SEPTICKÝ ŠOK

Jsou bolusy tekutin „the right way“ ?

Roman Kula, KARIM FN Ostrava

AKUTNE.CZ®

Tekutiny jsou FAJN …

Tekutiny jsou FAJN …

… nejčastější léčebná intervence na ICU

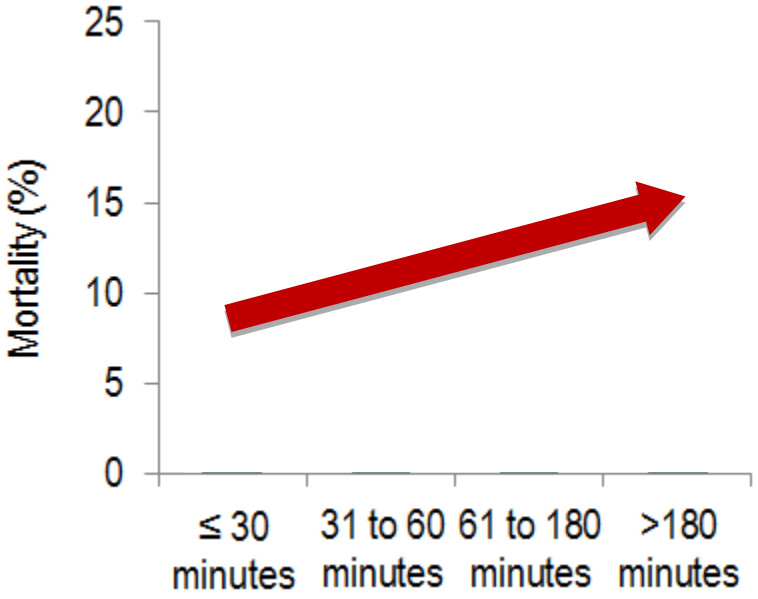
… kauzální léčebná intervence u hypovolémie/hypovolemického šoku

Tekutiny u SS jsou FAJN …

Association of Fluid Resuscitation Initiation Within 30 Minutes of Severe Sepsis and Septic Shock Recognition With Reduced Mortality and Length of Stay

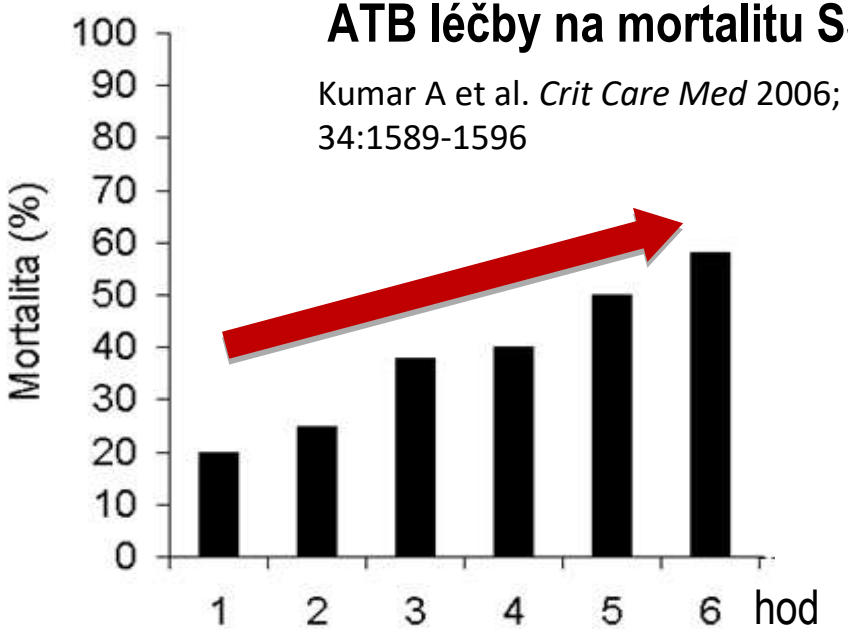
Leisman D et al., *Ann Emerg Med*. 2016;68:298-311

Vliv zpoždění v zahájení



ATB léčby na mortalitu SS

Kumar A et al. *Crit Care Med* 2006; 34:1589-1596



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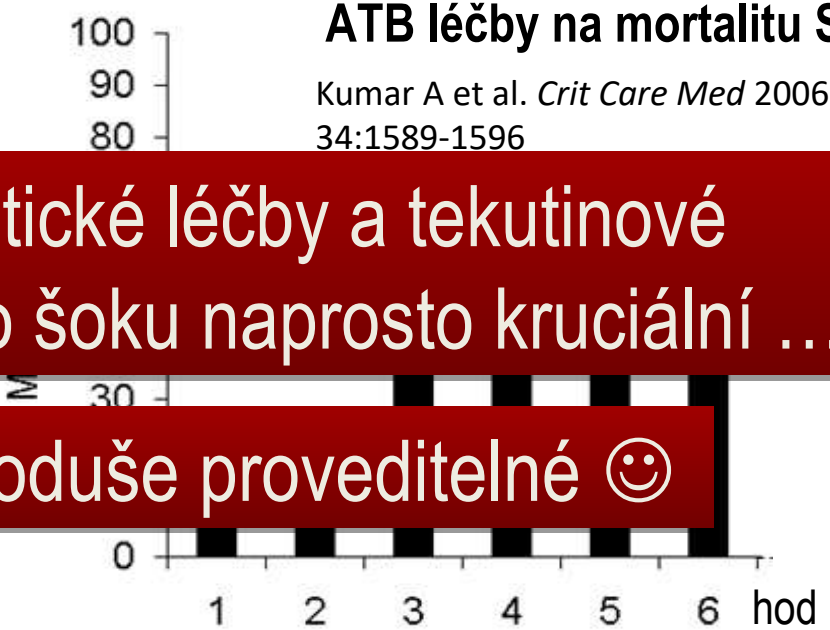

Časné zahájení antibiotické léčby a tekutinové resuscitace je u septického šoku naprosto kruciální …

… a v praxi také jednoduše proveditelné ☺

Tekutiny u SS jsou FAJN, ALE …

Fluid overload … rok 2000

Fluid overload … rok 2000

CHEST 2000; 117:1749–1754

critical care review

Negative Fluid Balance Predicts Survival in Patients With Septic Shock*

A Retrospective Pilot Study

Fadi Alsous, MD; Mohammad Khamiees, MD; Angela DeGirolamo, MD; Yaw Amoateng-Adjepong, MD, PhD; and Constantine A. Manthous, MD, FCCP

Conclusion: These results suggest that at least 1 day of negative fluid balance achieved by the third day of treatment may be a good independent predictor of survival in patients with septic shock.

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Fluid overload … rok 2000

CHEST 1998; 114:854–860

Reviews

The Hemodynamic Derangements in Sepsis*

Implications for Treatment Strategies

Paul E. Marik, MD, FCCP; and Joseph Varon, MD, FCCP

„Aggressive volume resuscitation is considered the best initial therapy for the cardiovascular instability of sepsis. Hypotension can often be reversed with fluid administration alone. Fluid requirements for the initial resuscitation of patients with septic shock are frequently large, with up to 10 L of crystalloid or 4 L of colloid being required in the first 24 hours“.

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X

CHEST 2000; 117:1535 - 6

critical care review

Fluid Balance in Sepsis

Are We Ready for a Negative Balance?

Varon J, Fromm RE Jr.

Fluid overload … rok 2000

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Crit Care. 2000; 4(Suppl 1): P19.
Published online 2000 Mar 21. doi: 10.1186/cc739
PMCID: PMC3332943

The clinical relevance of the fluid balance in critically ill patients

I Petrašovicová,[1] P Sklienka,[1] L Kolár,[1] J Jahoda,[1] and R Kula[1]

NONSURVIVORS (n=47)		**SURVIVORS** (n=70)
1580 ± 1900 ml	$p < 0.05$	**520** ± 1480 ml

In the nonsurvivors group a **much more positive fluid balance was found within the interval from 3rd until 13th day of ICU stay** …

Fluid overload … rok 2000

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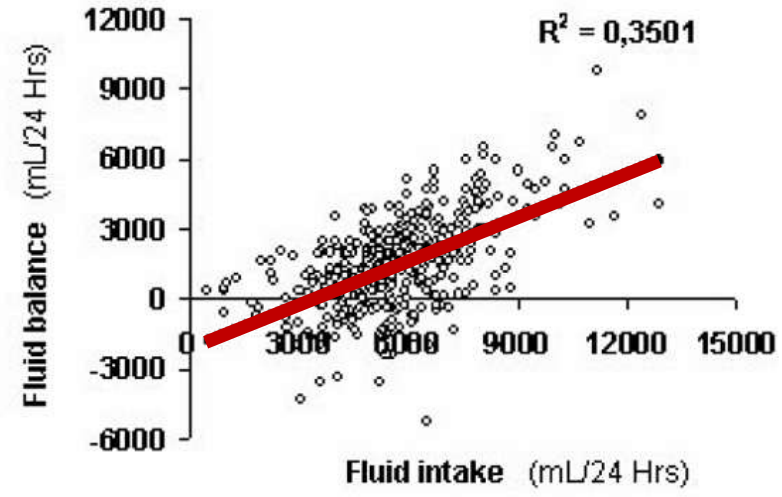
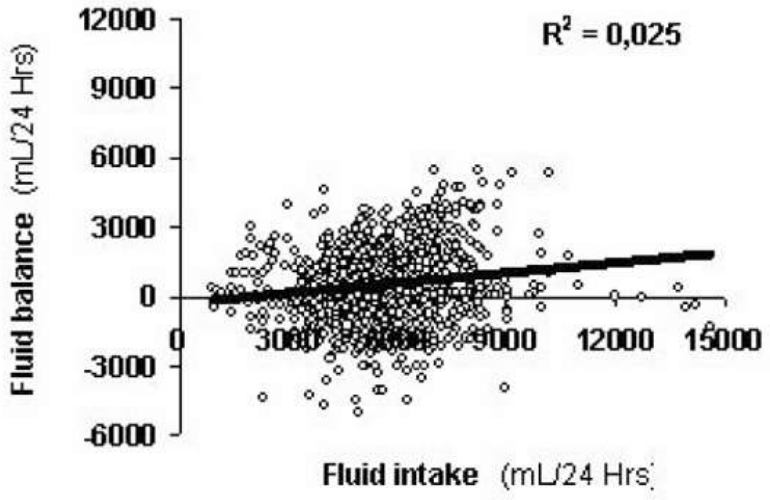


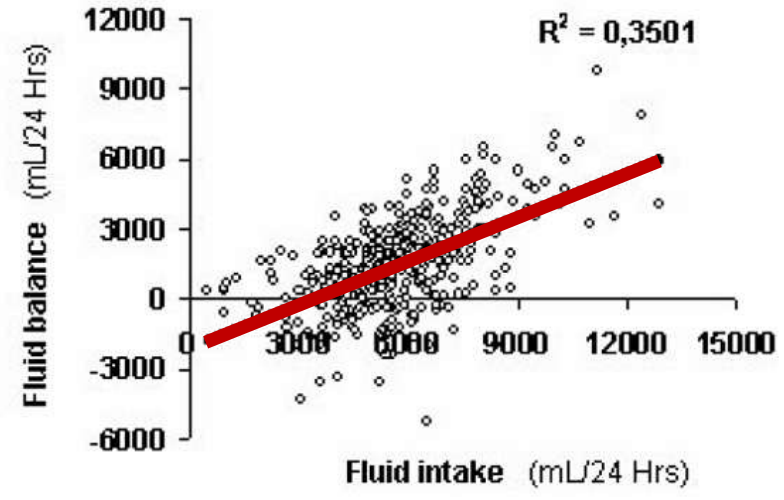
SURVIVORS



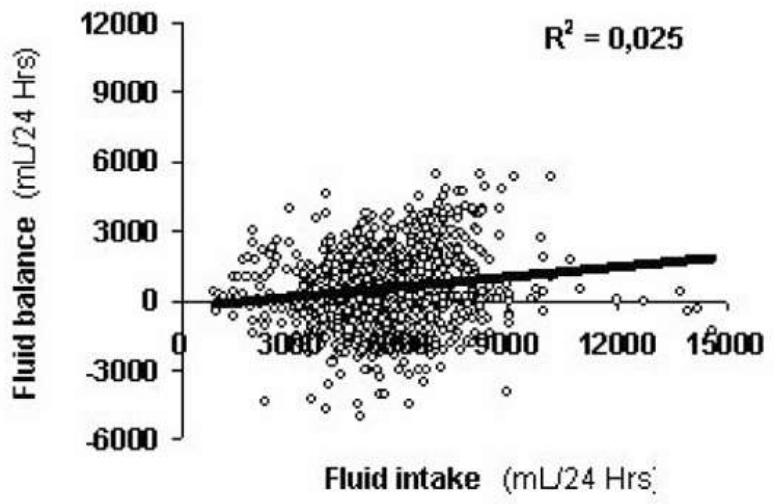
Fluid overload … rok 2000

Conclusion: In the nonsurvivors group a much more positive fluid balance was found within the interval from 3rd until 13th day of ICU stay, together with increasing extent of the organ dysfunction. The stronger correlation between fluid intake and fluid balance in nonsurviving patients compared to survivors points to the need for careful fluid management in critically ill patients, especially in those with an intensive inflammatory response.

NONSURVIVORS (CRP 125±62)



SURVIVORS (CRP 92±60)



Fluid overload … rok 2000

toto není šťastný pacient …!

Fluid overload … rok 2000

toto JE šťastný pacient ...!

otoky jsou pouze kozmetický problém :-(

Fluid overload … rok 2006

Sepsis in European intensive care units: Results of the SOAP study*

Jean-Louis Vincent, MD, PhD, FCCM; Yasser Sakr, MB, BCh, MSc; Charles L. Sprung, MD; V. Marco Ranieri, MD; Konrad Reinhart, MD, PhD; Herwig Gerlach, MD, PhD; Rui Moreno, MD, PhD; Jean Carlet, MD, PhD; Jean-Roger Le Gall, MD; Didier Payen, MD; on behalf of the Sepsis Occurrence in Acutely Ill Patients Investigators

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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
Cumulative fluid balance during first 72 hours		
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

2. místo

Fluid overload … rok 2006

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Discussion

… this is a new finding that raises the hypothesis that reducing fluid balance may result in better outcomes from sepsis, and this needs further investigation.

Fluid overload … od roku 2006 -

Fluid overload … od roku 2006 -

Uchino S et al. *Crit Care* 2006;10:R174

Wiedemann HP et al. *NEJM* 2006;354:2564-75

Arlati S. *et al. Resuscitation* 2007; 72:371-78

Payen D et al. *Crit Care* 2008;12:R74.

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McArdle GT et al. *Ann Surg* 2009; 250:28-34

Bouchard J et al. *Kidney Int* 2009;76:422-27

Rosenberg AL et al. *J Intensive Care Med* 2009, 24:35-46

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de Almeida et al. *Acta Anaesthesiol Scand* 2012;56:712-7

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- Pozitivní tekutinová bilance je spojená s horší prognózou

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- Pozitivní tekutinová bilance je spojená s horší prognózou
- Pozitivní tekutinová bilance je nezávislým prediktorem mortality

Fluid overload … a dekongesce

SHOCK, Vol. 43, No. 1, pp. 68–73, 2015

FLUID OVERLOAD IN PATIENTS WITH SEVERE SEPSIS AND SEPTIC SHOCK TREATED WITH EARLY GOAL-DIRECTED THERAPY IS ASSOCIATED WITH INCREASED ACUTE NEED FOR FLUID-RELATED MEDICAL INTERVENTIONS AND HOSPITAL DEATH

Diana J. Kelm,*† Jared T. Perrin,* Rodrigo Cartin-Ceba,*† Ognjen Gajic,*†
Louis Schenck,‡ and Cassie C. Kennedy*†

… přesto, že metody dekongesce u „přelitých“ pacientů aplikujeme, **je jejich mortalita vyšší**, než u pacientu „nepřelitých“ !

Fluid overload … a prevence

REVIEW

Curr Opin Crit Care 2015, 21:315–321

CURRENT OPINION

How to avoid fluid overload

Ogbonna C. Ogbu[a,b], *David J. Murphy*[a,b,c], *and Greg S. Martin*[a,b,c]

Purpose of review
This review highlights the recent evidence describing the outcomes associated with fluid overload in critically ill patients and provides an overview of fluid management strategies aimed at preventing fluid overload during the resuscitation of patients with shock.

Recent findings
Fluid overload is a common complication of fluid resuscitation and is associated with increased hospital costs, morbidity and mortality.

Summary
Fluid management goals differ during the resuscitation, optimization, stabilization and evacuation phases of fluid resuscitation. To prevent fluid overload, strategies that reduce excessive fluid infusions and emphasize the removal of accumulated fluids should be implemented.

Keywords
fluid overload, fluid resuscitation, shock

Fluid overload … a prevence

SEVEN-DAY PROFILE PUBLICATION

Intensive Care Med (2015) 41:1529–1537
DOI 10.1007/s00134-015-3850-x

CrossMark

Fluid challenges in intensive care: the FENICE study

A global inception cohort study

Cecconi M et al

ORIGINAL

Intensive Care Med (2015) 41:248–256
DOI 10.1007/s00134-014-3576-1

Volume expansion in the first 4 days of shock: a prospective multicentre study in 19 French intensive care units

Boulain T et al

Fluid overload … a prevence

SEVEN-DAY PROFILE PUBLICATION

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CrossMark

Fluid challenges in intensive care: the FENICE study

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Cecconi M et al

Fluid BOLUS Therapy …

Agresivní léčba …

Agresivní léčba …

… snaha o rychlou korekci život ohrožující odchylky homeostázy je na ICU běžná praxe

AKUTNÍ respirační selhání

… hypoxemie ($paO2 = 6$ kPa)

… hyperkapnie ($paCO2 = 11$ kPa)

… $pH < 7.3.$, $BE = -10$ (MAC+RAC)

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Tracheální intubace a UPV s cílem AGRESIVNÍ úpravy krevních plynů do normálního pásma

Agresivní léčba …

… snaha o rychlou korekci život ohrožující odchylky homeostázy je na ICU běžná praxe

CHRONICKÉ respirační selhání

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CHRONICKÉ respirační selhání

… hypoxemie (paO2 = 6 kPa)

… hyperkapnie (paCO2 = 11 kPa, RAC)

… pH < 7.3., **BE = + 11** (**metabolická kompenzace** RAC)

Tracheální intubace a UPV s cílem OPATRNÉ úpravy CO2 tak, aby se pH nedostalo na „alkalickou stranu“

Agresivní léčba …

… snaha o rychlou korekci život ohrožující odchylky homeostázy je na ICU běžná praxe

Agresivní léčba tekutinami …

… experiment - **hemoragický šok**

SHOCK, Vol. 18, No. 3, pp. 242–247, 2002

DETRIMENTAL EFFECTS OF RAPID FLUID RESUSCITATION ON HEPATOCELLULAR FUNCTION AND SURVIVAL AFTER HEMORRHAGIC SHOCK

Kaushal J. Shah, William C. Chiu, Thomas M. Scalea, and Drew E. Carlson

Department of Surgery and Program in Trauma, R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Baltimore, Maryland 21201

Agresivní léčba tekutinami …

… experiment - **hemoragický šok**

- experiment (potkany)

Shah KJ et al., *Shock* 2002., 18:242-247

RK2005

Agresivní léčba tekutinami …

… experiment - **hemoragický šok**

- experiment (potkany)
- fáza krvácania: 33-36 ml/kg/2.5 hod

Shah KJ et al., *Shock* 2002., 18:242-247

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Agresivní léčba tekutinami …

… experiment - **hemoragický šok**

- experiment (potkany)
- fáza krvácania: 33-36 ml/kg/2.5 hod
- fáza hypovolémie: 150 min

Shah KJ et al., *Shock* 2002., 18:242-247

RK2005

Agresivní léčba tekutinami …

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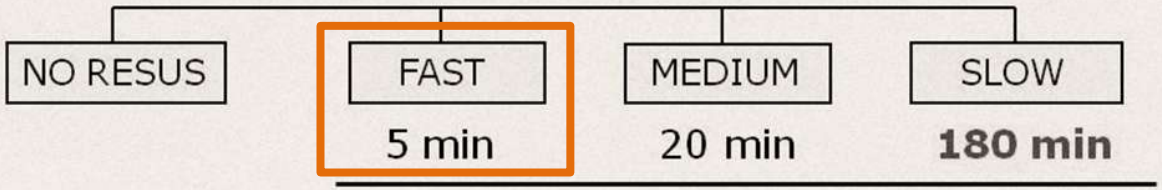
- fáza hypovolémie: **150 min**
- fáza objemovej resuscitácie:



BOLUS Ringer laktát o objeme = 3x krvná strata

Shah KJ et al., *Shock* 2002., 18:242-247

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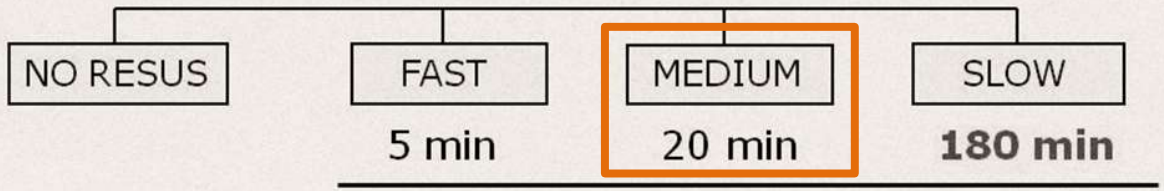

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- experiment (potkany)
- fáza krvácania: 33-36 ml/kg/2.5 hod
- fáza hypovolémie: **150 min**
- fáza objemovej resuscitácie:

NO RESUS	FAST	MEDIUM	SLOW
	5 min	20 min	**180 min**

BOLUS Ringer laktát o objeme = 3x krvná strata

Shah KJ et al., *Shock* 2002., 18:242-247

RK2005

Agresivní léčba tekutinami …

… experiment - **hemoragický šok**

Příčina úmrtí ve FAST group – **kardiovaskulární kolaps**

- experiment (potkany)
- fáza krvácania: 33-36 ml/kg/2.5 hod
- fáza hypovolémie: 150 min
- **PREŽÍVANIE** (po 72 hodinách., $p<0.05$)

Shah KJ et al., *Shock* 2002., 18:242-247

RK2005

Agresivní léčba tekutinami …

… experiment - **septický šok**

SHOCK, Vol. 18, No. 3, pp. 242–247, 2002

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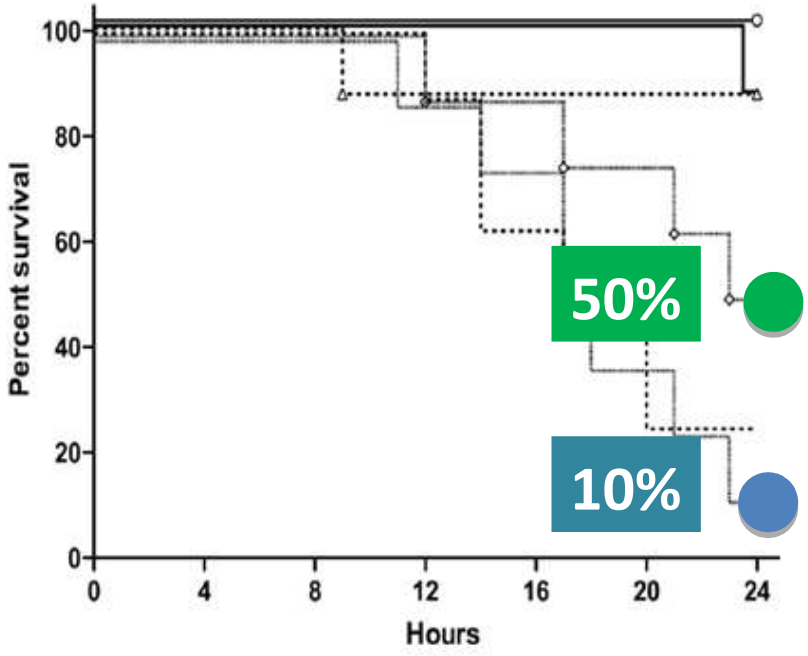
Agresivní léčba tekutinami …

… experiment - **septický šok**

Diskutovaná **role vazodilatace po bolusech tekutin** … potenciální mechanizmus škodlivosti bolusů = **KVS kolaps** …

Přežívání zvířat s peritonitidou



Tekutinová resuscitace

POUZE kontinuální infuze
10 ml/kg/h H1/1

Brandt S et al. *Critical Care* 2009, 13:R186

Agresivní léčba tekutinami …

… humánní studie - **septický šok**

SHOCK, Vol. 40, No. 1, pp. 28–34, 2013

POST RESUSICITATION FLUID BOLUSES IN SEVERE SEPSIS OR SEPTIC SHOCK: PREVALENCE AND EFFICACY (PRICE STUDY)

Shailesh Bihari,*† Shivesh Prakash,* and Andrew D. Bersten*†

**Department of Intensive and Critical Care Unit, Flinders Medical Centre; and †Critical Care Medicine, Flinders University, Bedford Park, Adelaide, South Australia.*

Agresivní léčba tekutinami …

… humánní studie - **traumatický šok**

J Trauma Acute Care Surg 2013;74: 1207-1214

Goal-directed resuscitation in the prehospital setting: A propensity-adjusted analysis

Joshua B. Brown, MD, Mitchell J. Cohen, MD, Joseph P. Minei, MD, Ronald V. Maier, MD, Michael A. West, MD, Timothy R. Billiar, MD, Andrew B. Peitzman, MD, Ernest E. Moore, MD, Joseph Cuschieri, MD, Jason L. Sperry, MD, MPH,
and **The Inflammation and the Host Response to Injury Investigators,** *Pittsburgh, Pennsylvania*

Pokud dostali **normotenzní, tachykardičtí a „kyselí“ pacienti** s „blunt trauma“ v přednemocniční péči bolus tekutin (>500 ml krystloidu) pak:

Agresivní léčba tekutinami …

… humánní studie - **septický šok**

Maitland K et al., *N Engl J Med* 2011;364:2483-95.

Mortality after Fluid Bolus in African Children with Severe Infection

… 3000 septických dětí **se známkami tkáňové hypoperfuze**

Agresivní léčba tekutinami …

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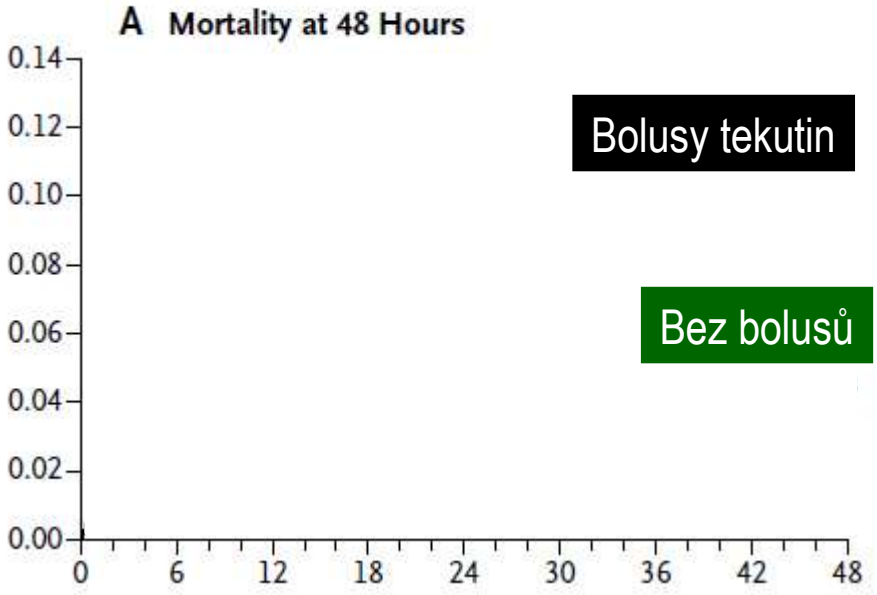

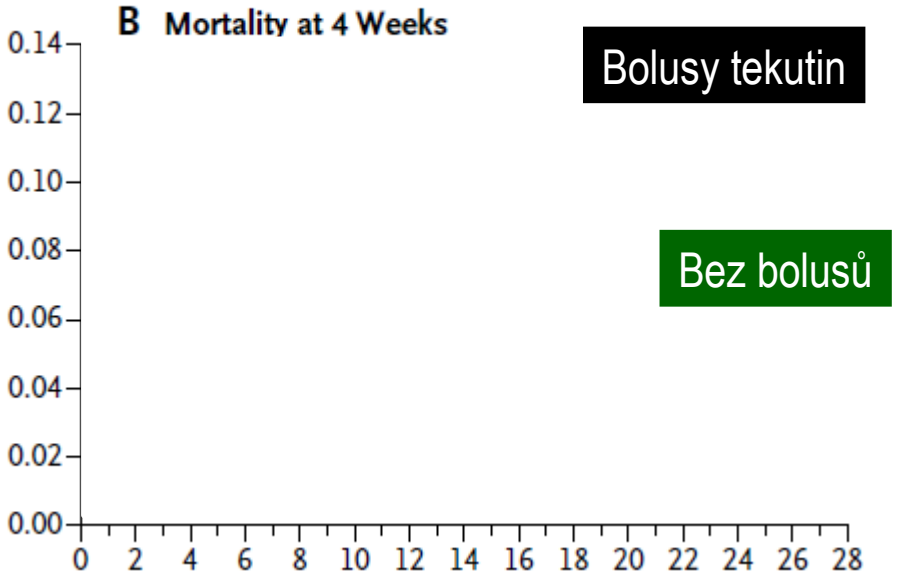

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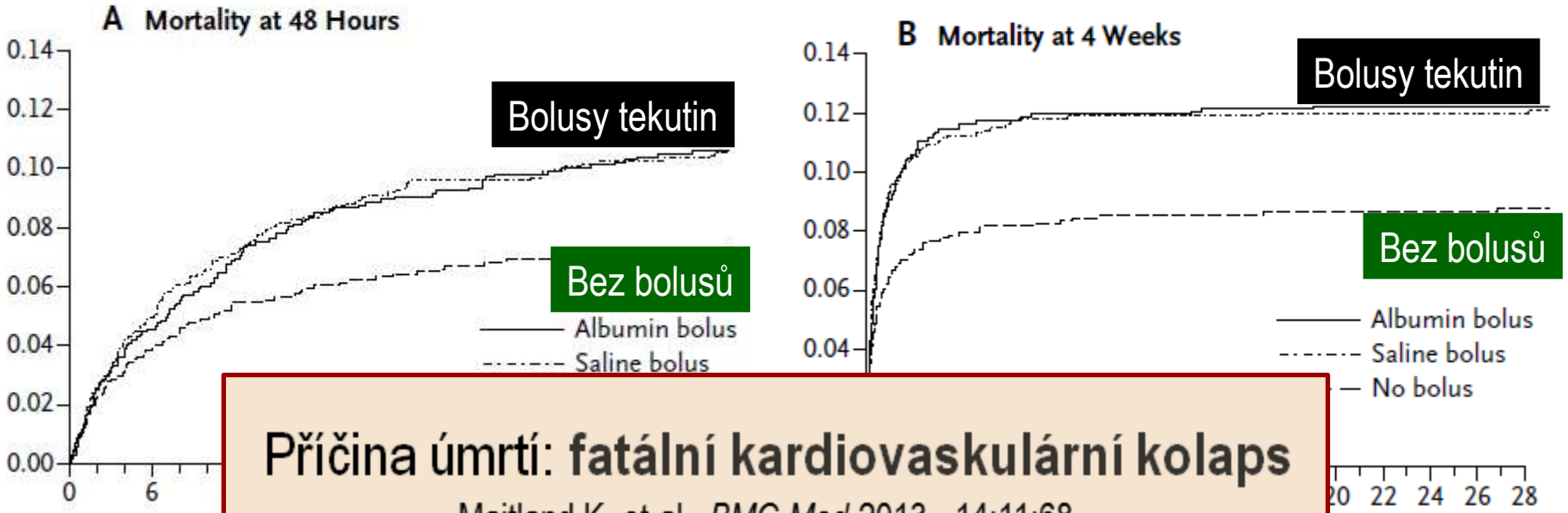

Příčina úmrtí: fatální kardiovaskulární kolaps

Maitland K, et al., *BMC Med* 2013., 14;11:68

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Mortality after Fluid Bolus in African Children with Severe Infection

… 3000 septických dětí **se známkami tkáňové hypoperfuze**

Pokud dostali **normotenzní, tachykardičtí a „kyselí“ dětští pacienti** se sepsí bolus tekutin (albumin, FR) pak **měli o 30% vyšší mortalitu** ve srovnání s dětmi, které dostali pouze udržovací dávku FR (4 ml/kg/hod) …

Příčina úmrtí: **fatální kardiovaskulární kolaps**

Maitland K, et al., *BMC Med* 2013., 14;11:68

Agresivní léčba tekutinami …

… humánní studie - **septický šok**

JAMA. 2017;318(13):1233-1240.

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of an Early Resuscitation Protocol on In-hospital Mortality Among Adults With Sepsis and Hypotension
A Randomized Clinical Trial

Ben Andrews, MD; Matthew W. Semler, MD, MSc; Levy Muchemwa, MBChB; Paul Kelly, MD, FRCP; Shabir Lakhi, MBChB; Douglas C. Heimburger, MD, MS; Chileshe Mabula, MBChB; Mwango Bwalya, MBChB; Gordon R. Bernard, MD

Pokud byli **tachykardičtí, „kyselí“, lehce hypotenzní mladí pacienti** (37 let) se sepsí (50% pneumonie, 90% HIV+) oběhově/6 hod resuscitování podle protokolu, pak měli o **45% vyšší mortalitu,** než pacienti se „zvyklou“ péči …

Agresivní léčba tekutinami …

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Protocol group: v průměru **5x vyšší potřeba vazopresoru** v průběhu prvních 24 hodin …

KVS kolaps po FBT ...

… mechanizmy **nejsou** zcela jasné

FBT = VAZODILATACE !!!

BJA 2016, 116: 339–49

Fluid boluses should be considered vasodilator therapy in patients with sepsis and that aggressive fluid resuscitation may potentiate the hyperdynamic state.

R. Bellomo

„Sečteno a podtrženo“…

… tekutinová resuscitace septického šoku:

Důkazy…

Důkazy… EGDT trials

	Tekutiny/6 hod	Mortalita
EGDT		
ProCESS		
ProMISe		
ARISE		

Peake et al. *N Engl J Med* 2014; 371:1496-506

Mouncey et al. *N Engl J Med* 2015; 372:1301-11

Angus et al. *N Engl J Med* 2014; 370: 1383-93

Rivers et al. *N Engl J Med* 2001; 345: 1368-77

Důkazy… CLASSIC trial

Restricting volumes of resuscitation fluid in adults with septic shock after initial management: the CLASSIC randomised, parallel-group, multicentre feasibility trial

Peter B. Hjortrup[1], Nicolai Haase[1], Helle Bundgaard[2], Simon L. Thomsen[3], Robert Winding[4], Ville Pettilä[5], Anne Aaen[6], David Lodahl[7], Rasmus E. Berthelsen[8], Henrik Christensen[9], Martin B. Madsen[1], Per Winkel[10], Jørn Wetterslev[10], Anders Perner[1,11*], The CLASSIC Trial Group, The Scandinavian Critical Care Trials Group

	Fluid Restriction	Standard Care	P value
	No. of events / No. at risk		
Death by day 90	25/75 (33%)	31/76 (41%)	36-1.40) 0.32
Ischemic events in the ICU	3/75 (4%)	9/76 (12%)	08-1.27) 0.11
Worsening of AKI	27/73 (37%)	39/72 (54%)	23-0.92) 0.03