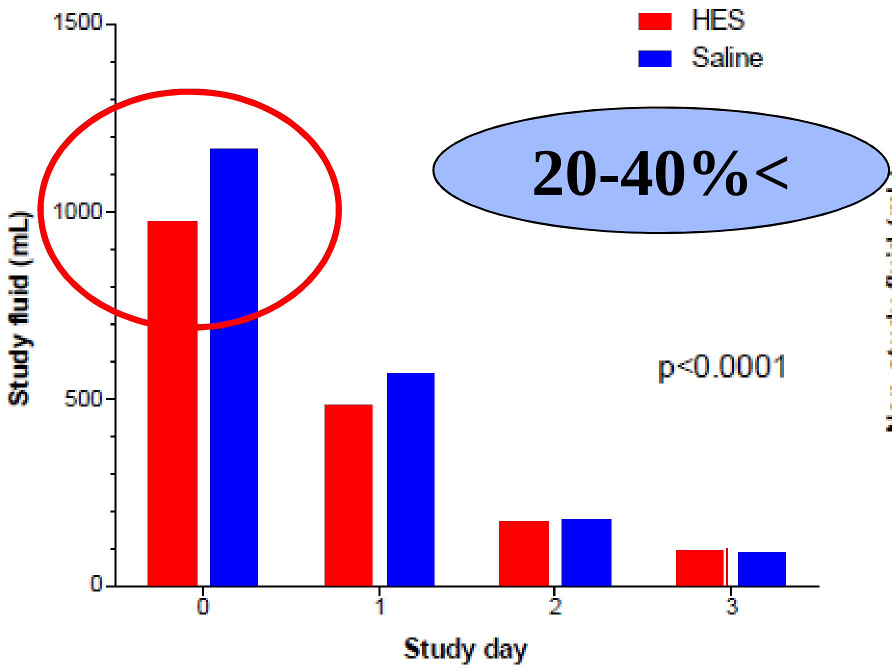

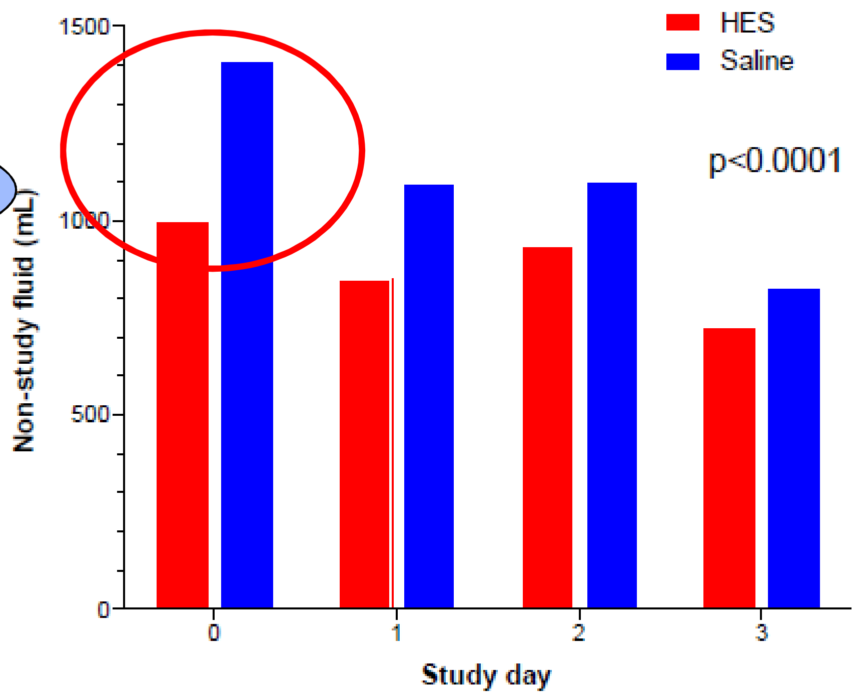

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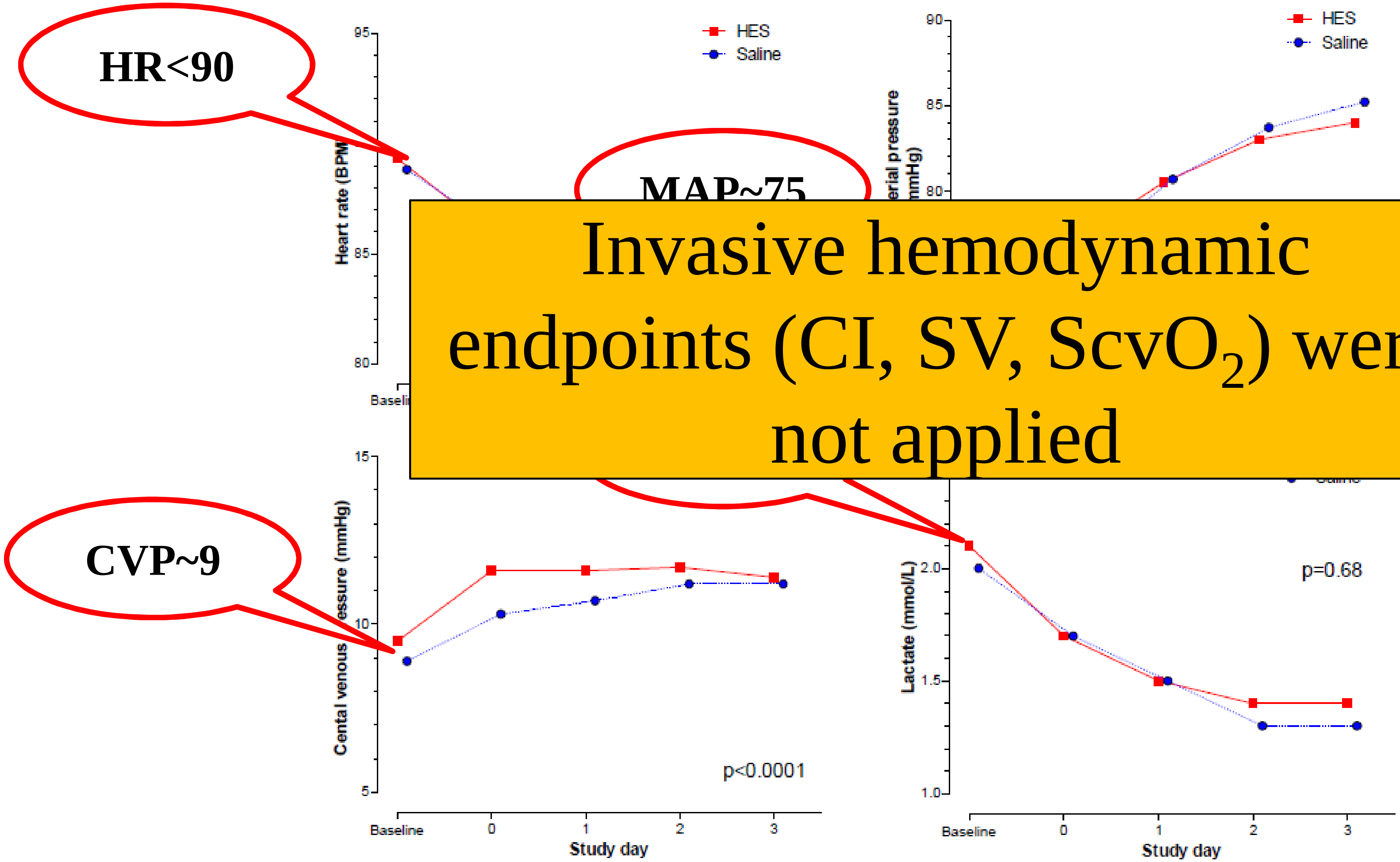


Invasive hemodynamic endpoints (CI, SV, $ScvO_2$) were not applied

Is physiology wrong?

Central venous oxygen saturation is a good indicator of altered oxygen balance in isovolemic anemia

S. Kocsi[1], G. Demeter[1], J. Fogas[1], D. Érces[2], J. Kaszaki[2] and Z. Molnár[1]

Acta Anaesthesiol Scand 2012; ***56: 291–297***

Hemodynamic effects of isovolemic anemia.

	T_0	T_1	T_2	T_3	T_4	T_5
Hb (g/l)	125 (113–134)	102 (90–109)*†	79 (73–93)*†	68 (60–76)*†	59 (53–67)*†	49 (43–55)*†
(mmol/l)	7. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.0 (2.6–3.4)
HR (beats/min)	125 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47 (131–177)*
MAP (mm Hg)	91 (79–105)	89 (79–101)	83 (75–98)*	82 (68–90)*	72 (59–85)*	72 (63–86)*
CVP (mm Hg)	6 (5–8)	8 (5–9)	7 (4–9)	7 (5–9)	7 (5–9)	7 (3–10)
CI (L/min/m²)	2.6 (2.3–2.8)	3.3 (2.7–3.6)*†	3.6 (2.9–3.8)*†	3.6 (3.3–4.1)*	3.5 (3.2–4.0)*	3.9 (3.6–4.1)*
GEDI (ml/m²)	270 (243–284)	271 (245–320)	276 (248–298)	274 (236–305)	268 (227–302)	261 (232–298)
ITBI (ml/m²)	335 (307–352)	335 (305–400)	343 (303–373)	342 (295–383)	334 (282–375)	333 (285–375)
ELWI (ml/kg)	9 (9–10)	10 (10–10)	9 (9–10)	10 (9–10)	10 (9–10)	10 (9–11)
SVI (ml/m²)	21 (18–29)	26 (23–31)	27 (24–31)	28 (25–31)	25 (21–33)	28 (22–31)
SVV (%)	17 (14–21)	15 (12–21)	19 (9–21)	15 (11–20)	19 (11–25)	14 (11–27)
dPmx (mm Hg/s)	540 (485–790 [illegible]	[illegible]	[illegible]	[illegible]	[illegible] 60)*	975 (562–1275)*

Decrease by 60%

Bleeding: 150 ± 33 ml/event

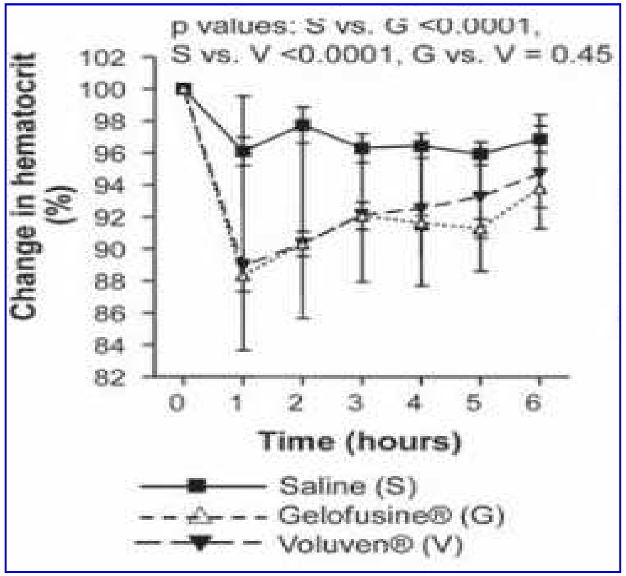
Blood:HES = 1:1

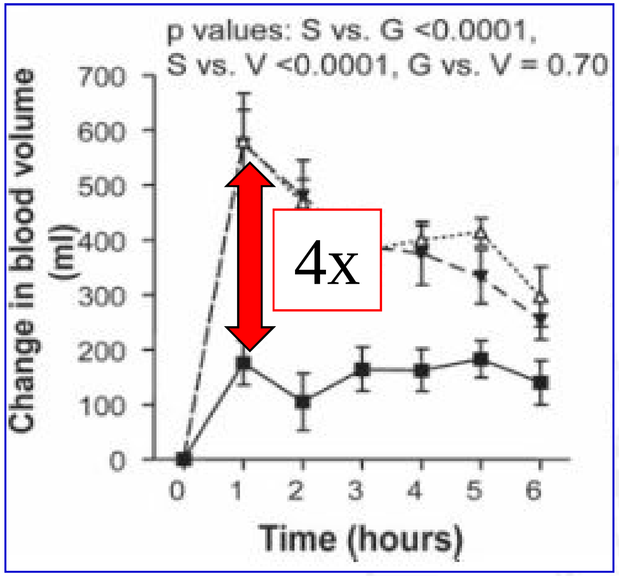
Effect of volume loading with 1 liter intravenous infusions of 0.9% saline, 4% succinylated gelatine (Gelofusine) and 6% hydroxyethyl starch (Voluven) on blood volume and endocrine responses: A randomized, three-way crossover study in healthy volunteers

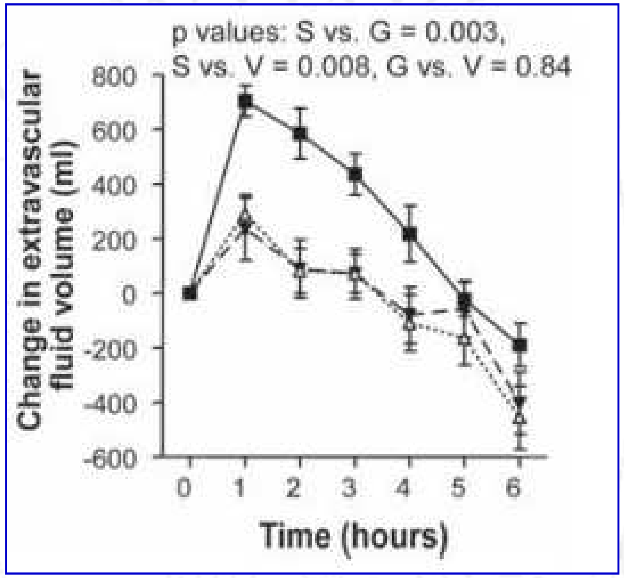
Dileep N. Lobo, DM, FRCS; Zeno Stanga, MD; Mark M. Aloysius, MRCS; Catherine Wicks, BMedSci, BM, BS; Quentin M. Nunes, MRCS; Katharine L. Ingram, FRCA; Lorenz Risch, MD, MPH; Simon P. Allison, MD, FRCP

Crit Care Med. 2010 58(2):1-7

10 healthy adults
1000 ml fluid/60 min







Intensive Care Med (2004) 30:1356–1360
DOI 10.1007/s00134-004-2278-5

ORIGINAL

Zsolt Molnár
András Mikor
Tamás Leiner
Tamás Szakmány

Fluid resuscitation with colloids of different molecular weight in septic shock

	t_b	t_{ep}	t_{30}	t_{60}
$ITBVI_{HES}$ (ml/m^2)	798±37	956±53*	904±70*	854±116*
$ITBVI_{GEL}$	791±52	967±71*	897±96*	905±92*
CI_{HES} (l·min·m^2)	3.84±0.96	5.06±1.19*	4.69±1.14*	4.04±1.09
CI_{GEL}	3.82±0.88	4.88±0.85*	4.69±0.77*	4.58±1.25
Hb_{HES} (g/l)	99±14	97±15	97±18	96±16
Hb_{GEL}	95±21	95±22	93±22	94±22
DO_2I_{HES} (ml·min·m^2)	477±99	630±183*	598±126*	527±109
DO_2I_{GEL}	457±101	615±186*	560±163*	550±178
$EVLW_{HE}$	[illegible]	[illegible]	[illegible]	±6
$EVLW_{GE}$	[illegible]	[illegible]	[illegible]	±3
MAP_{HES}	[illegible]	[illegible]	[illegible]	±10
MAP_{GEL}	[illegible]	[illegible]	[illegible]	±13
CVP_{HES} (	[illegible]	[illegible]	[illegible]	±6
CVP_{GEL}	[illegible]	[illegible]	[illegible]	±8
HR_{HES} (beats/min)	107±9	102±12	103±12	104±10
HR_{GEL}	116±30	110±26	108±26	110±28
PaO_2/FiO_{2HES}(mmHg)	207±114	206±100	189±52	189±78
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Colloid *vs.* Colloid:
Size doesn't matter

$\Delta ITBV/100\ ml_{HES}$	–	26±19
$\Delta ITBV/100\ ml_{GEL}$	–	30±19

Facts and fiction

1. Fluid therapy is life saving in acute hypovolemia
2. Less colloid is needed for the same change in CI
3. V/R ratio (Cryst/Coll) may be 4:1 in healthy but ~2:1 or even less in critically ill
4. Is there any point dealing with colloids at all?

Microcirculation

Part 1: Sepsis

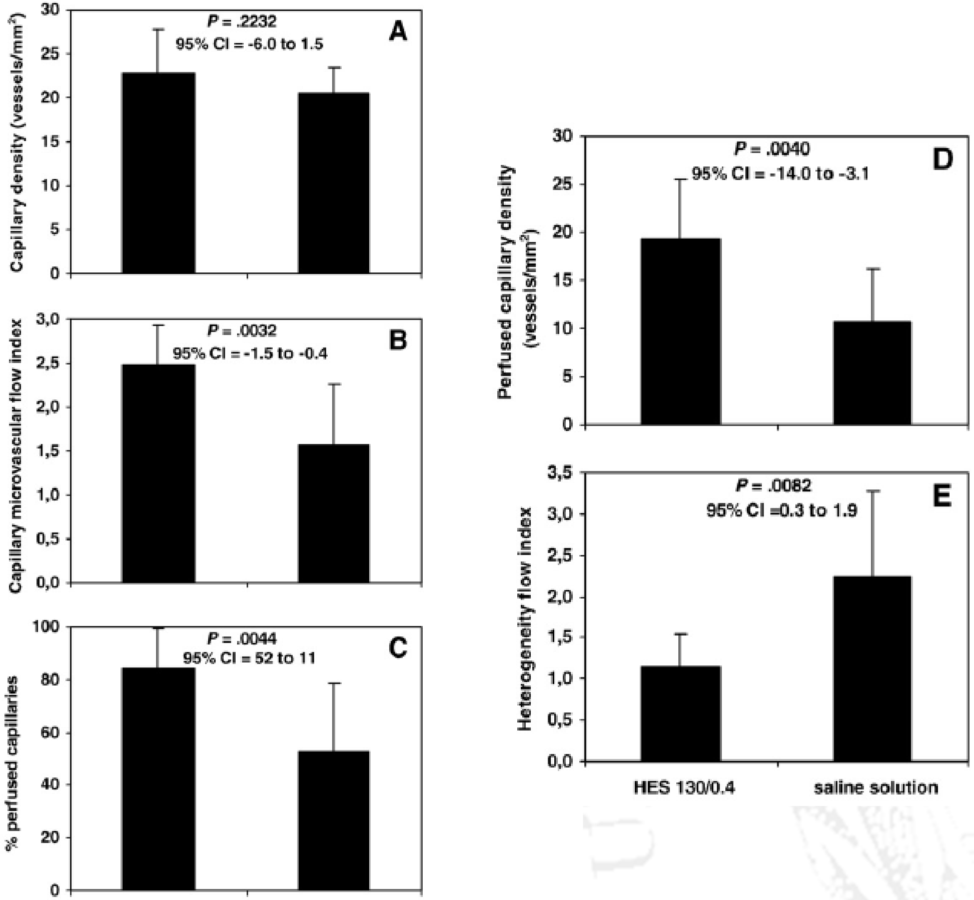
Journal of Critical Care (2010) 25, 659.e1–659.e8

ELSEVIER

Journal of Critical Care

Comparison of 6% hydroxyethyl starch 130/0.4 and saline solution for resuscitation of the microcirculation during the early goal-directed therapy of septic patients☆,☆☆

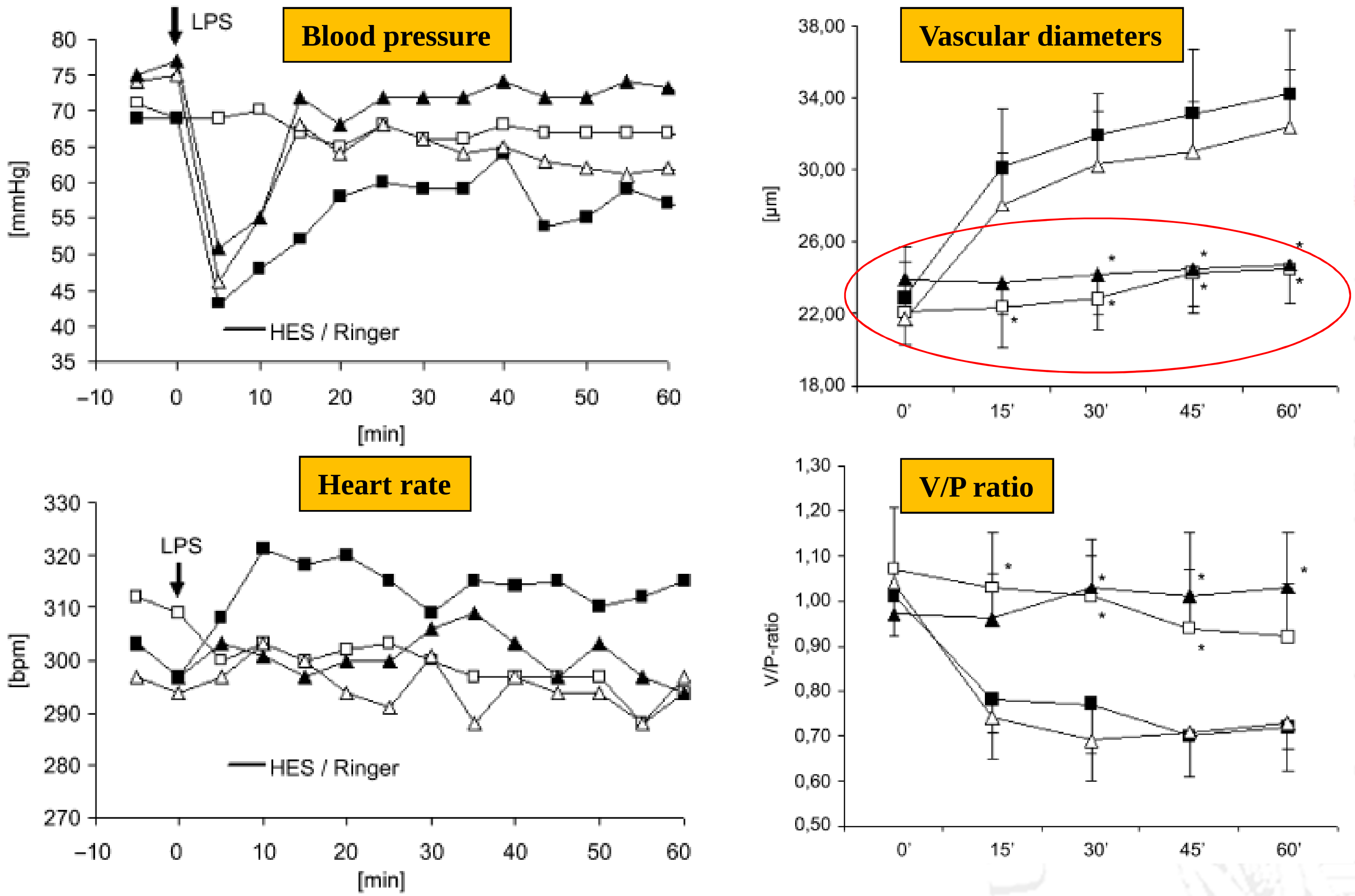
Arnaldo Dubin MD[a,b,*], Mario O. Pozo MD[c], Christian A. Casabella MD[a], Gastón Murias MD[c], Fernando Pálizas Jr. MD[c], Miriam C. Moseinco MD[a], Vanina S. Kanoore Edul MD[a,b], Fernando Pálizas MD[c], Elisa Estenssoro MD[d], Can Ince PhD[e,1]



SHOCK, Vol. 28, No. 3, pp. 300–308, 2007

HYDROXYETHYL STARCH NORMALIZES PLATELET AND LEUKOCYTE ADHESION WITHIN PULMONARY MICROCIRCULATION DURING LPS-INDUCED ENDOTOXEMIA

Sebastian Küpper,* Soeren Torge Mees,* Peter Gassmann,* Martin F. Brodde,† Beate Kehrel,† and Joerg Haier*



NaCl 0.9% (□)

LPS group without treatment (■)

Hydroxyethyl starch (▲)

Ringer lactate (△)

SHOCK, Vol. 28, No. 3, pp. 300–308, 2007

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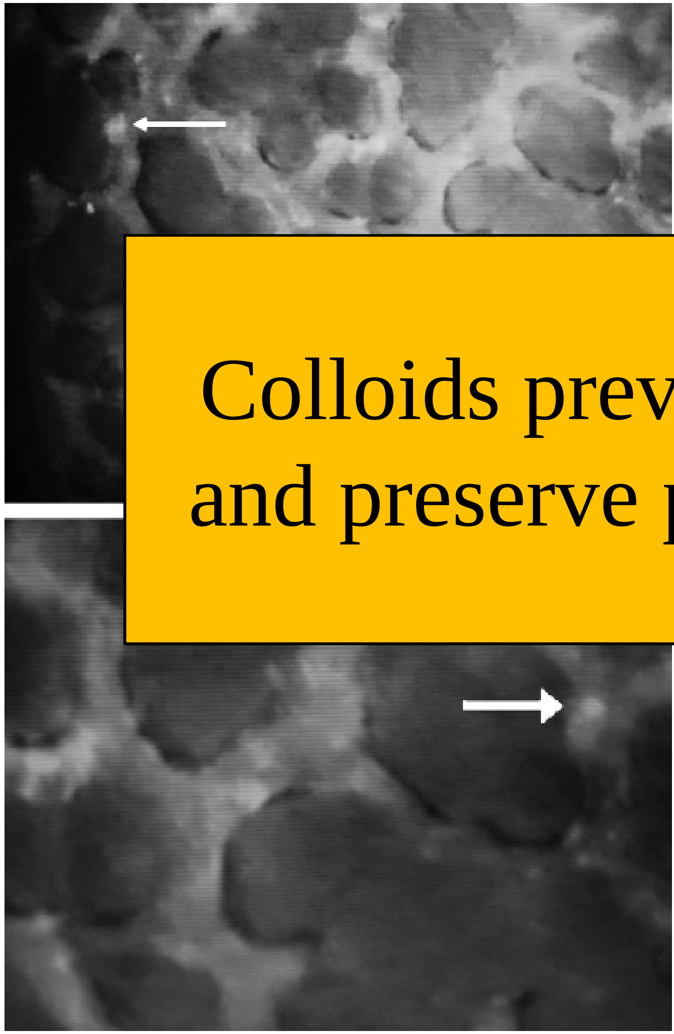
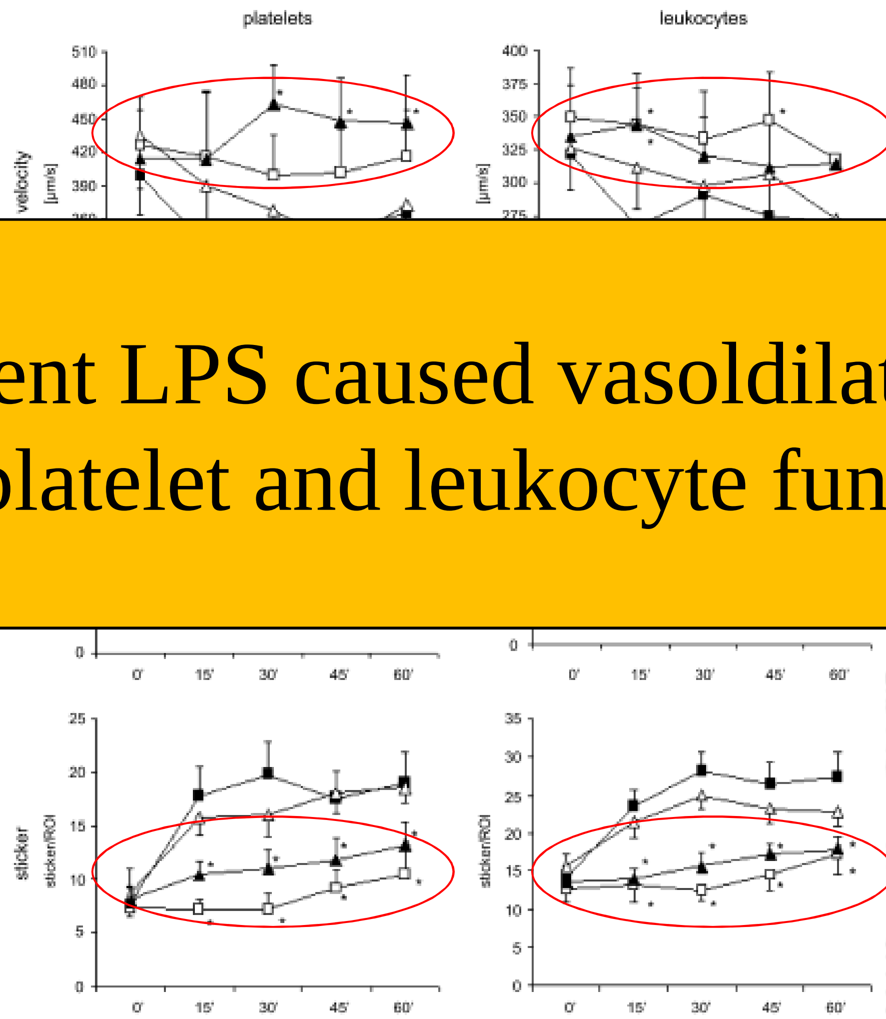




Colloids prevent LPS caused vasoldilataion and preserve platelet and leukocyte function

Part 2: Surgery and bleeding

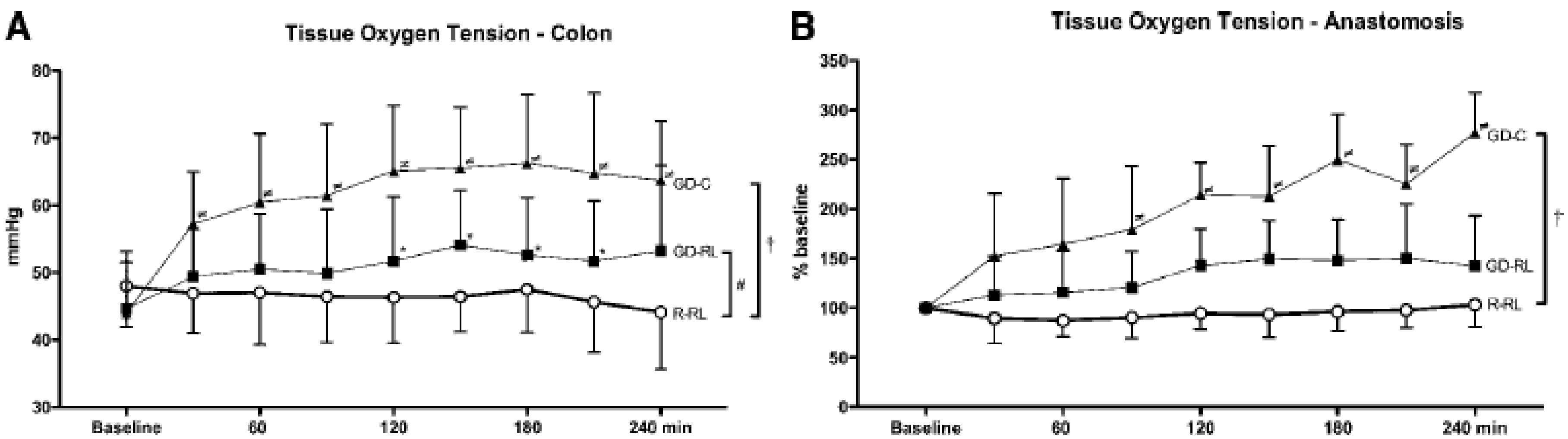
Anesthesiology 2009; 110:496–504

Goal-directed Colloid Administration Improves the Microcirculation of Healthy and Perianastomotic Colon

Oliver Kimberger, M.D., Michael Arnberger, M.D.,* Sebastian Brandt, M.D.,* Jan Plock, M.D.,†*
*Gisli H. Sigurdsson, M.D., Ph.D.,‡ Andrea Kurz, M.D.,§ Luzius Hiltebrand, M.D.**

Colon anastomosis – 240 minutes observatoin

R-RL group: 3ml/kg fluid
GD-RL group: 3ml/kg fluid + 250 ml if $ScvO_2$<60%
GD-C group: 3ml/kg fluid + 250 ml if $ScvO_2$<60%

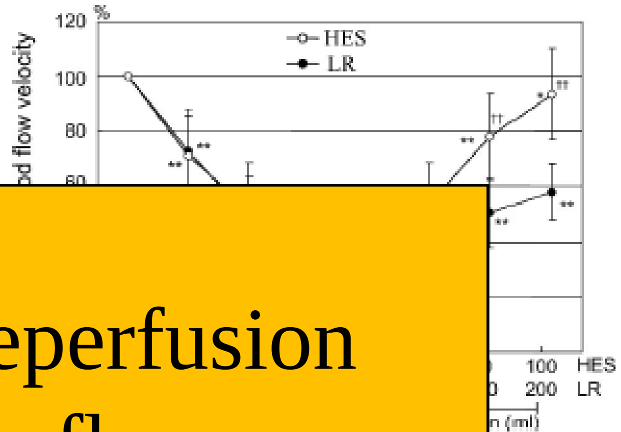


SHOCK, Vol. 23, No. 4, pp. 377–382, 2005

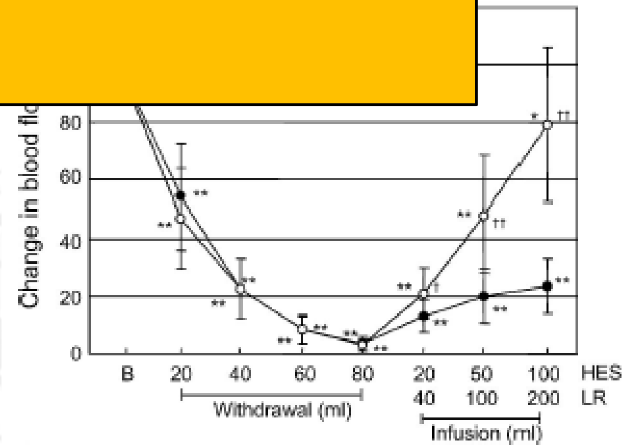
EFFECTS OF COLLOID RESUSCITATION ON PERIPHERAL MICROCIRCULATION, HEMODYNAMICS, AND COLLOIDAL OSMOTIC PRESSURE DURING ACUTE SEVERE HEMORRHAGE IN RABBITS

Makiko Komori,* Katsumi Takada,* Yasuko Tomizawa,† Shoichi Uezono,* Keiko Nishiyama,* and Makoto Ozaki*

Baseline



Colloids preserve ischaemia-reperfusion caused microcirculatory flow



After resuscitation

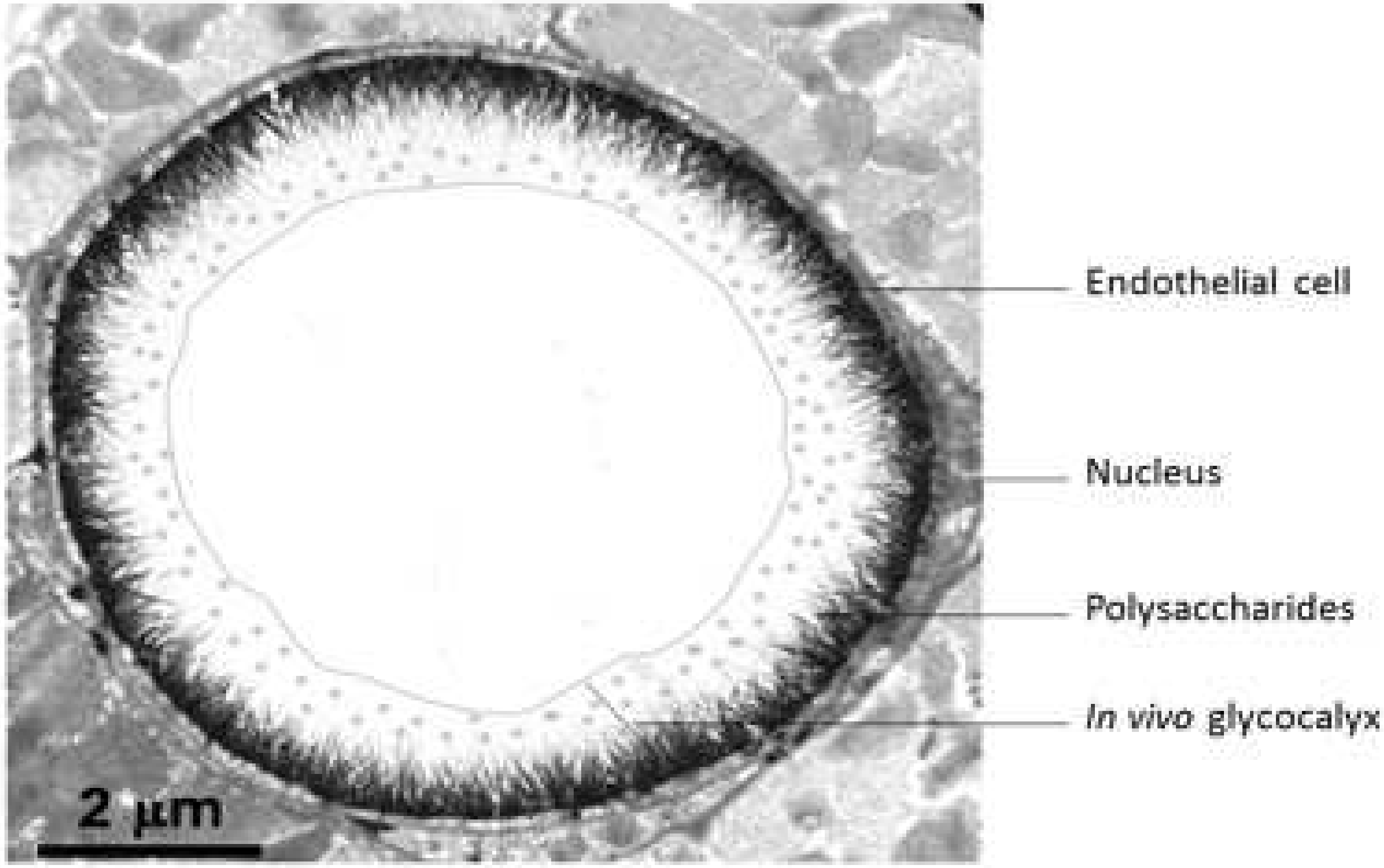
HES

LR

Physiological background

The secret: Glycocalyx

Reitsma S, et al. *J Vasc Res* 2011, 48:297-306



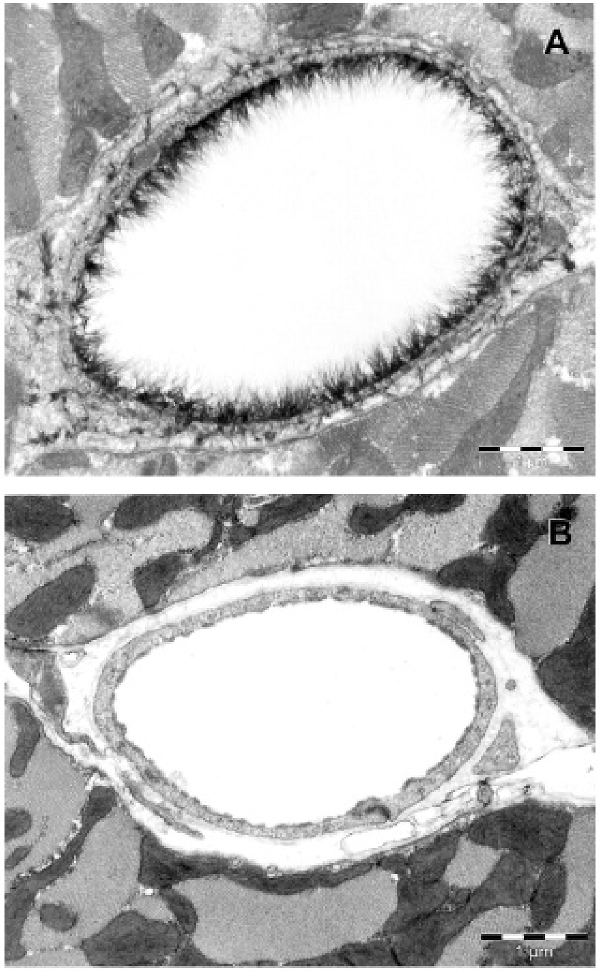
The secret: Glycocalyx

Bernard M. et al. *Circulation Research*. 2003; 92: 592-594

SIRS

Severe sepsis

Chappel D, et al. Curr Opin Anaesthesiol 2009; 22: 155-62



Hypervolemia

Bruegger D, et al. Am J Physiol Heart Cicr Physiol 2005; 289: H1993-1999

HES is bad for you…

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch 130/0.4 versus Ringer's Acetate in Severe Sepsis

Perner A et al. 2012; DOI: 10.1056/NEJMoa1204242

- Patients with severe sepsis assigned to fluid resuscitation with HES 130/0.4 had an increased risk of death at day 90 and were more likely to require renal-

Had these patients received bolus fluids unnecessarily?

Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

Myburh JA et al. 2012; DOI: 10.1056/NEJMoa1209759

- In patients in the ICU, there was no significant difference in 90-day mortality between patients resuscitated with 6% HES (130/0.4) or saline. However, more patients who received resuscitation with HES were treated with renal-replacement therapy.

Wrap it up!

1. Glycocalyx is impaired in many critically ill

2. Colloids act farster and longer – if the glycocalix is intact

3. They improve microcirculation and cause less edema as compared to crystalloids

My dilemma

What should we give?

vs.

When should we give?

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

CRITICAL CARE MEDICINE

Simon R. Finfer, M.D., and Jean-Louis Vincent, M.D., Ph.D., *Editors*

Resuscitation Fluids

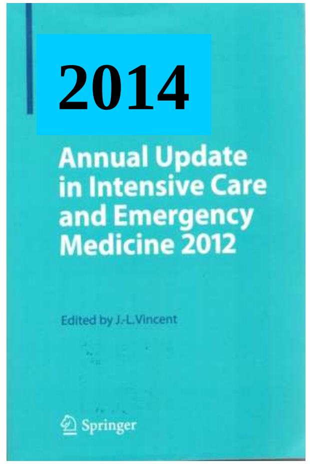
John A. Myburgh, M.B., B.Ch., Ph.D., and Michael G. Mythen, M.D., M.B., B.S.

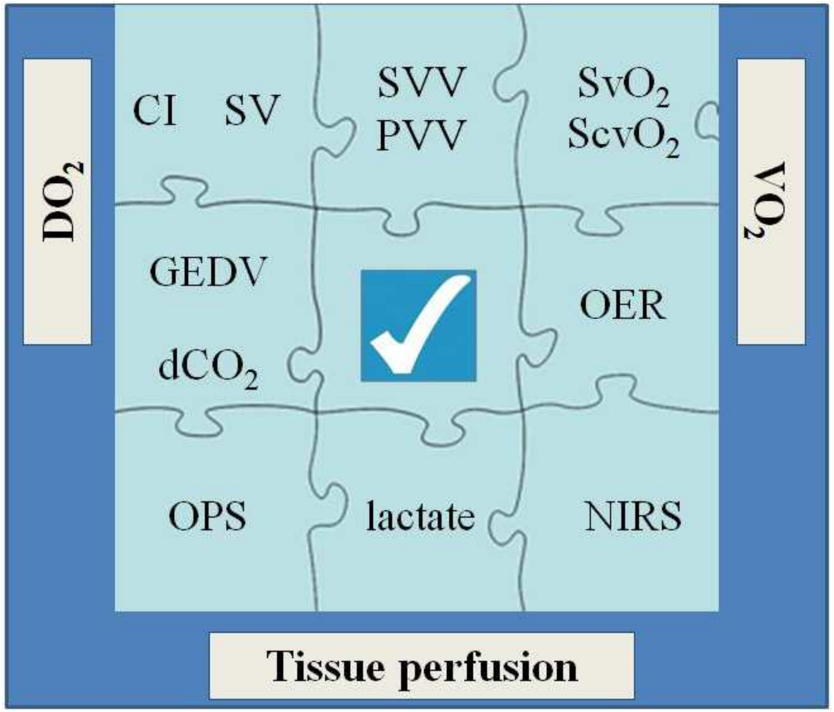
TYPES OF RESUSCITATION FLUID

Globally, there is wide variation in clinical practice with respect to the selection of resuscitation fluid. The choice is determined largely by regional and clinician preferences that are based on institutional protocols, availability, cost, and commercial marketing.[11] Consensus documents about the use of resuscitation fluids have been developed and directed primarily at specific patient populations,[12-14] but such recommendations have been based largely on expert opinion or low-quality clinical evidence. Systematic reviews of

Solve the hemodynamic puzzle first!

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





Computers in Biology and Medicine 41 (2011) 1022–1032

Contents lists available at SciVerse ScienceDirect

Computers in Biology and Medicine

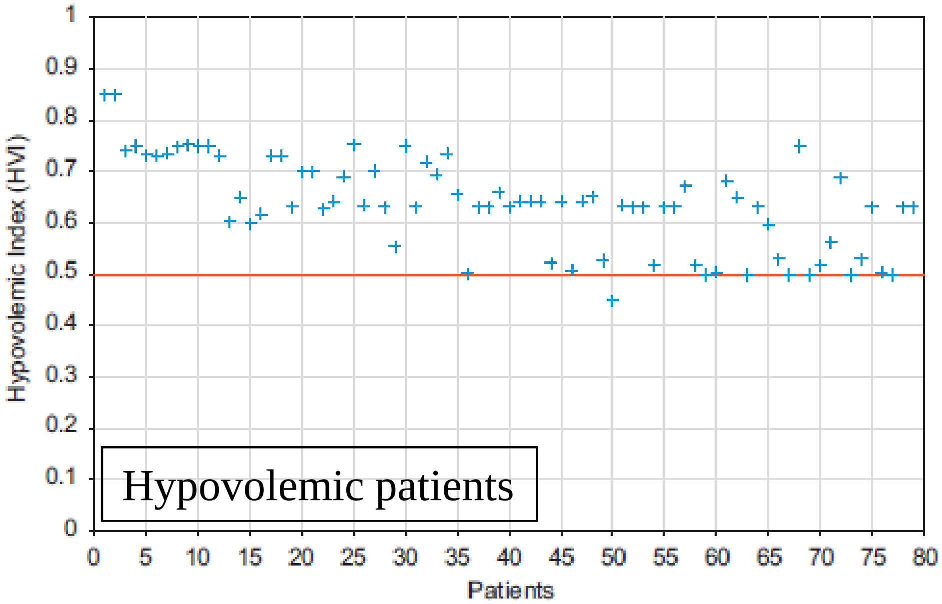
journal homepage: www.elsevier.com/locate/cbm

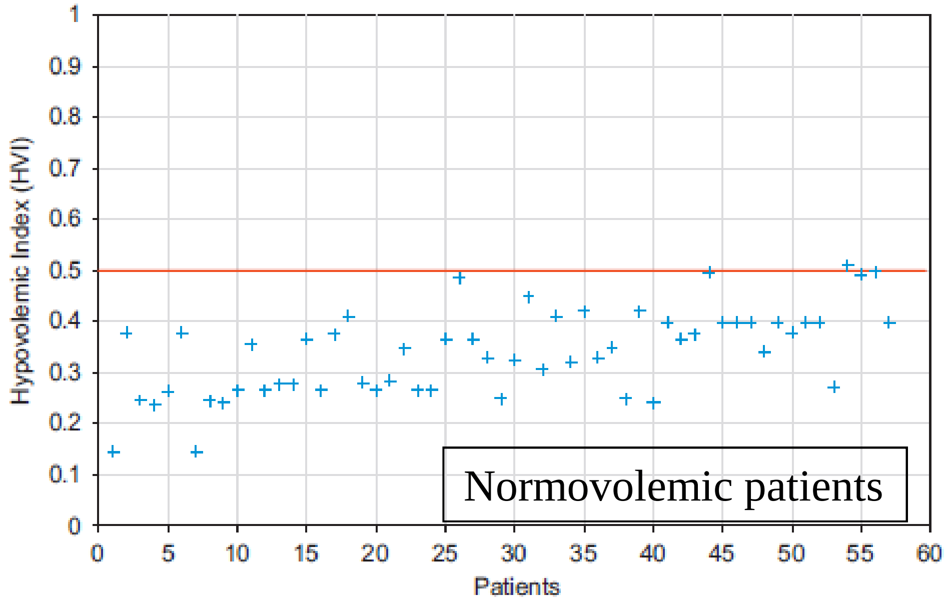
The diagnosis of hypovolemia using advanced statistical methods

Gergely Bárdossy [a,*], Gábor Halász [a], Tibor Gondos [b]

[a] Budapest University of Technology and Economics, Department of Hydrodynamic Systems, 1111 Budapest Műegyetem rkp. 3, Budapest, Hungary
[b] Semmelweis University Budapest, Faculty of Health Sciences, 1088 Budapest, Vas u. 17, Hungary

Input: $ScvO_2$, CVP, CI, GEDVI, SVV, MAP

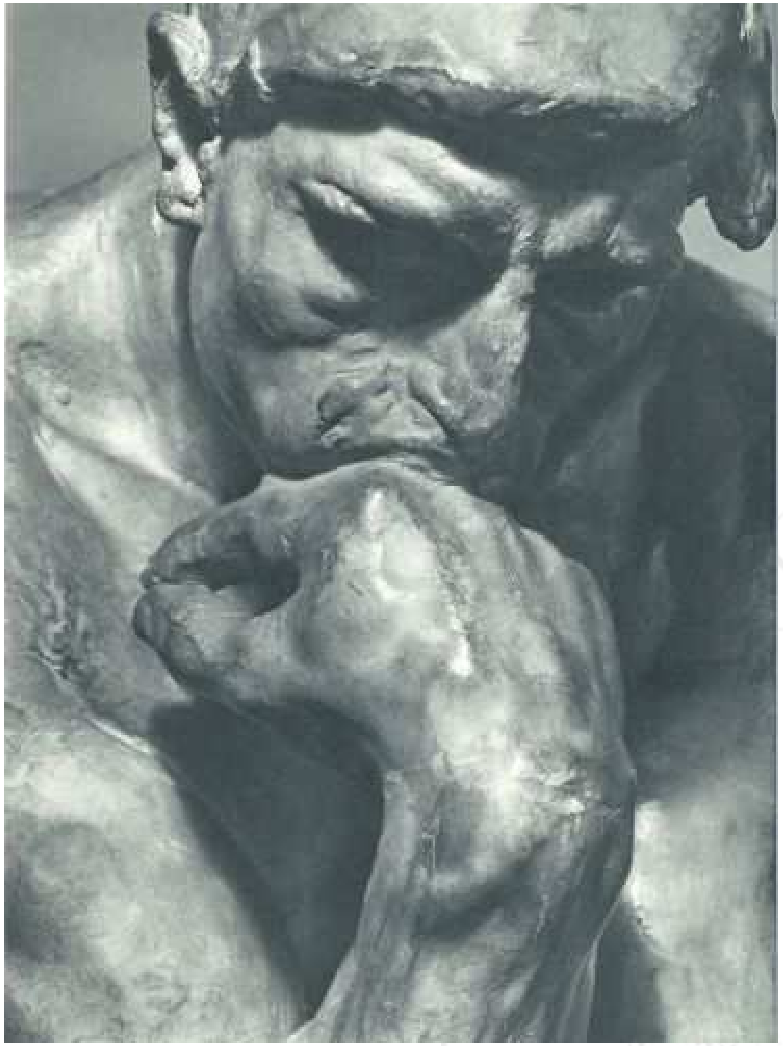




Your wish…

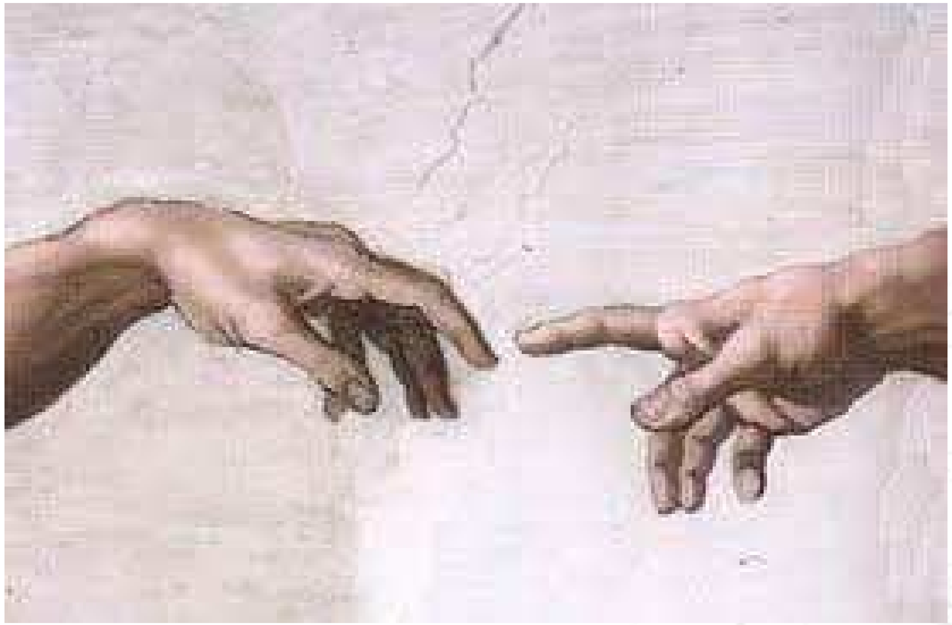
Fluid therapy – in just 24 hours!

The most important lesson



Auguste Rodin: The Thinker

Is physiology wrong?



No, it's us, who misunderstand the data!

„Together we win, divided we're slow!"

Jean-Louis VINCENT	Belgium
Daniel De BACKER	Belgium
Alan SUSTIC	Croatia
Ino HUSEDZINOVIC	Croatia
Jan BENES	Czech Republic
Jean-Louis TEBOUL	France
Xavier MONNET	France
Wolfgang HUBER	Germany
Daniel REUTER	Germany
Frank BRUNKHORST	Germany
Ákos Csomós	Hungary
Béla FÜLESDI	Hungary
János FAZAKAS	Hungary
Lajos BOGÁR	Hungary
Zsolt MOLNÁR	Hungary
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Roman ZAHORECZ	Slovakia
Matej PODBREGAR	Slovenia
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SepsEast 2014

2nd Central and Eastern European Sepsis Forum

FREE for junior doctors!