Perioperatív folyadék-, és vérpótlás

Molnár Zsolt
Aneszteziológiai és Intenzív terápiás Intézet

Szegedi Tudományegyetem

2012

Bemelegítés

- 44 éves nő, krónikus betegség miatti kezelés
- Rossz közérzet miatt kórházi felvétel (1. nap)
- Laborok:

Na	125 mmol/l
K	4.4 mmol/l

- Kezelés (3. nap, reggel 7:00):

Ri-Lac	500 ml
Salsol + 10% NaCl	500 ml

- 11:00 - hypoglikémia

Bemelegítés

- 11:00-18:00:

Isodex (5% dextróz)	2000 ml
40% glukóz	40 ml
Mannitol	200 ml
Emetron	2a

- 4. nap reggel

Na	**101 mmol/l**
K	**2.5 mmol/l**

Mi történt?

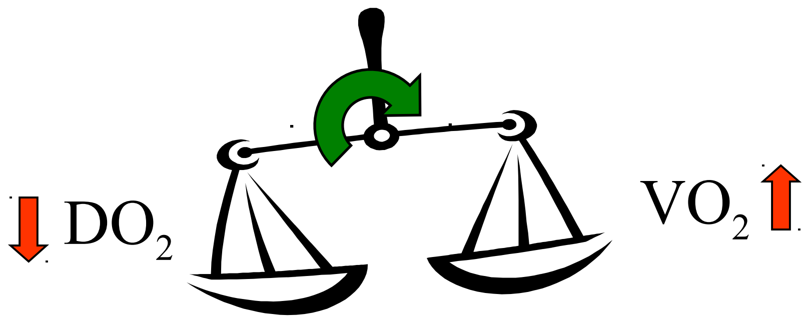
Élettan

Az adósság…

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

Az adósság…

- $DO_2 = \underbrace{(SV \cdot P)}_{CO} \cdot \underbrace{(Hb \cdot 1.39 \cdot SaO_2 + 0.003 \cdot PaO_2)}_{CaO_2} \sim 1000 ml/p\ (SaO_2 = 100\%)$
- $VO_2 = CO \bullet (CaO_2 - CvO_2) \sim 250\ ml/p\ (ScvO_2 \sim 70\text{-}75\%)$
- A hypovolémiás, vérző beteg:



- Sokk = $VO_2 > DO_2$

Az oxigénadósság

- Hypovolaemia
- Vérzés, aneamia
- Hyxpoxaemia

- Fájdalom
- Stressz
- Tachypnoe

↓ DO_2 < ↑ VO_2

↓

Sokk

A sokktalanítás célja

- Hypovolaemia
- Vérzés, aneamia
- Hyxpoxaemia

- Fájdalom
- Stressz
- Tachypnoe

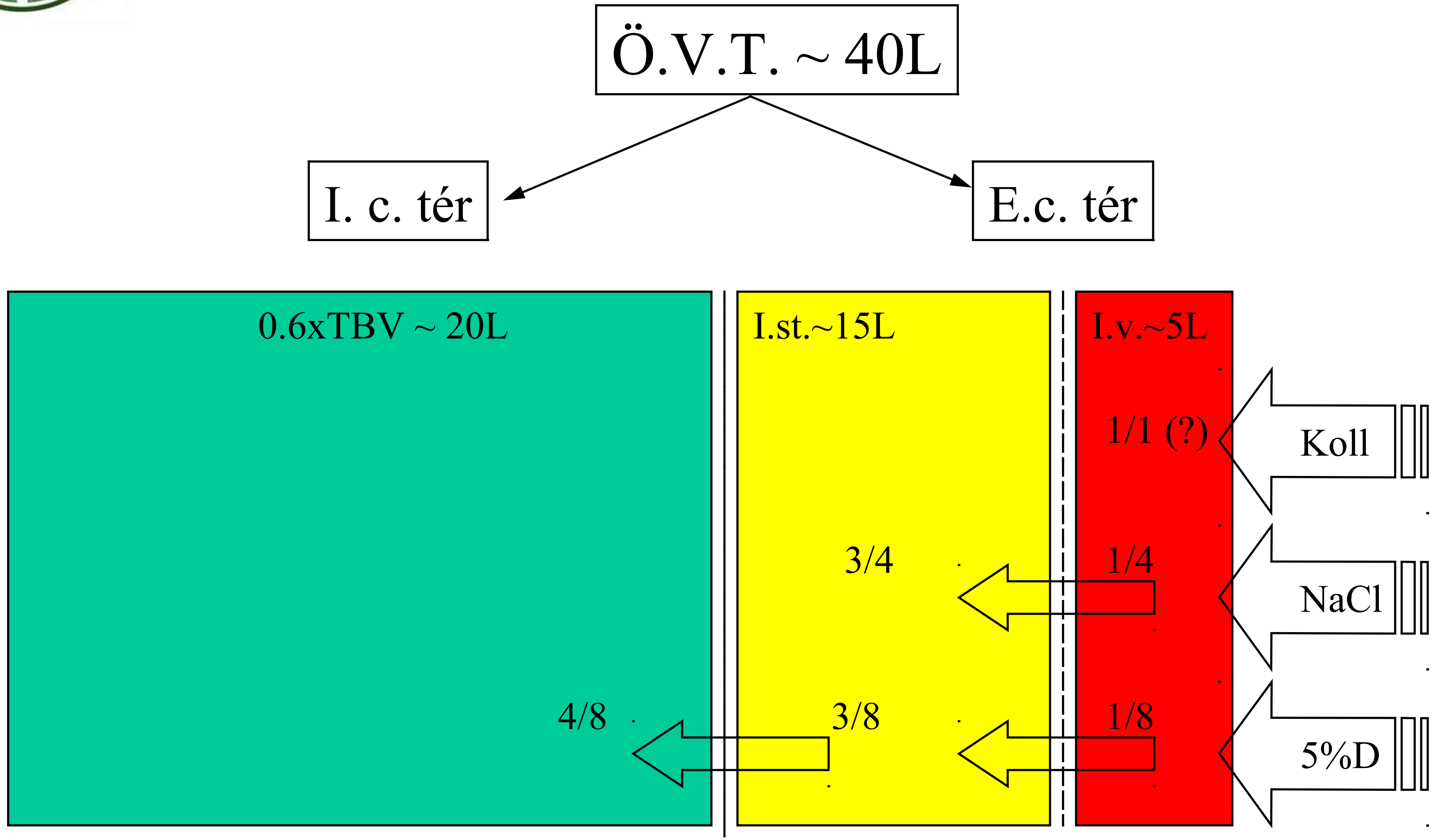
$\downarrow DO_2$ $<$ $\uparrow VO_2$

$\downarrow$

$\uparrow DO_2$ $>$ $\downarrow VO_2$

Milyen folyadékot adjunk?

Folyadékterek és infúziós oldatok



Bemelegítés - válasz

- 11:00-18:00:

Isodex (5% dextróz)	2000 ml
40% glukóz	40 ml
Mannitol	200 ml
Emetron	2a

- 4. nap reggel

Na	**101 mmol/l**
K	**2.5 mmol/l**

Vízmérgezés

Főbb szempontok – 2012-ig…

- Folyadékeloszlás:
  - Víz (5%D) az ÖVT-ben oszlik el (1/8)
  - Na^+ az e.c. térben (1/4)
  - Kolloid az i.v térben (1/1)
- Tehát:
  - 1 L vérvesztést…
  - …4 L izotóniás sóoldattal, vagy…
  - …1 L kolloiddal pótolhatunk.

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	954.0±1484.4	<0.001
Day 3	2210	268.0±554.5	2202	348.3±753.5	0.03
Day 4	1686	192.3±427.0	1664	228.6±642.6	0.57
Nonstudy fluid (ml)					
Day 1	3392	1459.4±1183.2	3405	1505.6±1254.3	0.30
Day 2	3051	2615.9±1372.5	3057	2707.3±1435.7	0.009
Day 3	2199	2618.5±1346.5	2191	2660.9±1319.3	0.15
Day 4	1680	2691.5±1228.7	1656	2707.7±1255.4	0.36
Packed red cells (ml)					
Day 1	3411	97.8±360.7	3415	71.7±296.8	<0.001
Day 2	3066	106.5±321.4	3074	61.1±235.2	<0.001
Day 3	2217	59.8±225.5	2210	49.5±190.8	0.30
Day 4	1692	43.6±167.5	1668	46.0±189.0	0.77
Net positive fluid balance (ml)					
Day 1	3363	1543.6±1619.7	3382	1990.5±2061.7	<0.001
Day 2	3044	1015.3±1826.9	3052	1505.1±2215.9	<0.001
Day 3	2190	422.1±1633.3	2182	553.0±1732.3	0.007
Day 4	1671	137.2±1491.0	1649	155.7±1650.6	0.70
Mean arterial pressure (mm Hg)					
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.

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.*

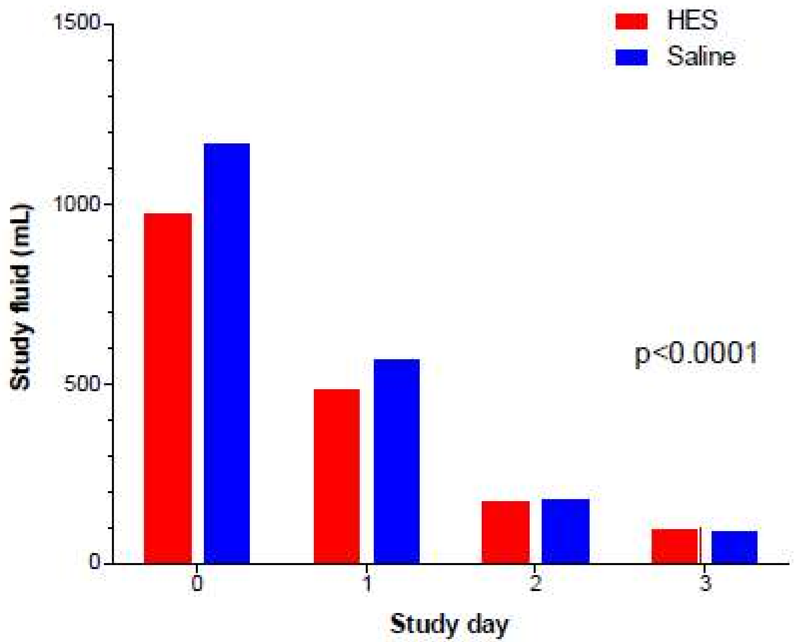
Variable	HES 130/0.4 (N=398)			Ringer's Acetate (N=400)			P Value†
	Patients	Volume Received‡		Patients	Volume Received‡		
		median	interquartile range		median	interquartile range	
	no./total no.§	*ml*		*no./total no.§*	*ml*		
Trial fluid							
Day 1¶	374/397	1500	1000–1500	375/400	1500	1000–2000	0.09
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 fluid							
Day 1¶	157/397	1500	1000–2000	177/400	1500	800–2500	0.21
Day 2	114/379	1000	500–1500	133/380	1000	500–2000	0.13
Day 3	54/329	900	500–1000	57/326	1000	500–1250	0.69

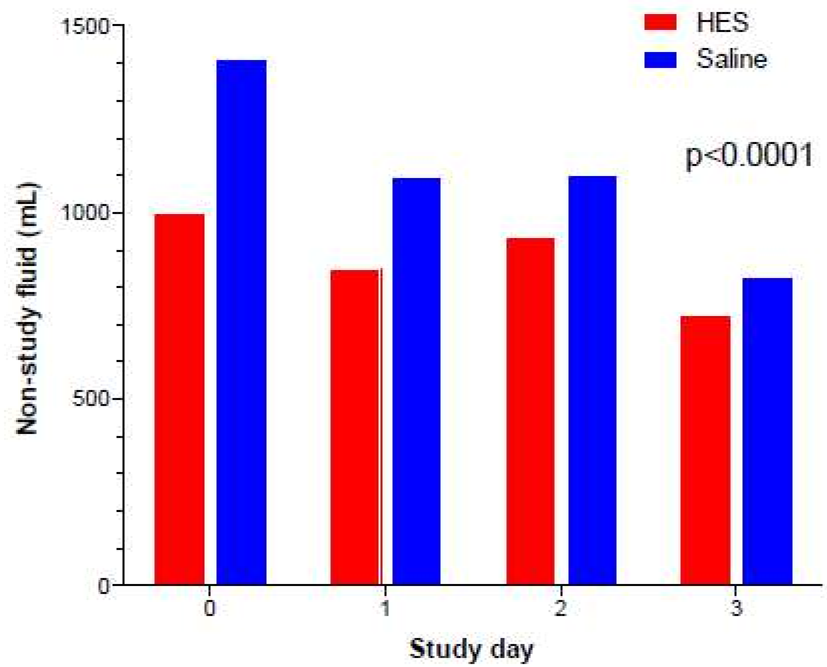
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

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



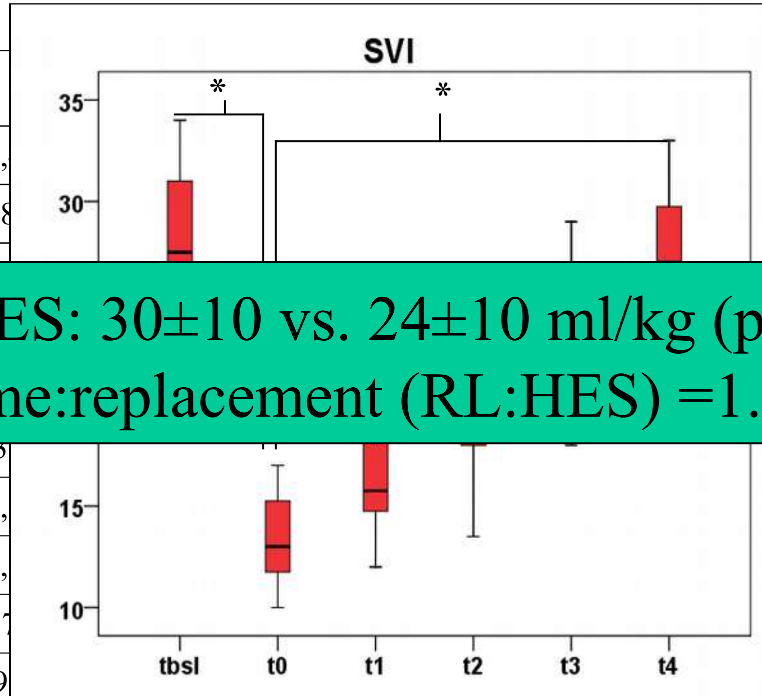


Daily average over the 1st 4 days: 526±425 vs. 616±488 ml (!!), p<0.001

ScvO$_2$ as resuscitation end-point in hypovolemia

Németh M, et al. SEPSIS, 2012; 4:144

Paraméter	tbsl				t3	t4
SVI	26,8±4,7	13,			22,3±4,1	26,6±4,1
CI	2,6±0,4	1,8			2,6±0,4	2,9±0,5*
HR						107±16*
MAP						91±19*
CVP						6,14±1,47
GEDI	309±57	23			268±48	287±49*
SVV	13,6±4,3	22,			16,6±5,4	12,2±4,3
PPV	13,0±4,5	24,			16±5,6	13±4,2
SVRI	3425±816	3257			2460±561	2340±526*
Dpmx	583±227	59			670±298	657±265



RL vs. HES: 30±10 vs. 24±10 ml/kg (p=0.02)
Volume:replacement (RL:HES) =1.25!

Parameters	tbsl					
SVI	26,8±4					
ScvO2	78±					
CO2gap	5,3±					

Főbb szempontok - 2012

- Folyadékeloszlás:
  - Víz (5%D) az ÖVT-ben oszlik el (1/8)
  - Na^+ az e.c. térben (1/4)
  - Kolloid inkább az i.v térben (1/2-3)
- Tehát:
  - 1 L vérvesztést…
  - …4 L izotóniás sóoldattal, vagy…
  - …2-3 L kolloiddal pótolhatunk.

Krisztaloid vagy kolloid?

Konklúziók

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.

Melyik krisztalloid?

Úttörők

- Sydney Ringer (1836-1910):
  - University College, London
  - Na^{+} = 130 mmol/l
- Alexis Hartmann (1898-1964):
  - Amerikai gyermekgyógyász
  - Diabeteszes ketoacidózis
  - Laktátot adott az oldathoz (HCO_3)
  - Hartmann oldat

Irányelv - 2011

British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients

GIFTASUP

Jeremy Powell-Tuck (chair)[1], Peter Gosling[2], Dileep N Lobo[1,3] Simon P Allison[1], Gordon L Carlson[3,4], Marcus Gore[3], Andrew J Lewington[5], Rupert M Pearse[6], Monty G Mythen[6]

Mit infundáljunk?

GIFTASUP 2011

- Recommendation 1
- *Because of the risk of inducing hyperchloraemic acidosis in routine practice, when crystalloid resuscitation or replacement is indicated, balanced salt solutions e.g. Ringer's lactate/acetate or Hartmann's solution should replace 0.9% saline, except in cases of hypochloraemia e.g. from vomiting or gastric drainage.*
- Evidence level 1b

O'Malley CM, et al. *Anesth Analg* 2005;100:1518-1524

Reid F, et al. *Clin Sci (Lond)* 2003;104:17-24

Wilkes NJ , et al. *Anesth Analg* 2001;93:811-816

Ho AM , et al. *J Trauma* 2001;51**:173-177**

Monitorozás, terápiás végpontok

A folyadék fontos, mert javítja a túlélést…

- „Early Goal-Directed Therapy” (EGDT)

Rivers E et al. *N Engl J Med* 2001; 345: 1368

- 6 hours of resuscitation in the ER:
  - Control group (n=133):
    - O_2
    - CVP: 8-12 mmHg
    - MAP: >65 mmHg
  - EGDT group (n=130):
    - Same
    - $ScvO_2 > 70\%$

→ Több folyadék

Mortalitás: 46 vs. 30% (p=0.009)

…de a túl sok ártalmas!

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

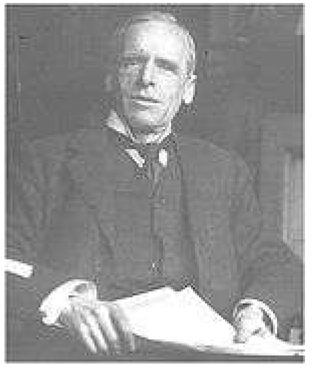
OR, odds ratio; CI, confidence interval; SAPA, Simplified Acute Physiology Score; SOFA, Sequential Organ Failure Assessment.

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

Úttörők

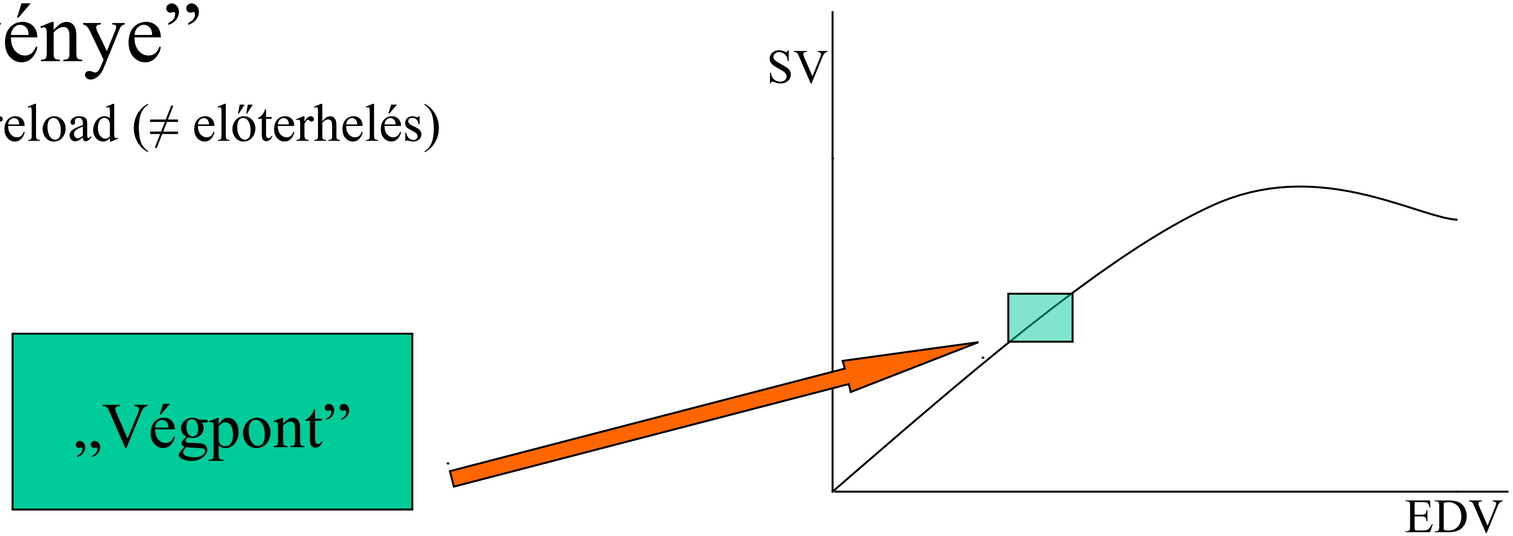
- Otto Frank (1865-1944):
  - Élettanász (Lipcse)
  - Zur Dynamik des Herzmuskels, Z Biol 32 (1895) 370

- Ernest Starling (1866-1927):
  - UCL
  - Starling erők, hormonok, stb



Hemodinamikai végpont

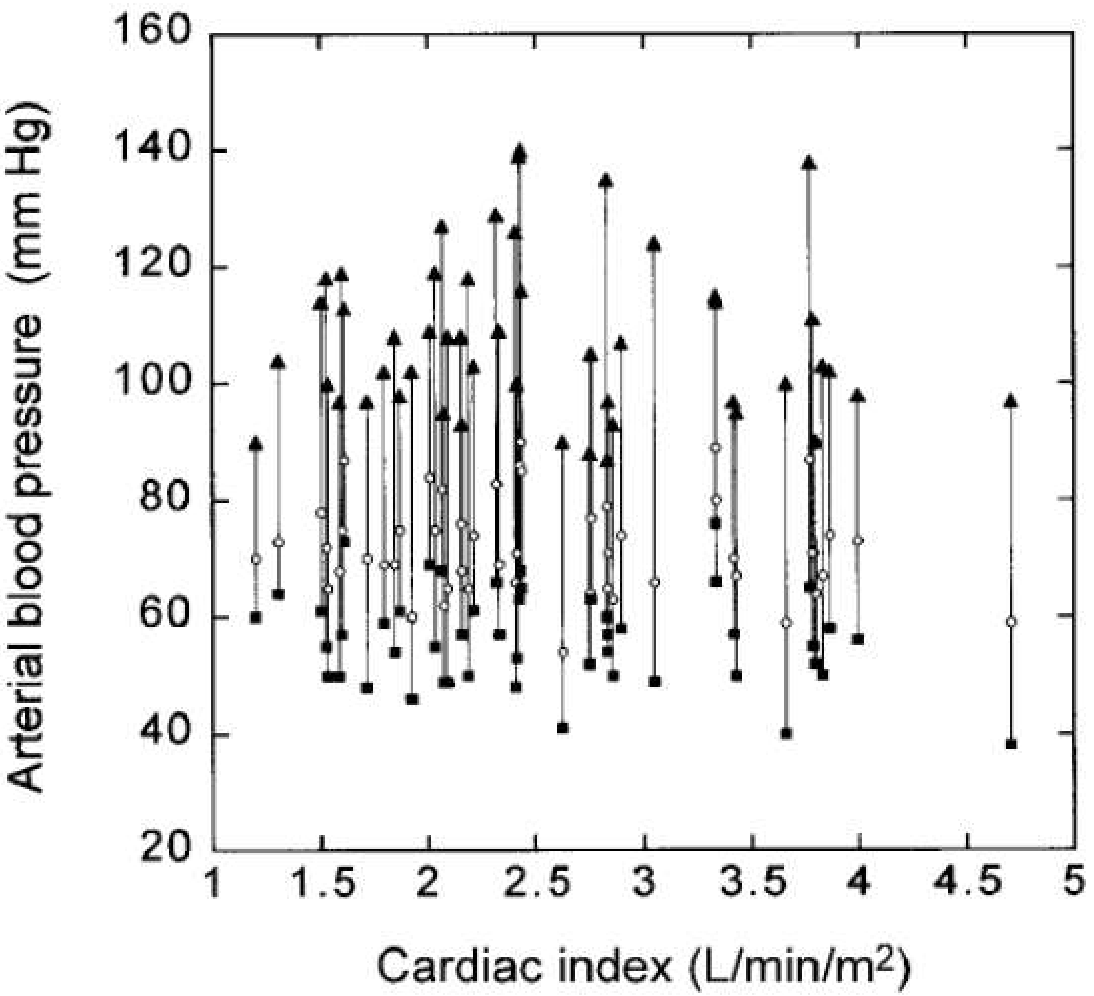
- Frank-Starling: A szív törvénye (1914)
  - „The mechanical energy set free in the passage from the resting to the active state is a function of the length of the fiber.„
  - „Within physiological limits, the force of contraction is directly proportional to the initial length of the muscle fiber"
- „A szív törvénye"
  - NB: Preload (≠ előterhelés)



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

Vérnyomás és perctérfogat

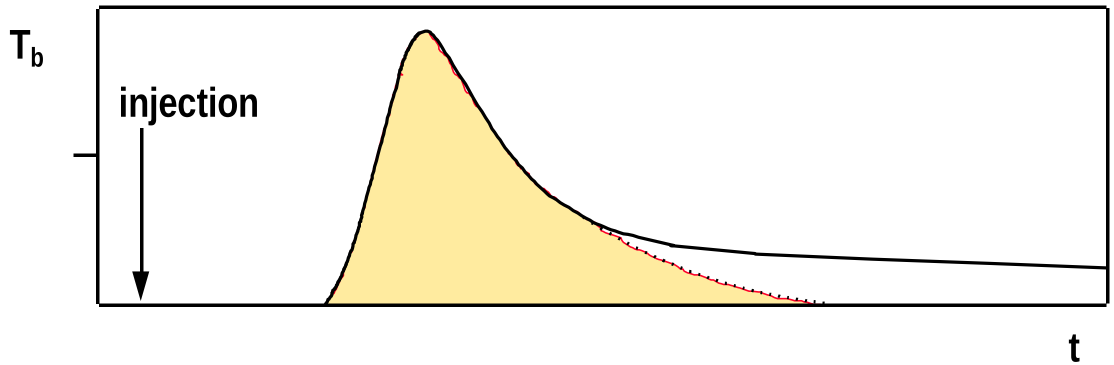
Linton RA, et al. *J Cardiothorac Vasc Anesth* 2002; 16: 4-7.



Stewart-Hamilton egyenlet

Thermodilution

Determination of cardiac output (C.O.)



$$C.O. = \frac{(T_b - T_i) \cdot V_i \cdot K}{\int \Delta T_b \cdot dt}$$

02.03.1999 U:\Freidoku\Schul\PiCCO\PiCCO0399E

A történet kezdete1970…

The NEW ENGLAND JOURNAL of MEDICINE

Swan HJ, Ganz W, Forrester J, Marcus H, Diamond G, Chonette D (August 1970). "Catheterization of the heart in man with use of a flow-directed balloon-tipped catheter". *N. Engl. J. Med.* **283** (9): 447–51

..és vége1996?

Connors AF, et al. *JAMA* 1996; 276: 889-97

Table 2.—Unadjusted Relationship of Right Heart Catheterization (RHC) to Outcomes for 5735 Critically Ill Patients*

Outcome	No RHC (n=3551)	RHC (n=2184)	*P*
Survival, No. (%)			
30 d	2463 (69.4)	1354 (62.0)	<.001
2 mo	2231 (62.8)	1190 (54.5)	<.001
6 mo	1906 (53.7)	1012 (46.3)	.001
Resource utilization†			
Total costs (× $1000)‡	74.3 [18.4, 37.1, 81.5]	131.9 [42.1, 81.7, 160.6]	<.001
Average TISS	28 [21, 27, 35]	35 [28, 35, 42]	<.001
Length of stay, d†			
ICU	10.3 [3, 6, 11]	15.5 [5, 9, 18]	<.001
Study	20.5 [8, 13, 23]	25.7 [9, 17, 32]	<.001

Pulmonary artery catheter use is associated with reduced mortality in severely injured patients: A National Trauma Data Bank analysis of 53,312 patients*

Randall S. Friese, MD; Shahid Shafi, MD; Larry M. Gentilello, MD

(Crit Care Med 2006; 34:1597–1601)

- N=53,312
- A PAC-betegek (n=1933) idősebbek, betegebbek
- Nagyobb eséllyel éltek túl:
  - Age: 61-90 years
  - ISS: 25-75
  - Felvételi BE < -11

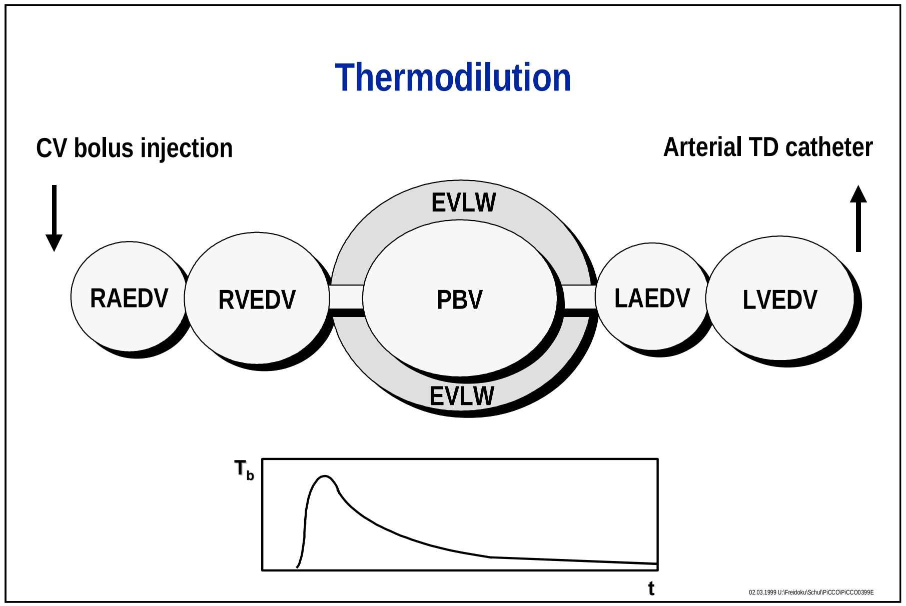
Continuous, Less Invasive, Hemodynamic Monitoring in Intensive Care After Cardiac Surgery

O. Gödje, K. Höke, P. Lamm, C. Schmitz, C. Thiel, M. Weinert, and B. Reichart
Department of Cardiac Surgery, University Hospital Großhadern, Ludwig-Maximilians University, Munich, Germany

Thorac. Cardiovasc. Surg. 46 (1998) 242–249

A possibility to avoid a PAC is transthoracic arterial thermodilution, a newly developed method for calibrating pulse contour analysis. For this technique only a thermistor-tipped arterial catheter and a central venous access is necessary. As almost every intensive care patient is applied these two vascular lines, no additional catheters are required and the system can be considered less invasive.

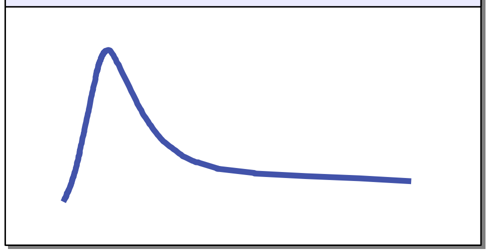
Transzpumonális termodilúció



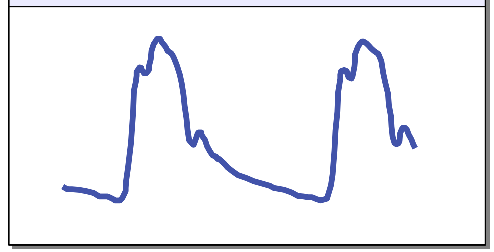
Pulzus-kontúr analízis

COMPLIANCE MEASUREMENT

Reference COa value from thermodilution



Measured blood pressure (P(t), MAP, CVP)

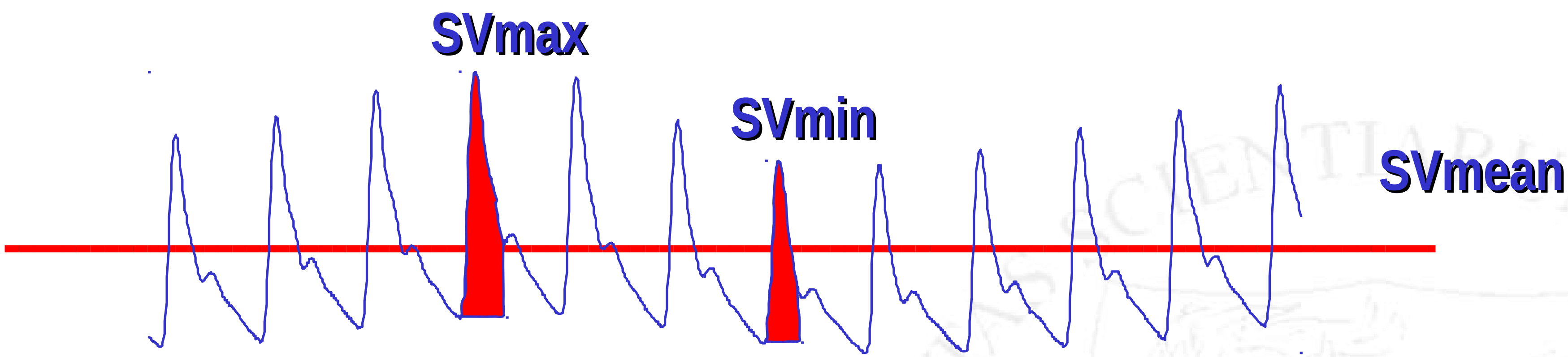


$$CO_a = cal \text{ x } A \text{ x } HR$$

Individual aortic compliance C(p)

Valsalva – pulzuskontúr analízis

IPPV = rövid Valsalva-manőverek sorozata

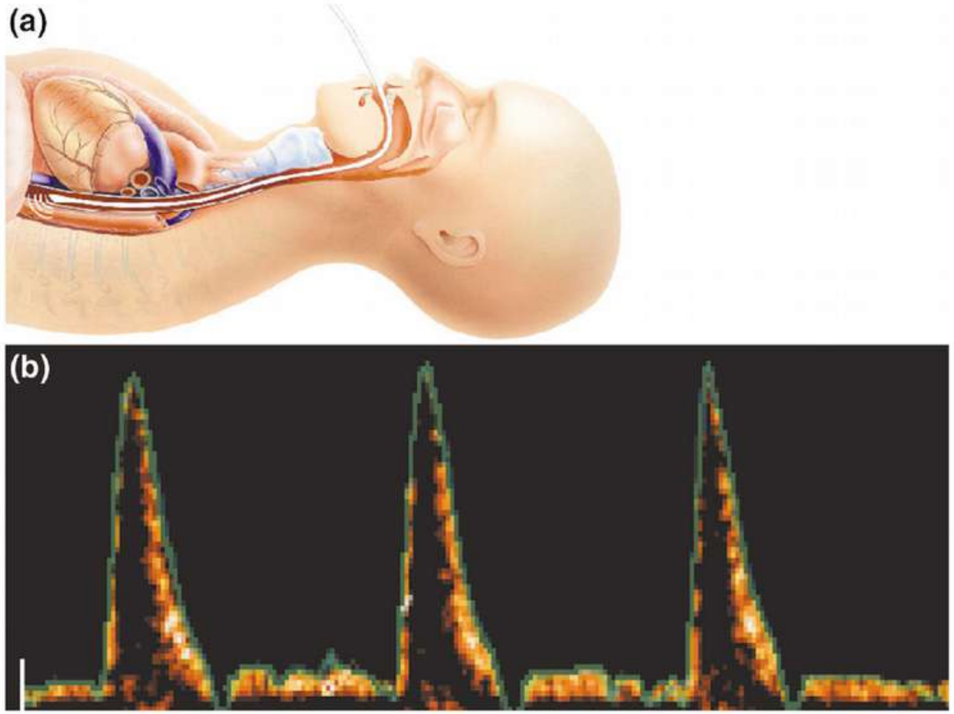


$$SVV = \frac{SVmax - SVmin}{SVmean}$$

PPV, SVV normális értéek <10%

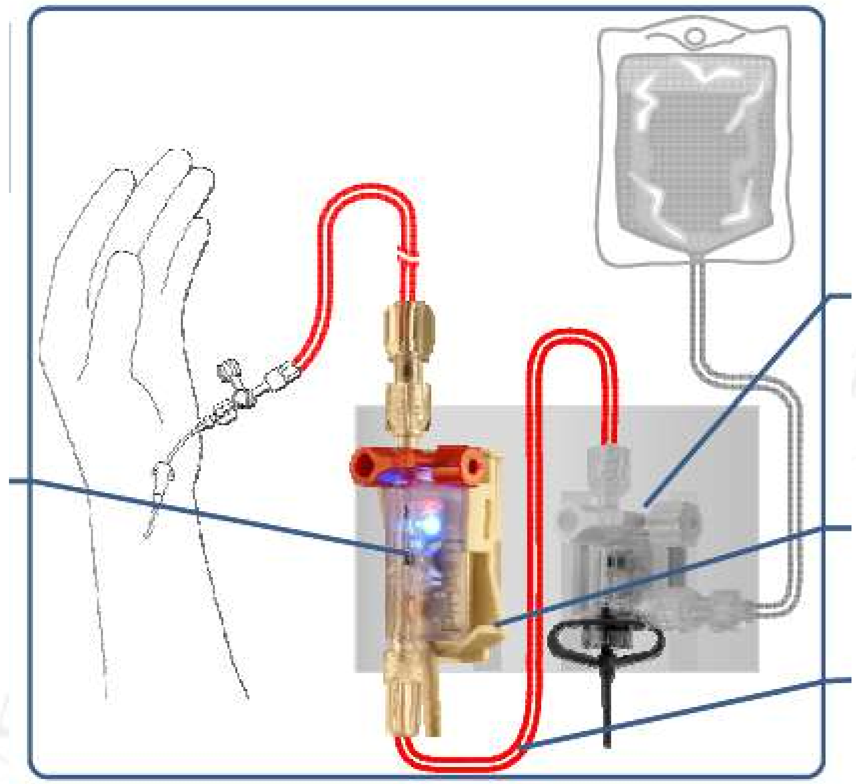
Vigileo és FloTrac

Transoesophagealis Doppler



Critical Care

PulzioFlex és ProAQT



Intraoperatív hemodinamikai optimalizálás

Effects of Intravenous Fluid Restriction on Postoperative Complications: Comparison of Two Perioperative Fluid Regimens

A Randomized Assessor-Blinded Multicenter Trial

Birgitte Brandstrup, MD, PhD, Hanne Tønnesen, MD, DMSc,* Randi Beier-Holgersen, MD,¶ Else Hjortsø, MD,‖ Helle Ørding, MD, DMSc,** Karen Lindorff-Larsen, MD,†† Morten S. Rasmussen, MD,† Charlotte Lanng, MD,‡ Lene Wallin, MD, DMSc,§ and The Danish Study Group on Periopera…*
Mette Okholm…
Birgit T…
Ann…

BJA Advance Access publish…
British Journal of Anaesthesia
doi:10.1093/bja/aen1…

Influence of systolic-pressure-variatio… m…

M. Buettne…

B…

Goal-directed hae… complications in ma…

M. T. Giglio…

Perioperative fluid volume optimization following proximal femoral fracture (Review)

Price JD, Sear JJW, Venn RRM

THE COCHRANE COLLABORATION®

ProAQT-outcome study

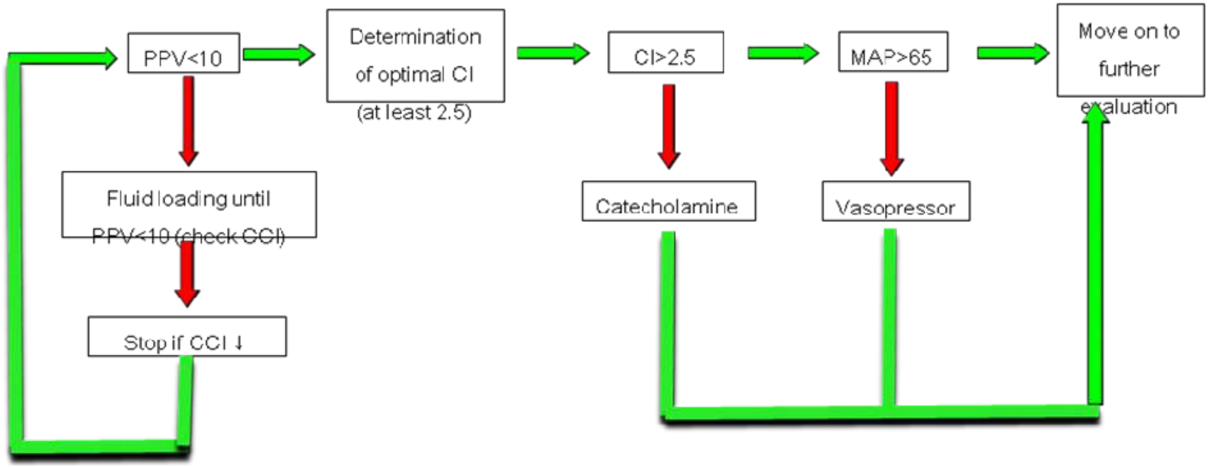
Perioperative goal-directed hemodynamic therapy based on radial arterial pulse pressure variation and continuous cardiac index trending reduces postoperative complications after major abdominal surgery.

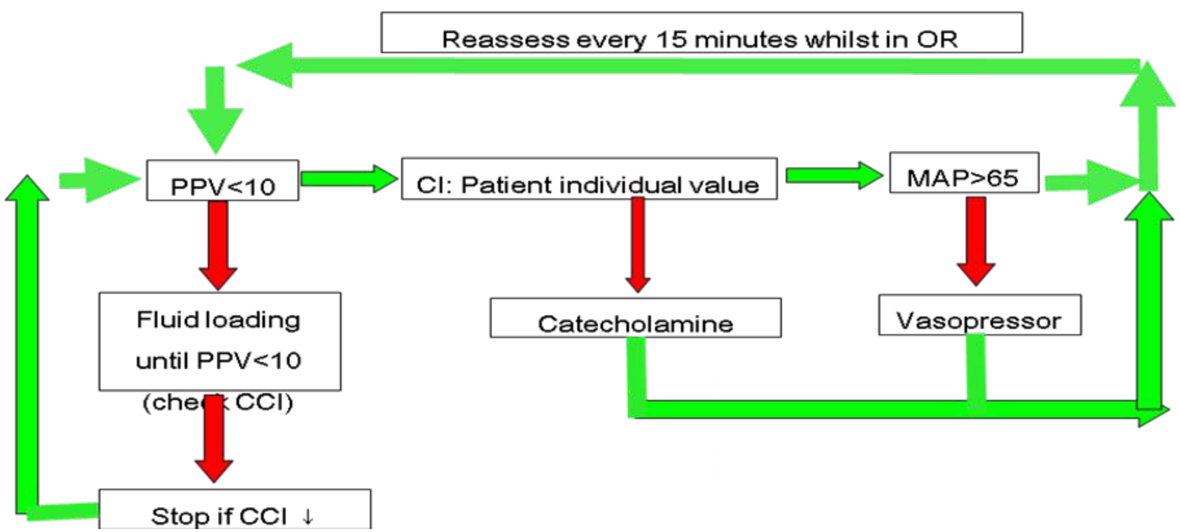
A multi-center, prospective, randomized study [NCT014001283].

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

ProAQT-outcome study

Salzwedel C, et al. *Under submission*





ProAQT-outcome study

Salzwedel C, et al. *Under submission*

Characteristics	Control group	proAQT	p-value
Number in group	58 (50%)	58 (50%)	
Age (years)	61,8 ± 14,1	63,4 ± 11,9	0,731
Male	50 (62,5%)	48 (60%)	
Type of surgery			
Hepato-biliary	12 (15%)	6 (7,5%)	
Upper gastro-intestinal	24 (30%)	24 (30%)	
Lower gastro-intestinal	13 (16,25%)	24 (30%)	
Gynecology	4 (5%)	3 (3,75%)	
Urology	19 (23,75%)	18 (22,5%)	
Other	8 (10%)	5 (6,25%)	
Height	171,8 ± 9,4	170,3 ± 9,4	0,314
Actual Body Weight	79,2 ± 18,2	77,7 ± 20,5	0,382
Predicted Body Weight	66,1 ± 10,1	64,6 ± 10,3	0,393
ASA Status 3	32 (40%)	33 (41%)	
POSSUM physiological	17,7 ± 5,4	17,4 ± 4,2	0,775
POSSUM operative	17,5 ± 6,0	16,1 ± 6,1	0,088

ProAQT-outcome study

Salzwedel C, et al. *Under submission*

Parameter	Control group	proAQT	p-value
Duration of surgery	237,4 ± 110,5	221,6 ± 88,3	0,588
Intraoperative			
Blood loss (ml)	694,4 ± 890,7	675,5 ± 678,8	0,367
Urine output (ml)	462,8 ± 476,5	415,4 ± 372,7	0,769
Crystalloids (ml)	2682,5 ± 1160,9	2847,5 ± 1224,6	0,345
Colloids (ml)	727,5 ± 724,3	782,8 ± 679,4	0,394
FFP (ml)	136,3 ± 622,3	72,8 ± 251,0	0,983
RBC (ml)	221,1 ± 1042,6	142,9 ± 369,6	0,816
Total fluid input (ml)	3767,3 ± 2845,1	3846,0 ± 1972,9	0,285
Fluid balance (ml)	2576,6 ± 2065,5	2783,4 ± 1417,0	0,128
24 hrs postoperative			
Blood loss (ml)	248,7 ± 392,1	268,8 ± 320,5	0,413
Urine output (ml)	1691,2 ± 927,8	1699,1 ± 1148,5	0,829
Crystalloids (ml)	3433,8 ± 2299,2	3191,2 ± 2157,4	0,557
Colloids (ml)	149,1 ± 309,3	55,6 ± 209,8	0,019 *
FFP (ml)	34,8 ± 191,0	0,0 ± 0,0	0,182
RBC (ml)	86,4 ± 382,4	44,0 ± 163,4	0,965
Total fluid input (ml)	3710,6 ± 2605,1	3232,5 ± 2193,9	0,370
Fluid balance (ml)	1698,0 ± 2387,1	1357,5 ± 1851,1	0,851

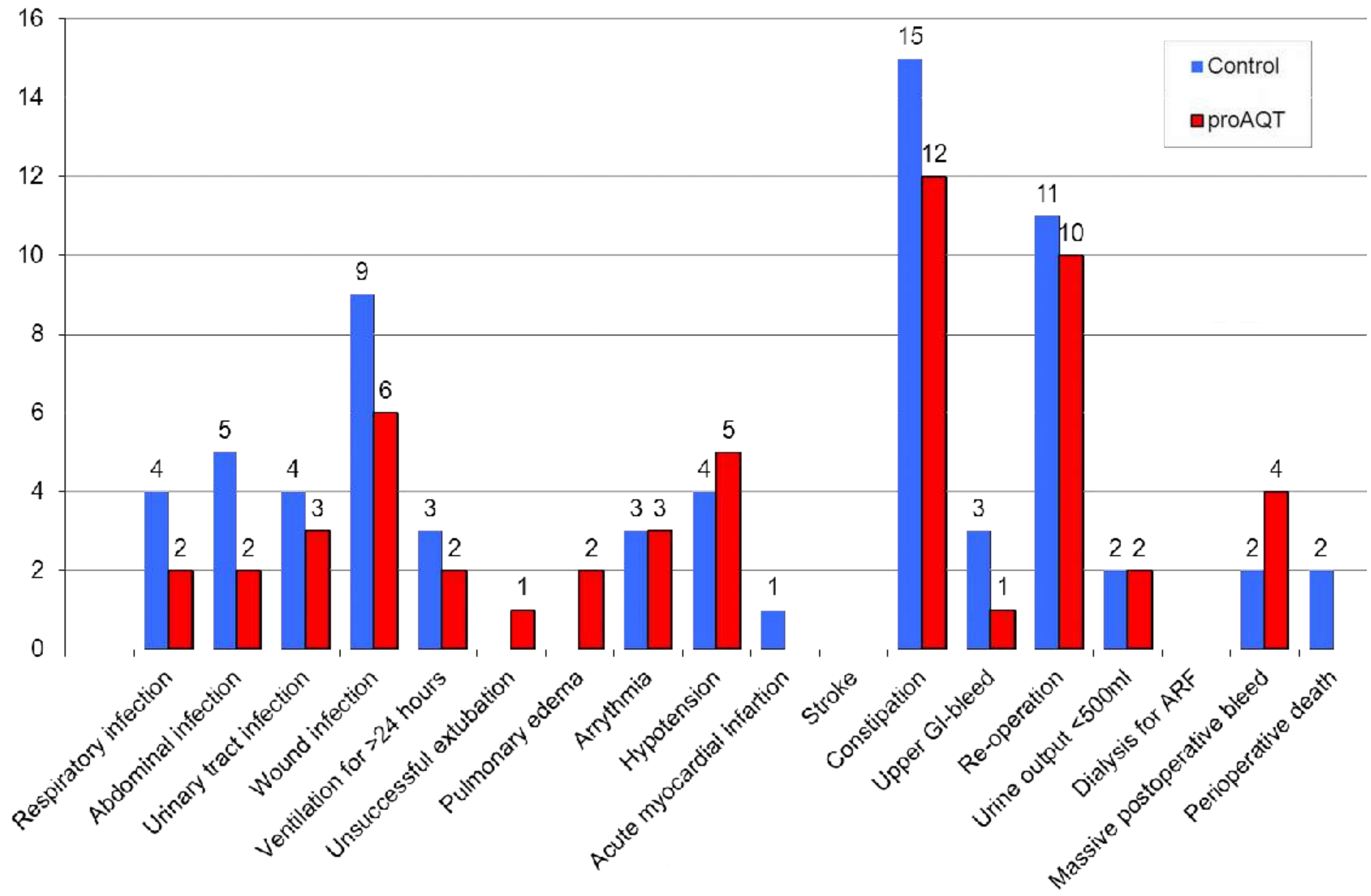
ProAQT-outcome study

Salzwedel C, et al. *Under submission*

Parameter	Control group	proAQT	p-value
Intraoperative			
Vasopressor (number of patients)	41 (51,3%)	42 (53,2%)	0,811
Catecholamine (number of patients)	1 (1,3%)	32 (40,5%)	<0,001*
24 hrs postoperative			
Vasopressor (number of patients)	9 (16,7%)	5 (9,8%)	0,306
Catecholamine (number of patients)	0 (0%)	0 (0%)	n.a.

ProAQT-outcome study

Salzwedel C, et al. *Under submission*



ProAQT-outcome study

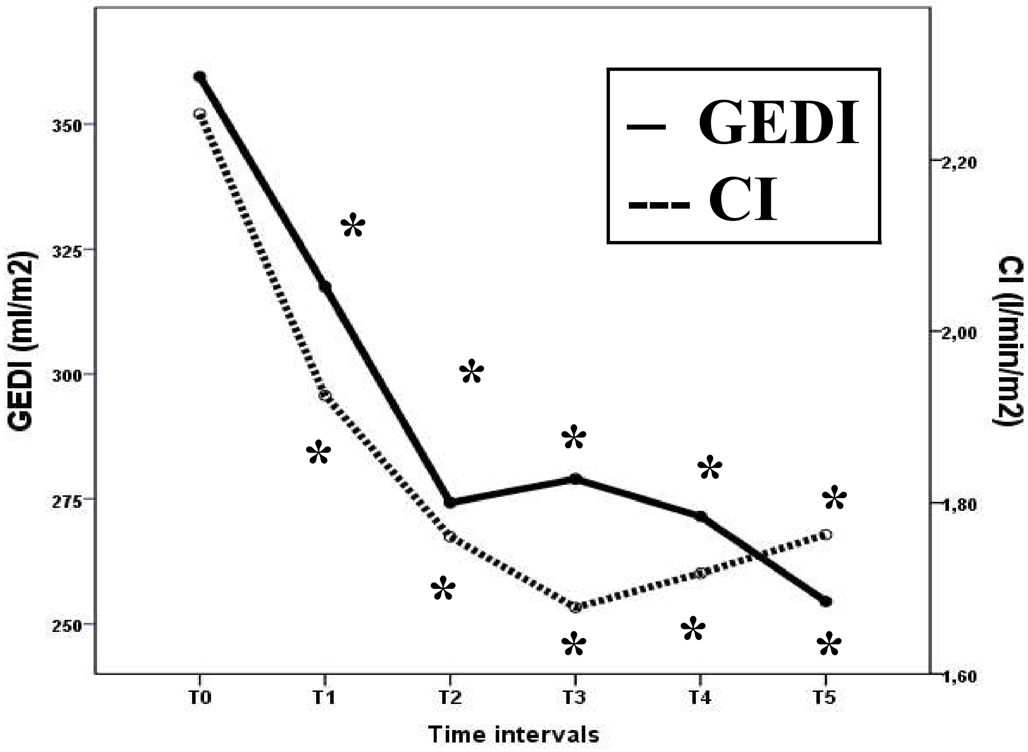
Salzwedel C, et al. *Under submission*

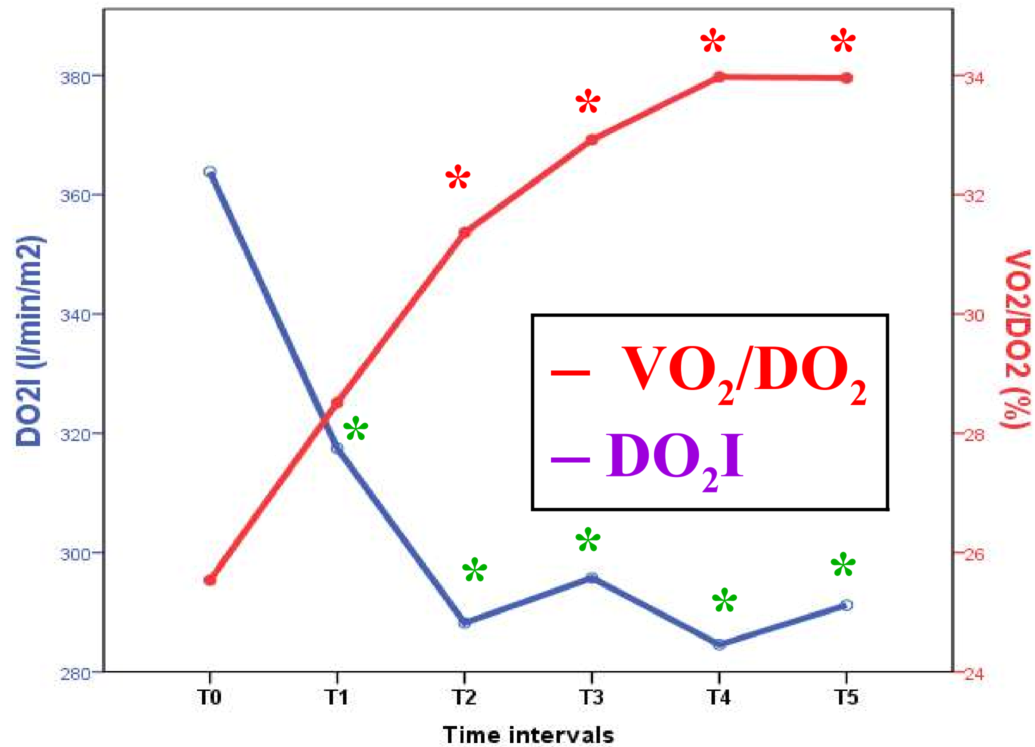
Outcome measure	**Control group**	**GDT group (proAQT)**	**p-value**
Total number of complications	68 (55,3%)	55 (44,7%)	0,033*
Total number of patients with complications	37 (48,7%)	21 (27,6%)	0,009*

Hypovolémia és oxigén adósság

Hemodinamikai változások hypovolémiában

Kocsi S, et al. *Intensive Care Med* 2011; 37(S1): S185

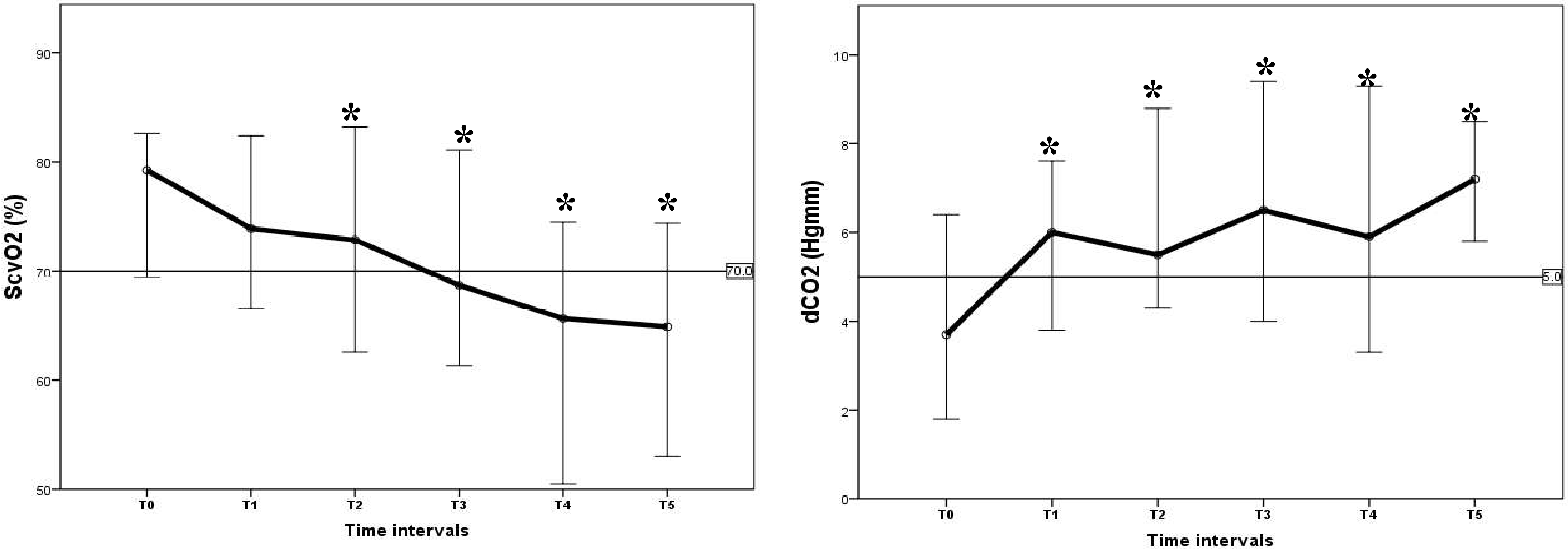




Data are presented as median, for statistical analysis repeated measures ANOVAwas used.
* $p<0.05$ as compared to T_0

$ScvO_2$ és dCO_2: T_0-T_5

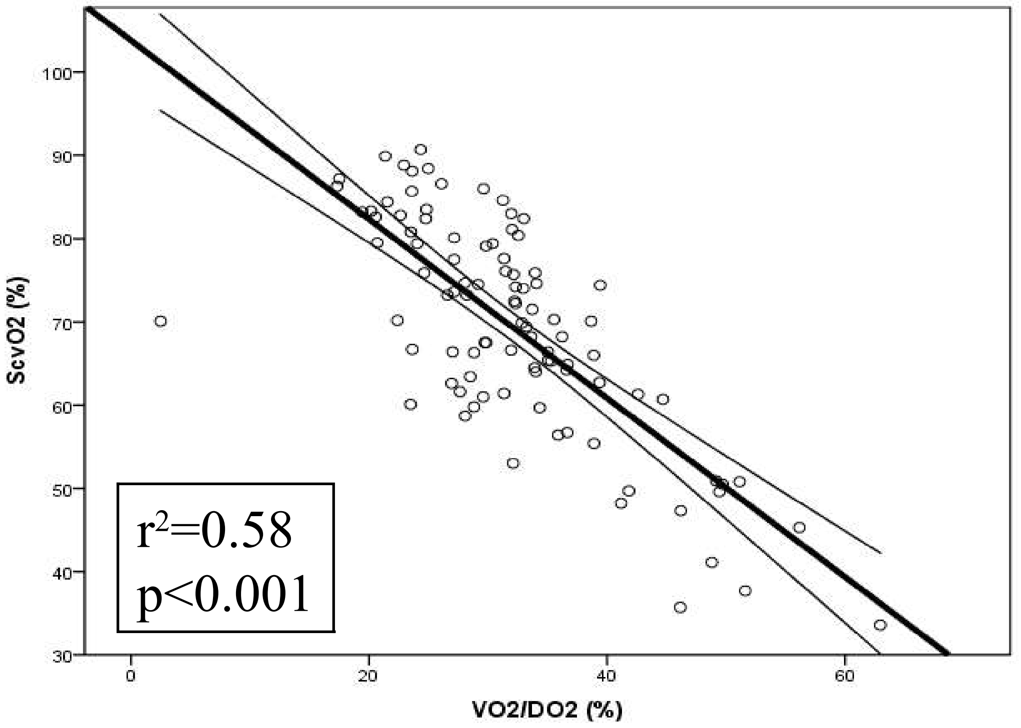
Kocsi S, et al. *Intensive Care Med* 2011; 37(S1): S185

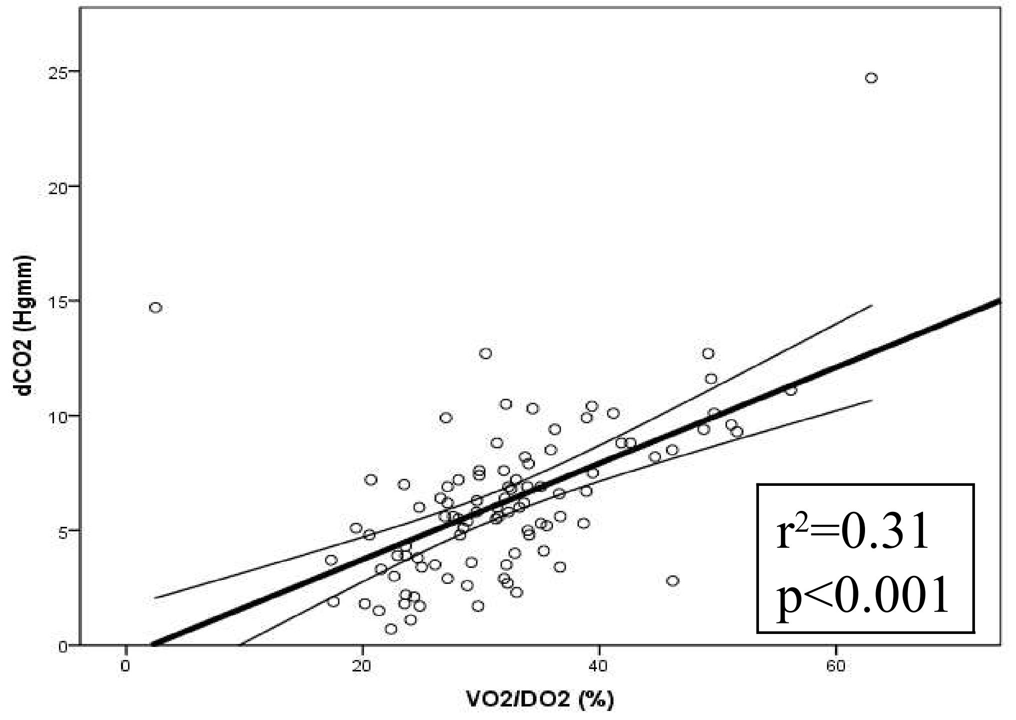


Data are presented as median and 95% CI, for statistical analysis repeated measures ANOVAwas used.
* $p<0.05$ as compared to T_0

Correlation between $ScvO_2$, dCO_2 and VO_2/DO_2

Kocsi S, et al. *Intensive Care Med* 2011; 37(S1): S185





Statistics were done with Pearson's correlation
Regression line and the means' 95% CI are shown

Hypovolémia „előrejelzés”

Kocsi S, et al. *Intensive Care Med* 2011; 37(S1): S185

	Sensitivity(%)	Specificity(%)	PPV(%)	NPV(%)
$ScvO_2$ < 73 %	78	83	91	63
CO_2-gap > 6 mmHg	71	72	85	52
$ScvO_2$ + CO_2-gap (<73%) (> 6 mmHg)	58	100	100	72

Transzfúzió

Kérdések

- Transzfúzió
  - Nem veszélytelen, sőt…
  - Drága
  - „Hiánycikk”
  - Restriktív szemlélet
    - Posztreszuszcitációs cél Hb = 7-10 g/dl

Garder C, et al. *Scand J Surg* 2008; 97: 15-36

- Miért adunk vért?
- Miért a Hb, miért nem a Htk?
- Elég ennyi?

Válaszok

- Miért adunk vért?
  - Cél: a megfelelő szöveti oxigenizáció fenntartása

Vallet B, et al, Crit Care; 2010: 14: 213

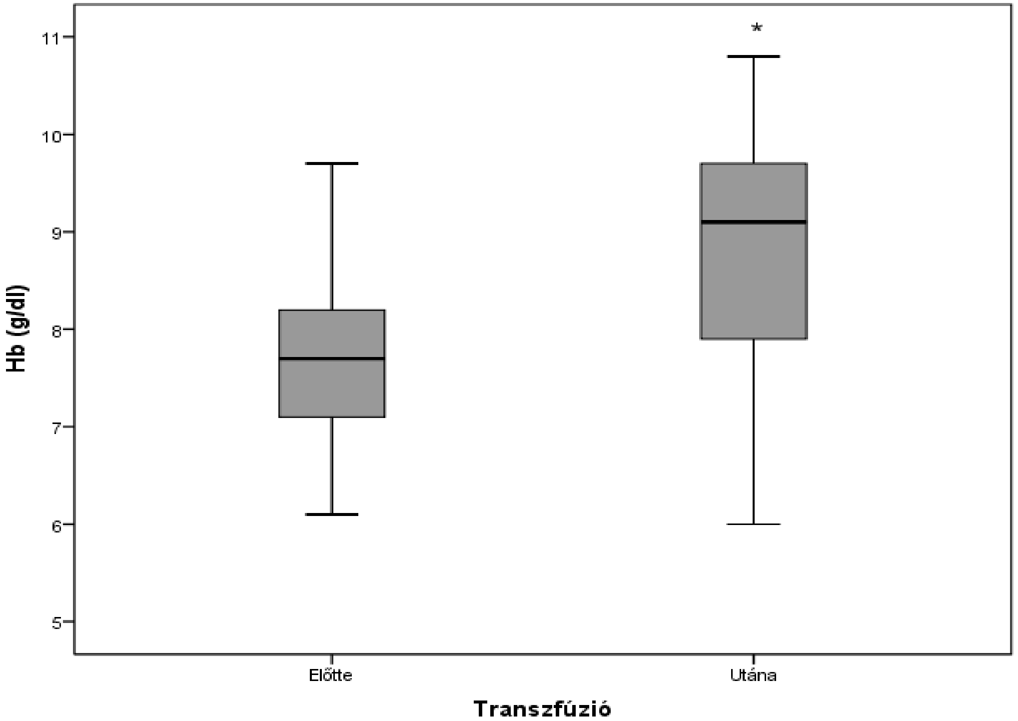
- Miért a Hb, miért nem a Htk?
  - DO_2-t a Hb befolyásolja és nem a Htk
- Elég a Hb és az anamnézis?
  - Alkalmazzunk oxigénadósságot jelző mutatókat?

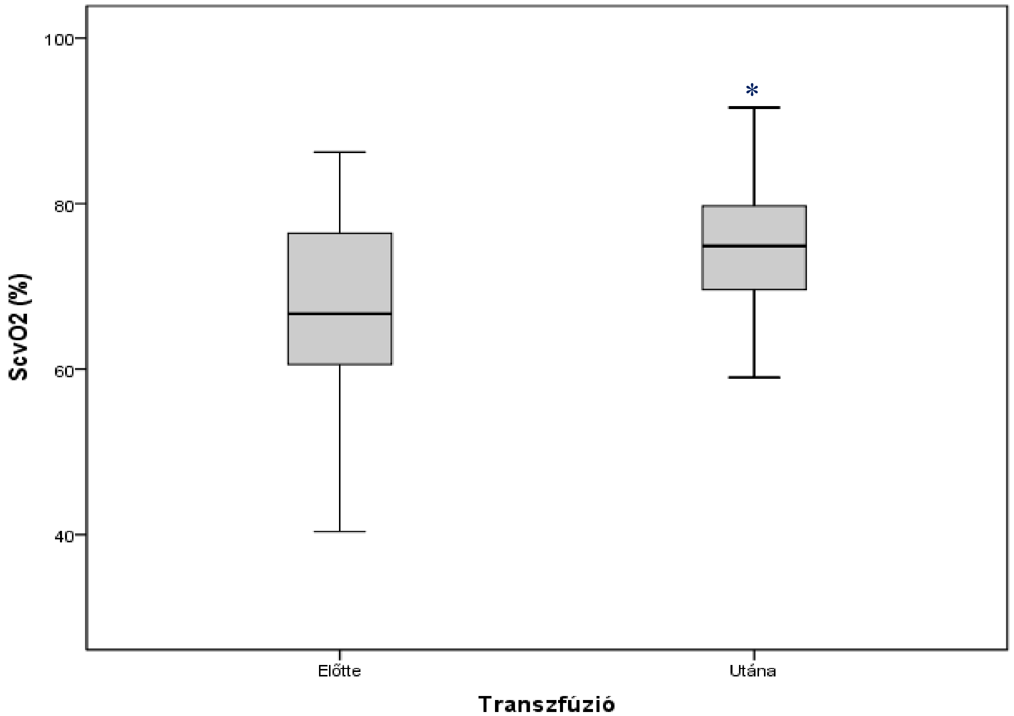
$ScvO_2$

$ScvO_2$ – transzfúzió

Kocsi S, et al. *Intensive Care Med* 2010; 36(S2): S351

41 beteg: 198 transzfúziós eseményének retrospektív elemzése





Az adatokat mint medián és interkvartilis tartomány ábrázoltuk
*p<0,01 Wilcoxon tesztel

Teljes minta medián $ScvO_2$ = 71%

$ScvO_2$ – transzfúzió

Kocsi S, et al. *Intensive Care Med* 2010; 36(S2): S351

$ScvO_2$ <71% = oxigén adósság
$ScvO_2$ ≥71% = nincs oxigén adósság

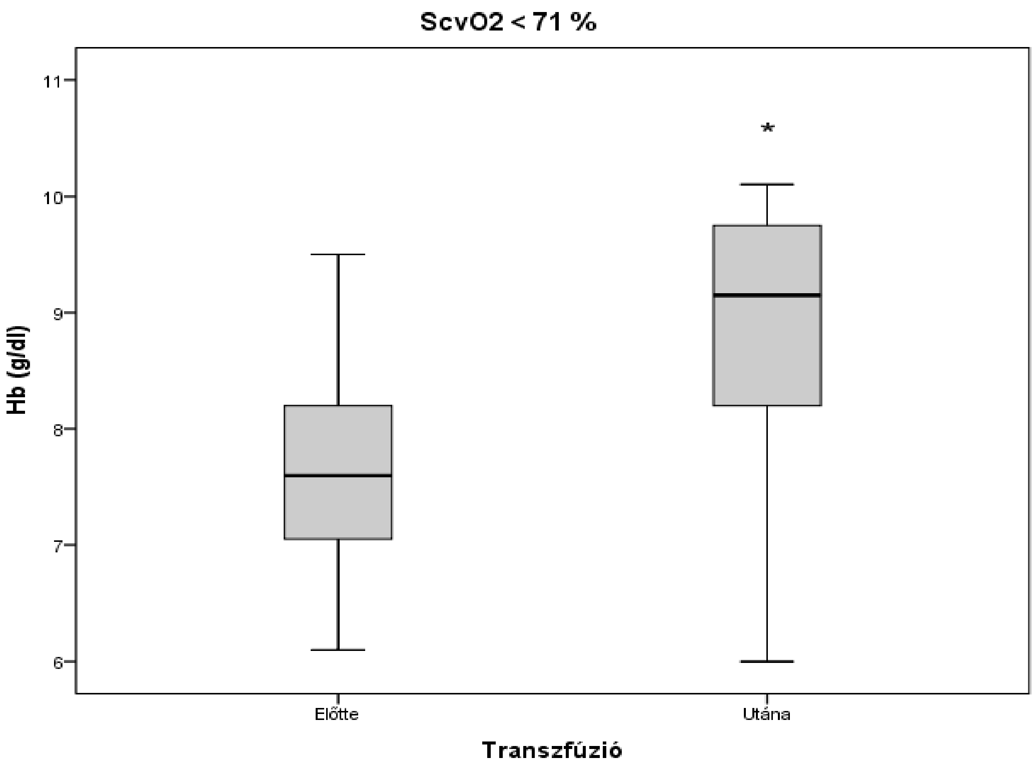
Hemodinamikai paraméterek a transzfúzió előtt

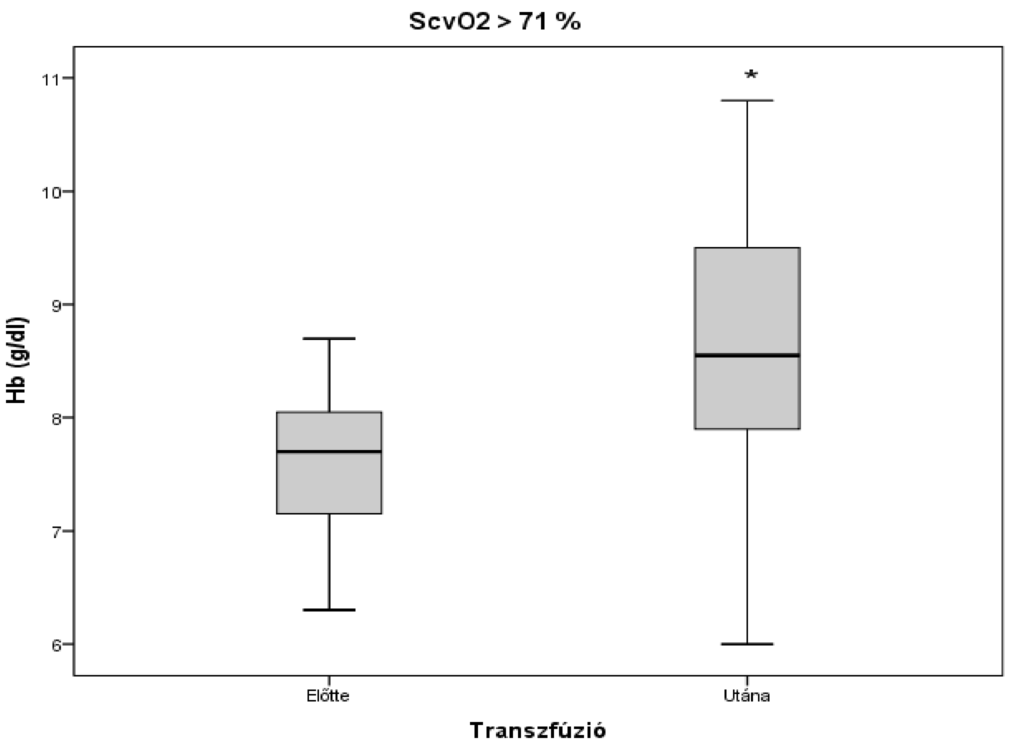
	$ScvO_2$ < 71 (n = 27)	**$ScvO_2$** ≥71 (n = 23)	**p**
Pulzusszám (/perc)	90 (80-120)	100 (89-110)	0,981
MAP (Hgmm)	75 (69-91)	80 (72-90)	0,724
Se laktát (mmol/l)	1,4 (0,9-3,4)	0,9 (0,6-1,3)	0,072
CVP (Hgmm)	10 (8-11)	8 (4-10)	0,041

Az adatokat mint medián és interkvartilis tartomány ábrázoltuk
*p<0,01 Wilcoxon teszttel

$ScvO_2$ – transzfúzió

Kocsi S, et al. *Intensive Care Med* 2010; 36(S2): S351

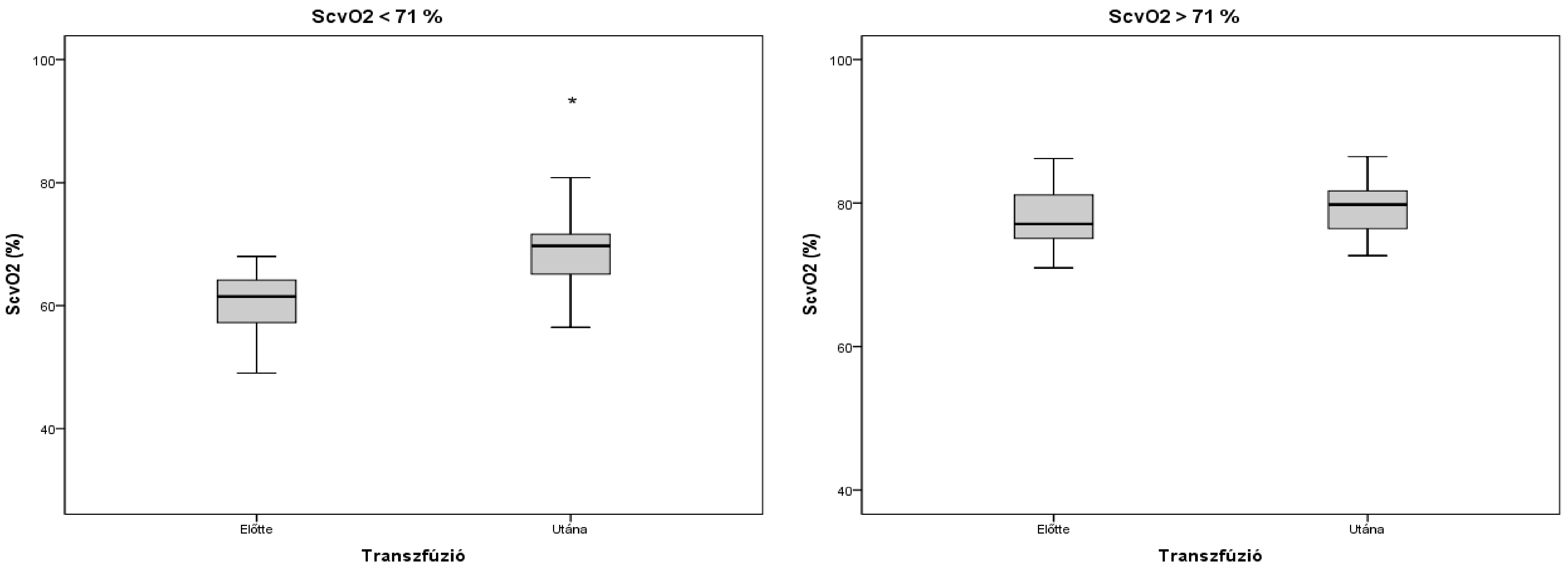




Az adatokat mint medián és interkvartilis tartomány ábrázoltuk
*p<0,01 Wilcoxon tesztel

$ScvO_2$ – transzfúzió

Kocsi S, et al. *Intensive Care Med* 2010; 36(S2): S351

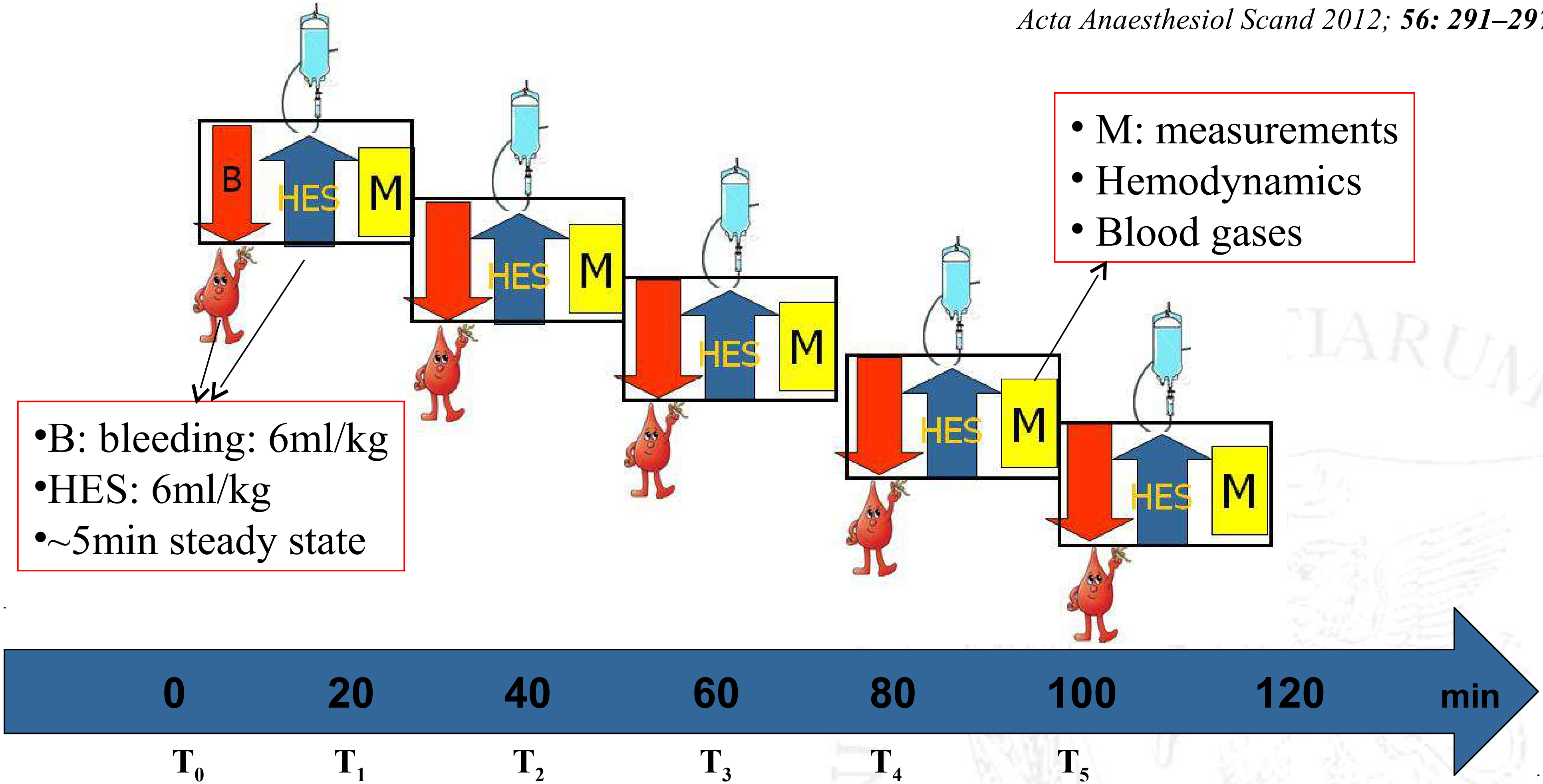


Az adatokat mint medián és interkvartilis tartomány ábrázoltuk
*p<0,01 Wilcoxon teszttel

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***



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]	3.0 (2.6–3.4)
HR (beats/min)	125	[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)	700 (540–985)*	800 (570–1075)*	810 (540–1480)*	880 (560–1360)*	975 (562–1275)*

Decrease by 60%

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***

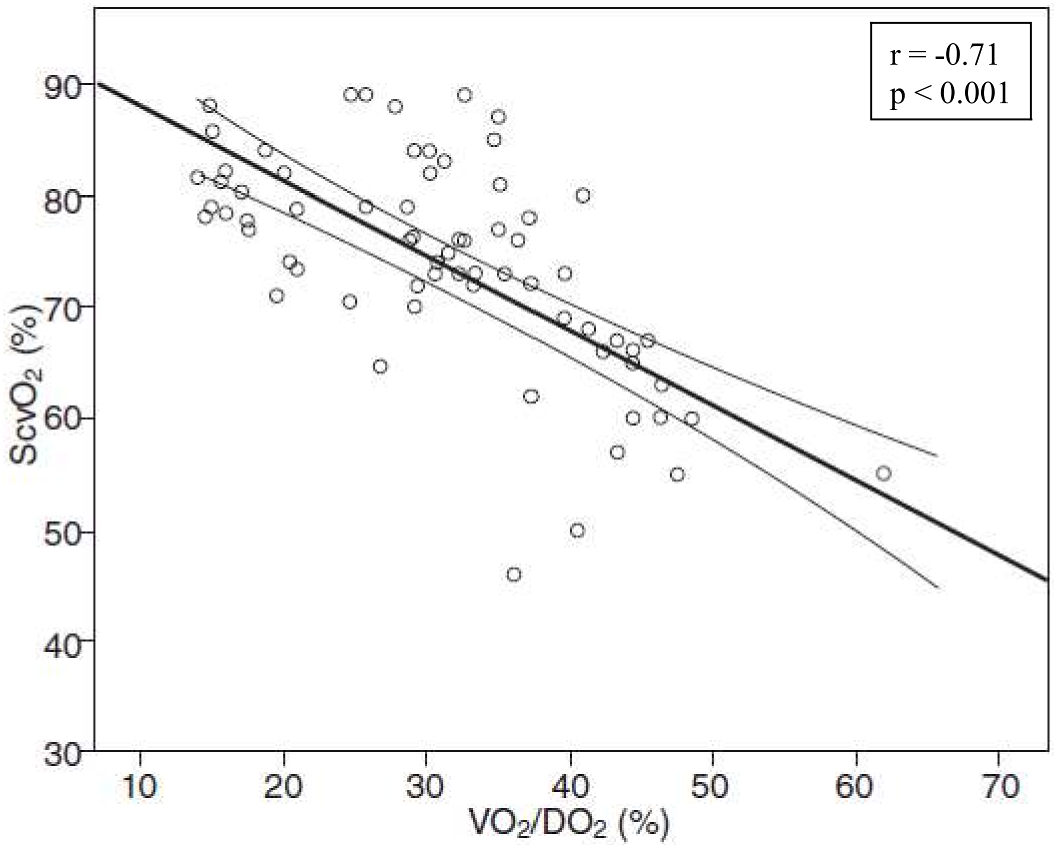
Effects of isovolemic anemia on oxygen balance.

	T_0	T_1	T_2	T_3	T_4	T_5
SaO_2 (%)	95 (92–97)	96 (94–97)	96 (95–97)	96 (95–97)	97 (97–97)	97 (97–97)
DO_2 (ml/min/m2)	431 (362–474)	438 (323–524)	378 (302–412)*†	344 (252–376)*	284 (236–333)*	247 (216–292)*†
VO_2 (ml/min/m2)	119 (82–139)	130 (77–151)	93 (66–136)	113 (67–141)	98 (72–120)	105 (70–120)
VO_2/DO_2 (%)	29 (18–33)	29 (17–33)	29 (18–32)	35 (21–40)*	37 (26–43)*	41 (27–47)*
ERO_2 (%)	19 (13–26)	19 (14–24)	20 (14–22)	21 (16–28)	30 (22–37)*	32 (21–39)*
SvO_2 (%)	68 (64–77)	67 (64–77)	68 (63–79)	64 (58–76)	62 (55–72)*	58 (52–72)*
$ScvO_2$ (%)	76 (69–83)	73 (72 (82)	77 (75–83)	77 (68–81)	68 (61–76)*	66 (60–76)*
Lactate (mmol/l)	4.5 (3.2–5.3)	4.2 (3.0–5.1)	5.0 (3.2–6.0)	4.1 (2.9–6.0)	4.2 (2.9–6.5)	4.0 (3.0–6.4)
pH	7.44 (7.40–7.50)	7.43 (7.40–7.50)	7.43 (7.41–7.50)	7.43 (7.39–7.49)	7.44 (7.42–7.49)	7.44 (7.40–7.47)
PaO_2 (mm Hg)	76 (66–80)	75 (72–80)	76 (73–80)	77 (72–82)	79 (75–85)*	81 (77–90)*
(kPa)	10.1 (8.8–10.7)	10.0 (9.6–10.7)	10.1 (9.7–10.7)	10.3 (9.6–10.9)	10.5 (10.0–11.3)	10.8 (10.3–12.0)
$PaCO_2$ (mm Hg)	39 (35–44)	38 (35–43)	37 (34–45)	39 (34–46)	37 (34–42)	38 (35–41)
(kPa)	5.2 (4.7–5.9)	5.1 (4.7–5.7)	4.9 (4.5–6.0)	5.2 (4.5–6.1)	4.9 (4.5–5.6)	5.1 (4.7–5.5)
$aHCO_3$ (mmol/l)	25 (24–27)	24 (24–26)	25 (23–27)	25 (23–27)	25 (22–27)	25 (21–25)
aBE (mmol/l)	0.90 (–0.05–2.50)	0.40 (–0.85–2.25)	0.60 (–0.9–2.45)	0.80 (–0.45–3.15)	0.90 (–1.45–2.35)	0.70 (0.43–1.08)

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***



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***

- At Hb=59 g/l, $ScvO_2$ ~ 70%
- „Textbook critical" values of Hb: 70-90 g/l are insufficient in every patient
- We should know more than this!
- Treat physiological transfusion triggers not guideline figures

Treat the triggers not the figures!®

Összefoglalás

- Élettani, fizikai alapok
- Olvassuk el mi van cimkén!
- Fiziológiás végpontok – számok helyett – individuális kezelés
- Cave: „Bubuc medicína”

Prof. Tekeres Miklós

- „Fiz. só” = mítosz

A diagnózis ráér, de a sejtek türelme véges!