Acidobazická rovnováha a laktát u kardiologického pacienta

MUDr. Jan Stašek

KARIM FN Brno

Kazuistika

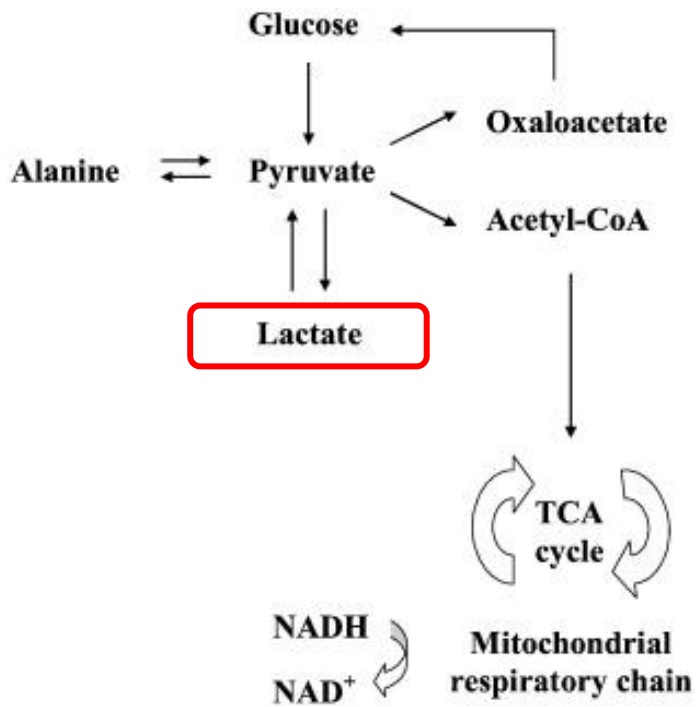
- 61- letý pacient přijat pro několik dní progredující dušnost a slabost. Z předchorobí chronická srdeční insuficience (hodnoceno jako v.s. posttachykardická kardiomyopatie), chronická fibrilace síní, ischemická choroba dolních končetin, etylismus, opakovaná non-compliance s léčbou.
- Na oddělení urgentního příjmu soporozní, tachypnoický s d.f. 35/min, SpO2 95% na oxygenoterapii polomaskou, TK 105/80 torr, fibrilace síní s komorovou odp. 120 - 130/min, chladná mramorovaná akra, zpomalený kapilární návrat.

- B(a)pH 7,12
- pCO2(T) 3,9 kPa
- B(a)pO2 13,2 kPa
- B(a)HCO3 11,2 mmol/l
- B(a)BD- -15,9 mmol/l
- B(a)sO2 0.933

- Na^+ 132 mmol/l
- K^+ 5,4 mmol/l
- Cl^- 103 mmol/l
- AG ≅ 23 mmol/l

- ***Laktát 9,6 mmol/l***

Laktát


Glucose
Oxaloacetate
Alanine
Pyruvate
Acetyl-CoA
Lactate
TCA
cycle
NADH
NAD+
Mitochondrial
respiratory chain

Hyperlaktacidémie

- Zvýšená produkce za aer. podmínek (křeče, akutní leukemie)
- Snížená dodávka kyslíku do tkání (šok jakékoliv etiologie)
- Snížený metabolismus laktátu (jaterní selhání, intoxikace ethanolem)
- Snížená utilizace kyslíku (intoxikace kyanidem, metforminem, deficit thiaminu, vrozené vady metabolismu)

Prognostická hodnota laktátu

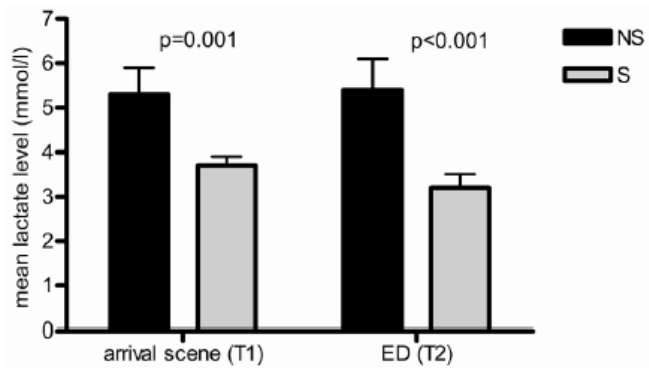
… aneb co nám řekne hyperlaktacidémie...

Research

Open Access

The prognostic value of blood lactate levels relative to that of vital signs in the pre-hospital setting: a pilot study

Tim C Jansen[1], Jasper van Bommel[1], Paul G Mulder[2], Johannes H Rommes[3], Selma JM Schieveld[3] and Jan Bakker[1]



Mean lactate levels in survivors (S) and non-survivors (NS) on arrival of the ambulance at the scene (T1) and just before or on arrival at the emergency department (T2). Arrow bar represents standard error. Number of patients at T1: n = 124 and at T2: n = 106.

Vermeulen *et al. Critical Care* 2010, **14**:R164
http://ccforum.com/content/14/5/R164

CRITICAL CARE

RESEARCH Open Access

Clinical correlates of arterial lactate levels in patients with ST-segment elevation myocardial infarction at admission: a descriptive study

Robert P Vermeulen[1*], Miriam Hoekstra[1], Maarten WN Nijsten[2], Iwan C van der Horst[1], L Joost van Pelt[3], Gillian A Jessurun[4], Tiny Jaarsma [1], Felix Zijlstra[5], Ad F van den Heuvel[1]

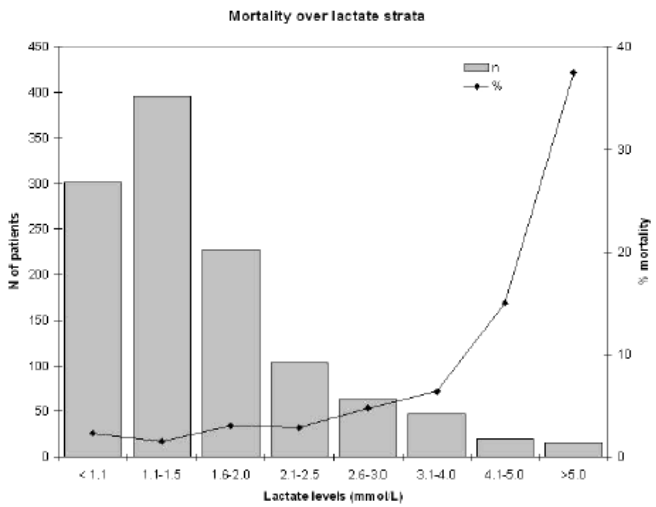


Figure 1 Distribution of 30-day mortality in relation to admission lactates.

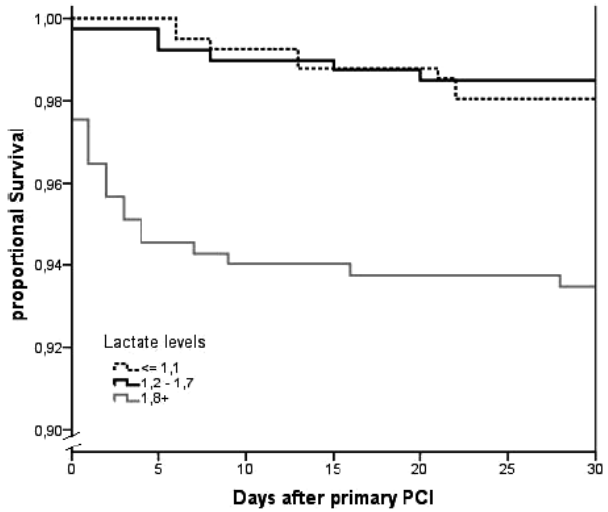


Figure 2 Kaplan-Meier curve displaying 30-day proportional survival after primary PCI. PCI, percutaneous coronary intervention.

International Journal of Cardiology 114 (2007) 176 – 182

Predictors of in-hospital mortality after percutaneous coronary intervention for cardiogenic shock

Serafina Valente [a,*], Chiara Lazzeri [a], Sabine Vecchio [a], Cristina Giglioli [a], Massimo Margheri [b], Pasquale Bernardo [a], Marco Comeglio [a], Silvia Chiocchini [a], Gian Franco Gensini [a]

Table 6
Binary logistic regression analysis for in-hospital death

	p value	OR	95% CI
TIMI post PCI ≤2	0.02	12.9	1.4–116.5
Creatinine >1.5 mg/dl	0.003	12.7	2.4–67.9
Uric acid >6.5 mg/dl	0.016	6.7	1.4–31.8
Glucose serum levels > 200 mg/dl	0.002	11.3	2.4–52.1
Hb A1c >5.8%	0.08	7.7	0.7–79.7
Lactate >6.5 mmol/l	<0.0001	54	5.8–494.9
History of hypertension	0.003	8.3	2–34.5
Diabetes	0.03	4.6	1.1–19.5
Age ≥75 years	0.002	8.5	2.1–33.8
EF <25%	0.03	4.2	1.1–16.3
Lactate >6.5 mmol/l[a]	0.01	295	3.4–25444
TIMI post PCI ≤2a	0.04	19.5	1.0–374.5

[a] Adjusted for sex, age, history of hypertension and diabetes.

The association of lactate and vasopressor need for mortality prediction in survivors of cardiac arrest

M. N. COCCHI [1, 2], J. MILLER [3], S. HUNZIKER [4], E. CARNEY [1], J. SALCICCIOLI [1], S. FARRIS [5], N. JOYCE [1], P. ZIMETBAUM [6], M. D. HOWELL [4], M. W. DONNINO [1, 4]

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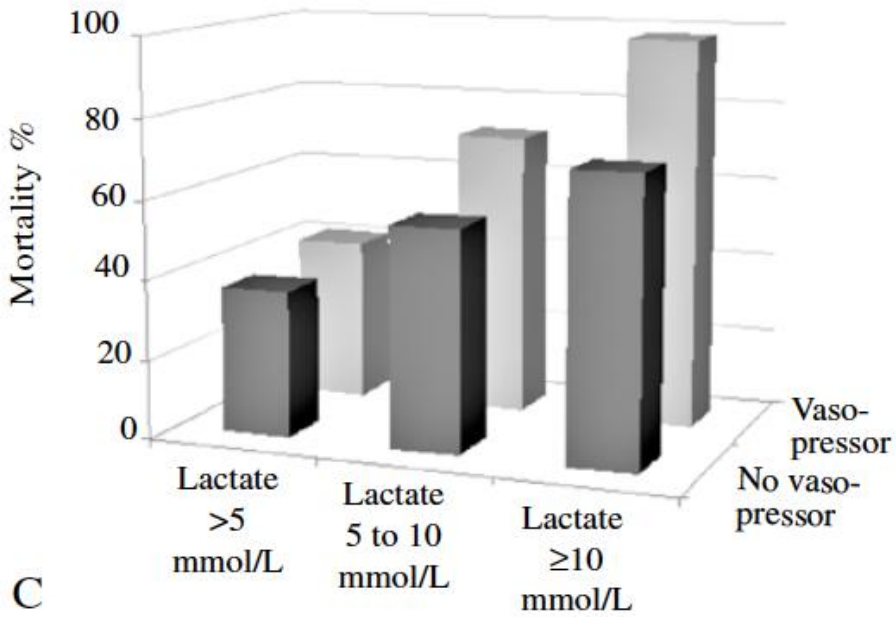
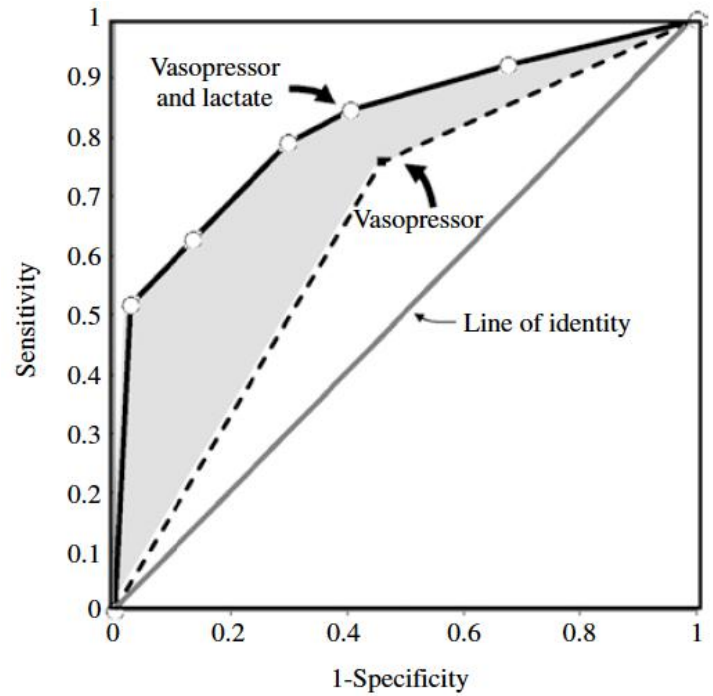
MINERVA ANESTESIOLOGICA



C



AHA SCIENTIFIC STATEMENT

Contemporary Management of Cardiogenic Shock

A Scientific Statement From the American Heart Association

Circulation. 2017;136:00–00. DOI: 10.1161/CIR.0000000000000525

Suggestions for Clinical Practice

We suggest that all patients with CS be evaluated with an ECG, chest x-ray, and comprehensive echocardiogram with the specific purpose of understanding the dominant mechanism responsible for acute hemodynamic instability. In the absence of contraindications, additional imaging with a computed tomography scan or transesophageal echocardiogram (as appropriate) if an acute aortic syndrome or pulmonary embolism is suspected is appropriate. Suggested laboratory tests include a complete blood count, electrolytes, creatinine, hepatic function tests, arterial blood gas and lactate, and serial cardiac troponin levels.

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Table 1. Pragmatic and Clinical Trial Definitions of CS

Clinical Definition	SHOCK Trial[9]*	IABP-SHOCK II[1]†	ESC HF Guidelines[15]
Cardiac disorder that results in both clinical and biochemical evidence of tissue hypoperfusion	Clinical criteria: SBP <90 mm Hg for ≥30 min OR Support to maintain SBP ≥90 mm Hg AND End-organ hypoperfusion (urine output <30 mL/h or cool extremities) Hemodynamic criteria: CI of ≤2.2 L·min^{-1}·m^{-2} AND PCWP ≥15 mm Hg	Clinical criteria: SBP <90 mm Hg for ≥30 min OR Catecholamines to maintain SBP >90 mm Hg AND Clinical pulmonary congestion AND Impaired end-organ perfusion (altered mental status, cold/clammy skin and extremities, urine output <30 mL/h, or lactate >2.0 mmol/L)	SBP <90 mm Hg with adequate volume and clinical or laboratory signs of hypoperfusion Clinical hypoperfusion: Cold extremities, oliguria, mental confusion, dizziness, narrow pulse pressure Laboratory hypoperfusion: Metabolic acidosis, elevated serum lactate, elevated serum creatinine

- Stav uzavřen jako kardiogenní šok v rámci dekompenzace chron. srdeční insuficience
- Příčinou non-compliance v léčbě + interkurentní virová infekce
- Pacient přijat na ICU
- Dle TTE dilatovaná, globálně hypokontraktilní LK s EF 15-20%

Clearance laktátu

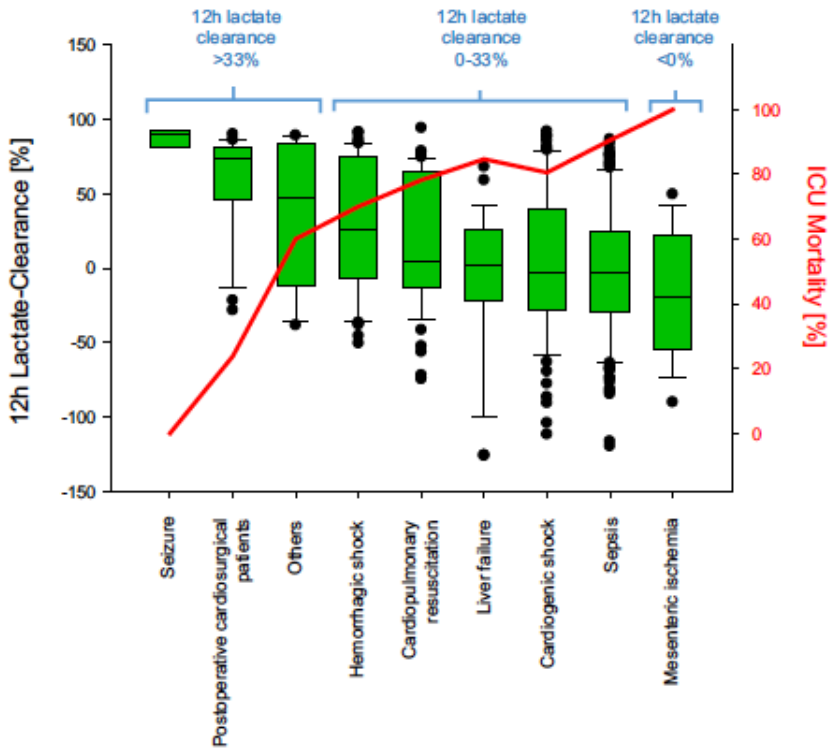
…neboli pokles hodnoty laktátu v čase

Intensive Care Med (2016) 42:202–210
DOI 10.1007/s00134-015-4127-0

ORIGINAL

Sebastian A. Haas
Theresa Lange
Bernd Saugel
Martin Petzoldt
Valentin Fuhrmann
Maria Metschke
Stefan Kluge

Severe hyperlactatemia, lactate clearance and mortality in unselected critically ill patients



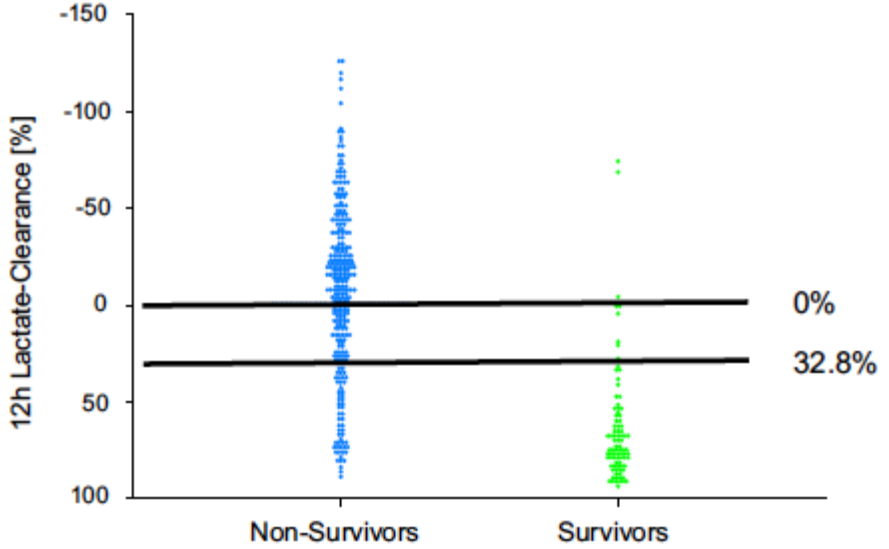
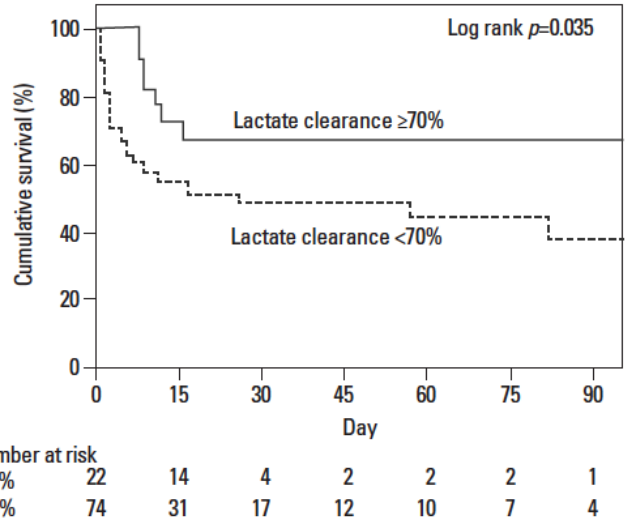


Fig. 5 Association between 12 h lactate clearance and mortality. Non-survivers are plotted by *blue dots* and survivers by *green dots*. The *black lines* show 12 h lactate clearance of 0 % and the cut off having highest ability to predict ICU mortality regarding sensitivity and specifity (12 h lactate clearance of 32.8 %)

Clinical Outcomes of Patients with Acute Myocardial Infarction Complicated by Severe Refractory Cardiogenic Shock Assisted with Percutaneous Cardiopulmonary Support

Taek Kyu Park,[1*] Jeong Hoon Yang,[1,2*] Seung-Hyuk Choi,[1] Young Bin Song,[1] Joo-Yong Hahn,[1] Jin-Ho Choi,[1] Kiick Sung,[3] Young Tak Lee,[3] Hyeon-Cheol Gwon,[1] and Sang Hoon Lee[1]

Yonsei Med J 55(4):920-927, 2014



	Non-survivors (n=51)	Survivors (n=45)	*p* value
Lactate, initial (mmol/L)	9.2 (3.6–13.6)	5.9 (2.2–8.9)	0.041
Lactate clearance for 48 hrs (%)	47.5 (30.1–71.2)	75.2 (45.7–82.7)	0.034

Lactate and lactate clearance as valuable tool to evaluate ECMO therapy in cardiogenic shock

Ingo Slottosch [a,*], Oliver Liakopoulos [b], Elmar Kuhn [b], Maximilian Scherner [a], Antje-Christin Deppe, Anton Sabashnikov [b], Navid Mader [b], Yeong-Hoon Choi [b], Jens Wippermann [a], Thorsten Wahlers [b]

Journal of Critical Care 42 (2017) 35–41

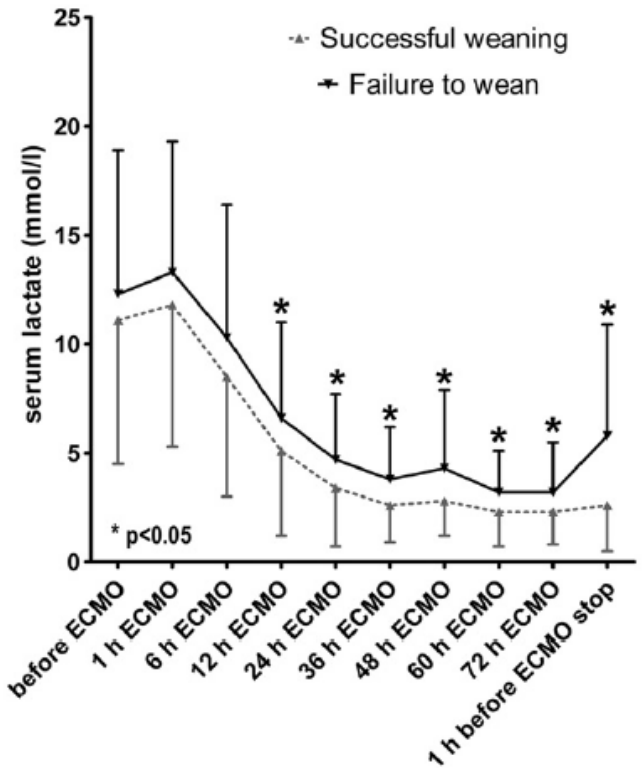


Fig. 1. Lactate and ECMO weaning Lactate levels (mean and standard deviation) of patients undergoing ECMO support comparing subgroups depending on successful weaning.

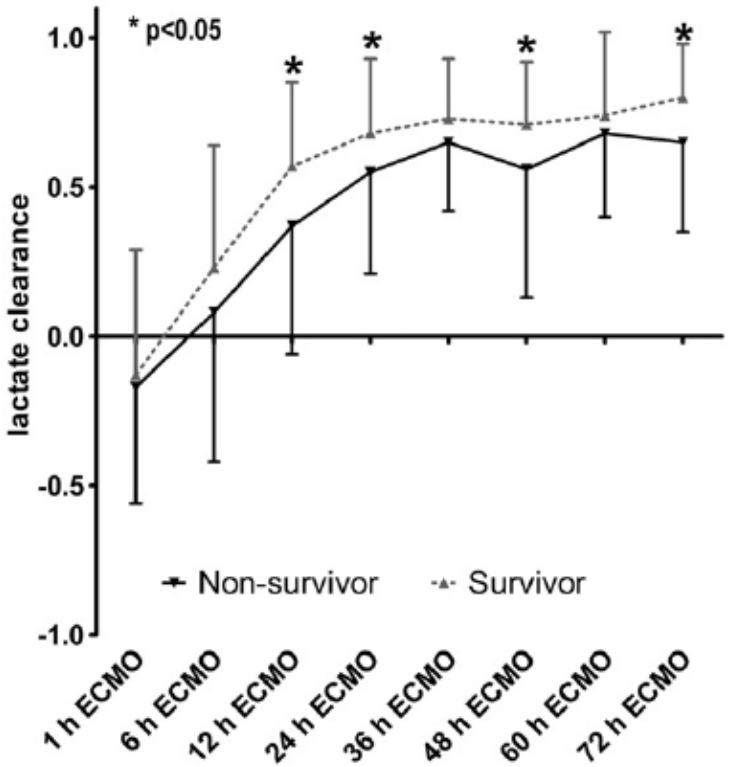


Fig. 3. Lactate clearance and mortality Lactate clearance (mean and standard deviation) of patients undergoing ECMO support comparing subgroups depending on 30-day mortality.

Clearance laktátu jako terapeutický cíl

… neboli naše terapeutické intervence cílíme na snížení hladiny laktátu

Lactate Clearance vs Central Venous Oxygen Saturation as Goals of Early Sepsis Therapy

A Randomized Clinical Trial

JAMA, February 24, 2010—Vol 303, No. 8

Table 5. Hospital Mortality and Length of Stay

Variable	Lactate Clearance Group (n = 150)	$ScvO_2$ Group (n = 150)	Proportion Difference (95% Confidence Interval)	*P* Value[b]
In-hospital mortality, No. (%)[a]				
Intent to treat	25 (17)	34 (23)	6 (–3 to 15)	
Per protocol	25 (17)	33 (22)	5 (–3 to 14)	
Length of stay, mean (SD), d				
ICU	5.9 (8.46)	5.6 (7.39)		.75
Hospital	11.4 (10.89)	12.1 (11.68)		.60
Hospital complications				
Ventilator-free days, mean (SD)	9.3 (10.31)	9.9 (11.09)		.67
Multiple organ failure, No. (%)	37 (25)	33 (22)		.68
Care withdrawn, No. (%)	14 (9)	23 (15)		.15

Early Lactate-Guided Therapy in Intensive Care Unit Patients

A Multicenter, Open-Label, Randomized Controlled Trial

Tim C. Jansen[1], Jasper van Bommel[1], F. Jeanette Schoonderbeek[3], Steven J. Sleeswijk Visser[4], Johan M. van der Klooster[5], Alex P. Lima[1], Sten P. Willemsen[2], and Jan Bakker[1], for the LACTATE study group*

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

TABLE 4. MORTALITY

Variable	Control Group (*n* = 177)	Lactate Group (*n* = 171)	Relative Risk (95% CI)	*P* Value
Unadjusted analysis, % (n)*				
In-hospital mortality	43.5 (77/177)	33.9 (58/171)	0.78 (0.60–1.02)	0.067
28-d mortality	35.6 (63/177)	30.4 (52/171)	0.85 (0.63–1.16)	0.30
ICU mortality	34.5 (61/177)	28.7 (49/171)	0.83 (0.61–1.14)	0.24
Adjusted analysis, hazard ratio (95% CI)†				
In-hospital mortality		0.61 (0.43–0.87)		0.006
28-d mortality		0.75 (0.52–1.09)		0.134
ICU mortality		0.66 (0.45–0.98)		0.037

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Circulation. 2017;136:00–00. DOI: 10.1161/CIR.0000000000000525

Table 3. Considerations for Initial Critical Care Monitoring in Patients With CS

Lactate	Every 1–4 h	Lactate clearance is a marker of resolving end-organ hypoperfusion, and lack of clearance is associated with a higher risk of mortality

Suggestions for Clinical Practice

higher MAP targets. We suggest that clinicians assess the adequacy of end-organ and tissue perfusion in response to individualized targets by integrating serial markers of systemic perfusion, including (but not limited to) arterial lactate, mixed or central venous oxygen saturations, urine output, creatinine, liver function tests, mental status, temperature, and other invasive hemodynamic variables.

Další průběh pacienta

- Pacient záhy pro progresi respirační tísně intubován a napojen na řízenou ventilaci. Pro hypotenzi nutnost vysokých dávek noradrenalinu.
- Dle PAC : CI 1,4 l/min/m^2, SvO_2 54 %, přidán dobutamin k optimalizaci srdečního výdeje.
- Dynamika arteriálního laktátu:

  po 3 hod – 6,0 mmol/l

  po 6 hod – 4,2 mmol/l

  po 9 hod – 2,0 mmol/l
- Pacient po komplexní terapii stabilizován, po 3 dnech extubován a po dalších 3 dnech přeložen v dobrém klinickém stavu na spádovou JIP.

Take – home messages

- Iniciální krevní plyny (přítomnost metabolické acidosy s vysokým anion gapem) spolu s laktátem pomáhají ***identifikovat vysoce rizikového pacienta*** (neboli pacienta v šoku).
- Cennější než-li jedna izolovaná hodnota laktátu je jeho dynamika v čase (***laktátová clearance***).
- Laktátová clearance může posloužit jako velmi jednoduchá a přitom cenná ***monitorace*** úspěšnosti našich terapeutických intervencí.