



**XXXI.**

kongres České společnosti  
anesteziologie, resuscitace  
a intenzivní medicíny

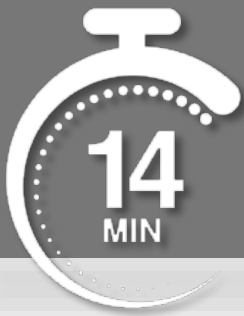
9.-11. ŘÍJNA 2025

CLARION CONGRESS HOTEL PRAGUE\*\*\*\*

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# OBĚH V SEPSI ...

Roman Kula, KARIM FNO&LFOU Ostrava



- **hemodynamická fenotypizace**  
septického šoku
- **poznámky k fenotypům**

# Phenotyping is ...



**AR ANNUAL  
REVIEWS**

Annu Rev Med. 2023  
27;74:457-471

*Annual Review of Medicine*

## Biological Phenotyping in Sepsis and Acute Respiratory Distress Syndrome

Pratik Sinha,<sup>1</sup> Nuala J. Meyer,<sup>2</sup> and Carolyn S. Calfee<sup>3</sup>

<sup>1</sup>Division of Clinical & Translational Research and Division of Critical Care, Department of Anesthesia, Washington University, St. Louis, Missouri, USA; email: p.sinha@wustl.edu

<sup>2</sup>Division of Pulmonary, Allergy, and Critical Care Medicine; Center for Translational Lung Biology; and Lung Biology Institute, University of Pennsylvania Perelman School of Medicine; Philadelphia, Pennsylvania, USA

<sup>3</sup>Division of Pulmonary, Critical Care, Allergy & Sleep Medicine, Department of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, USA

... umožní vám použít léčebnou intervenci, **kterou pacient**  
s velikou pravděpodobností **reálně potřebuje**

Phenotyping is ...



**Pacient**  
**V SEPTICKÉM ŠOKU**  
může potřebovat terapeuticky  
„tlačit“ na ...

# Phenotyping is ...



## Pacient V SEPTICKÉM ŠOKU

může potřebovat terapeuticky  
„tlačit“ na ...



**VAZOPRESORY**

pokud dominuje  
**vazodilatace**

# Phenotyping is ...



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**TEKUTINY**

pokud dominuje  
**hypovolémie**

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pokud dominuje  
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### INOTROPIKÁ

pokud dominuje  
**inotropní dysfunkce**

# Phenotyping is ...



## Pacient V SEPTICKÉM ŠOKU

může potřebovat terapeuticky  
„tlačit“ na ...



**VAZOPRESORY**



**TEKUTINY**



**INOTROPIKÁ**

... i vazopresory se dá udělat „dobrý tlak“  
ale pokud je přítomná hypovolemie  
tak je to katastrofa

# Phenotyping is ...



## Pacient V SEPTICKÉM ŠOKU

může potřebovat terapeuticky  
„tlačit“ na ...



**VAZOPRESORY**



**TEKUTINY**



**INOTROPIKÁ**

... pokračování v tekutinové resuscitaci  
u normovolemického pacienta s hypotenzí  
způsobenou vazodilatací povede jistě  
supranormální hodnotě DO<sub>2</sub>

# Phenotyping is ...



## The New England Journal of Medicine

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Vol. 330 No. 24

ELEVATION OF SYSTEMIC OXYGEN DELIVERY IN CRITICALLY ILL PATIENTS

1717

### ELEVATION OF SYSTEMIC OXYGEN DELIVERY IN THE TREATMENT OF CRITICALLY ILL PATIENTS

MICHELLE A. HAYES, F.R.C.A., ANDREW C. TIMMINS, F.R.C.A., ERNEST H.S. YAU, F.R.C.A.,  
MARK PALAZZO, F.R.C.A., CHARLES J. HINDS, F.R.C.A., AND DAVID WATSON, F.R.C.A.

**Abstract Background.** Elevation of systemic oxygen delivery and consumption has been associated with an improved outcome in critically ill patients. We conducted a randomized trial to determine whether boosting oxygen delivery by infusing the inotropic agent dobutamine would improve the outcome in a diverse group of such patients.

**Methods.** On the basis of previously published recommendations, we established the following goals: a cardiac index above 4.5 liters per minute per square meter of body-surface area, oxygen delivery above 600 ml per minute per square meter, and oxygen consumption above 170 ml per minute per square meter. If these goals were not achieved with volume expansion alone, patients were randomly assigned to a treatment or control group. The treatment group received intravenous dobutamine (5 to 200 µg per kilogram of body weight per minute) until all three goals had been achieved. Dobutamine was administered to the control group only if the cardiac index was below 2.8 liters per minute per square meter.

**Results.** A total of 109 patients were studied. In nine

patients the therapeutic goals were achieved with volume expansion alone; all nine patients survived to leave the hospital. Fifty patients were randomly assigned to the treatment group, and 50 to the control group. During treatment, there were no differences between the two groups in mean arterial pressure or oxygen consumption, despite a significantly higher cardiac index and level of oxygen delivery in the treatment group ( $P < 0.05$ ). Although the predicted risk of death during hospitalization was 34 percent for both groups, the in-hospital mortality was lower in the control group (34 percent) than in the treatment group (54 percent) ( $P = 0.04$ ; 95 percent confidence interval, 0.9 to 39.1 percent).

**Conclusions.** The use of dobutamine to boost the cardiac index and systemic oxygen delivery failed to improve the outcome in this heterogeneous group of critically ill patients. Contrary to what might have been expected, our results suggest that in some cases aggressive efforts to increase oxygen consumption may have been detrimental. (N Engl J Med 1994;330:1717-22.)

DESPITE improvements in resuscitation and supportive care, one or more vital organs fail in a large proportion of patients with acute, life-threatening illnesses.<sup>1</sup> It has been proposed that organ damage in critical illness is due to inadequate oxygen delivery, often exacerbated by a level of tissue oxygen extraction that fails to satisfy metabolic demands.<sup>2</sup> Consequently, some investigators have recommended that in patients at high risk who are

septic shock,<sup>7-9</sup> as well as in heterogeneous groups of critically ill patients.<sup>10</sup>

Some researchers, however, remain skeptical.<sup>11</sup> Provided volume replacement is optimal, it remains unclear whether achievement of these target values simply indicates an adequate physiologic reserve and therefore a better outcome. Although the prognosis is very good for patients in whom oxygen delivery and consumption reach the target levels, aggressive efforts



30 let  
„mrtvá strategie“

Hayes et al. *N Engl J Med*

1994, 330:1717-22

# Phenotyping is ...



## Pacient V SEPTICKÉM ŠOKU

může potřebovat terapeuticky  
„tlačit“ na ...



### VAZOPRESORY

pokud dominuje  
**vazodilatace**



### TEKUTINY

pokud dominuje  
**hypovolémie**



### INOTROPIKÁ

pokud dominuje  
**inotropní dysfunkce**

**JAK ROZLOUSKNOUT TENTO OŘÍŠEK JE ZVYKLE  
NEJTĚŽŠÍ U „ROZLÉČENÉHO“ PACIENTA**

# Phenotyping is ...



## **Hemodynamic Profiles of Shock in Patients With COVID-19**

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

# Phenotyping is ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

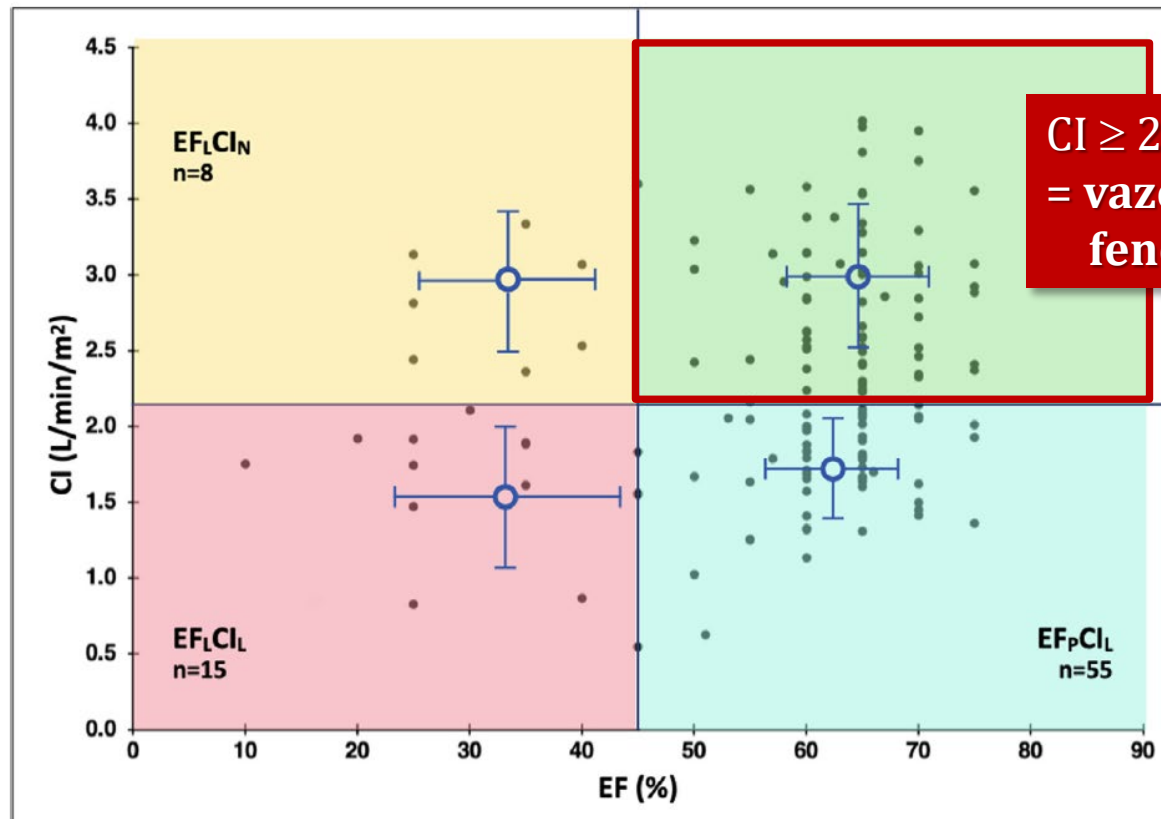
- **iniciální ECHO**kg zhodnocení pacientů se **septickým šokem** (COVID-19 pneumonie s bakteriální superinfekcí)
- podle **LVEF** (cutoff 45%) a **Cardiac index** (cutoff 2.2 L/min/m<sup>2</sup>) lze rozoznat 4 „logické“ hemodynamické fenotypy ...

# Phenotyping is ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

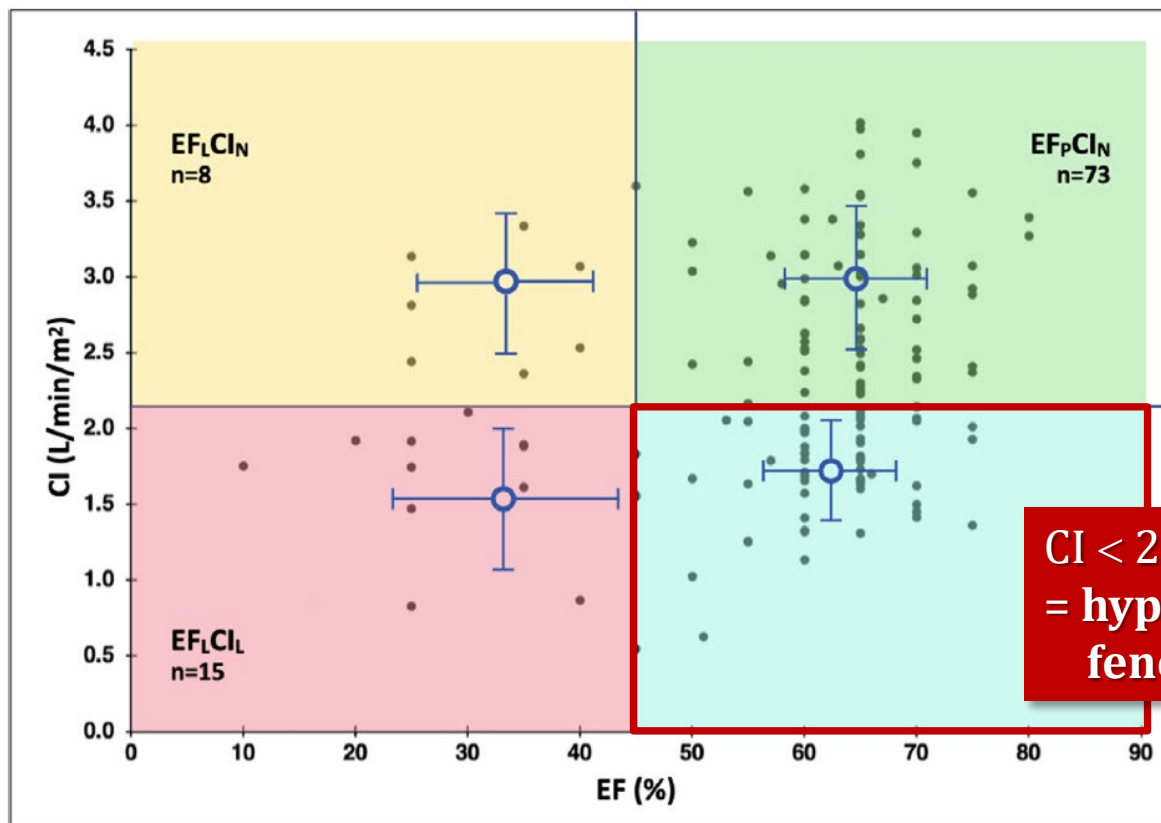


# Phenotyping is ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139



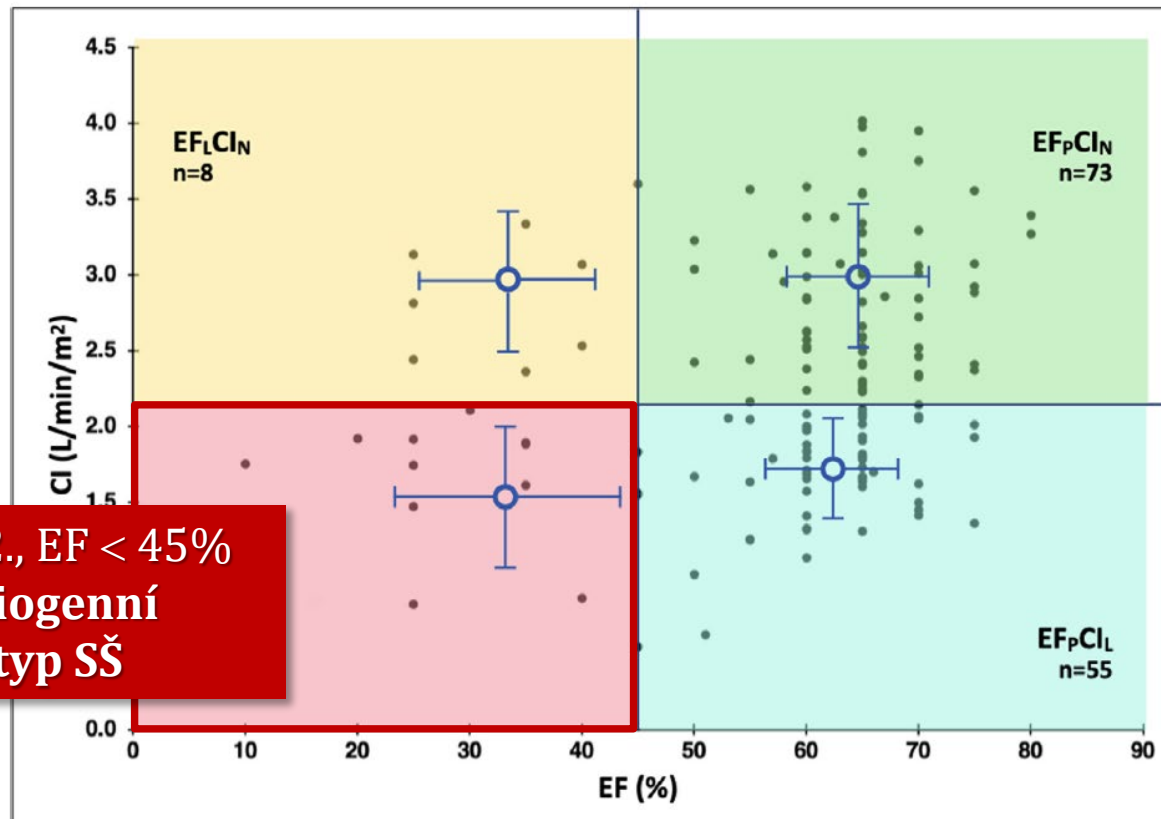
CI < 2.2., EF ≥ 45%  
= hypovolemický  
fenotyp SŠ

# Phenotyping is ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139



CI < 2.2., EF < 45%  
= kardiogenní  
fenotyp SŠ

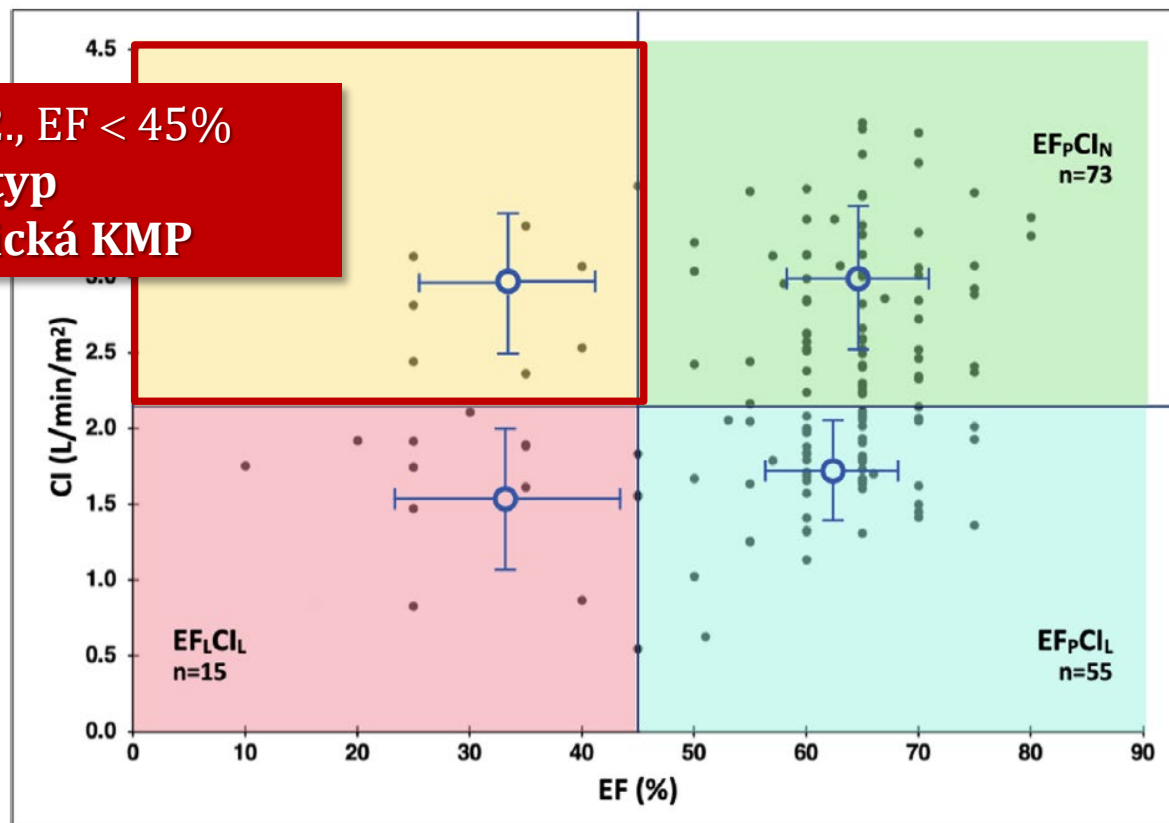
# Phenotyping is ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

$CI \geq 2.2$ ,  $EF < 45\%$   
= fenotyp  
septická KMP



# Klasická septická CMP...



M.M. Parker

## Profound but Reversible Myocardial Depression in Patients with Septic Shock

MARGARET M. PARKER, M.D.; JAMES H. SHELHAMER, M.D.; STEPHEN L. BACHARACH, Ph.D.;  
MICHAEL V. GREEN, M.S.; CHARLES NATANSON, M.D.; TERRI M. FREDERICK, B.S.N.; BARBARA A.  
DAMSKE, R.N.; and JOSEPH E. PARRILLO, M.D.; Bethesda, Maryland

To characterize the role of cardiac function in septic shock, serial radionuclide cineangiographic and hemodynamic evaluations were done on 20 patients with documented septic shock. Although all patients had a normal or elevated cardiac index, 10 patients had moderate to severe depression of their ejection fraction with values below 0.40. Thirteen of twenty patients survived their episode. Paradoxically, 10 of 13 survivors, but none of the 7 nonsurvivors, had an initial ejection fraction less than 0.40 ( $p < 0.005$ ). The mean initial ejection fraction for the survivors was  $0.32 \pm 0.04$ , and their mean end systolic and end diastolic ventricular volumes were substantially increased with a normal stroke volume. The survivors' serial scans showed a gradual return to normal ejection fraction and ventricular volume

group was normal; however, one quarter of these patients had a reduced ejection fraction on a single study (13). We have evaluated a series of patients with moderate to severe septic shock using radionuclide cineangiography and hemodynamic evaluations. We report the presence of severe, reversible myocardial depression in a substantial proportion of these patients.

### Methods

From April to December 1982, 20 patients with septic shock were studied in the medical intensive care unit of the National Institutes of Health. Seventeen patients had a temperature greater than  $38^\circ\text{C}$ , hypotension (mean arterial pressure less

Ann Intern Med. **1984** Apr;100(4):483-90.

... mechanism zachování CO spočívá v dilataci komory  
( $\uparrow$  EDV) čím se zachová stroke volume i při poklesu LVEF

# Epidemiologie fenotypů ...



## **Hemodynamic Profiles of Shock in Patients With COVID-19**

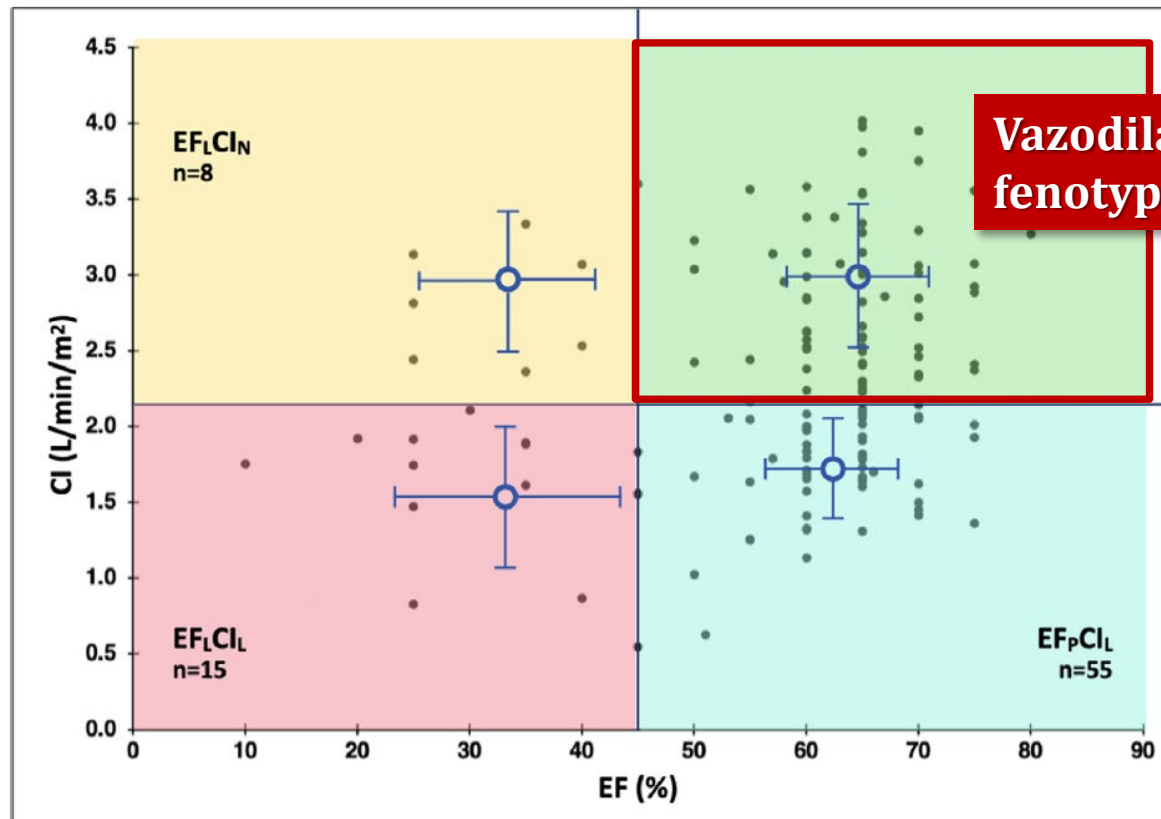
Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

# Epidemiologie fenotypů ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

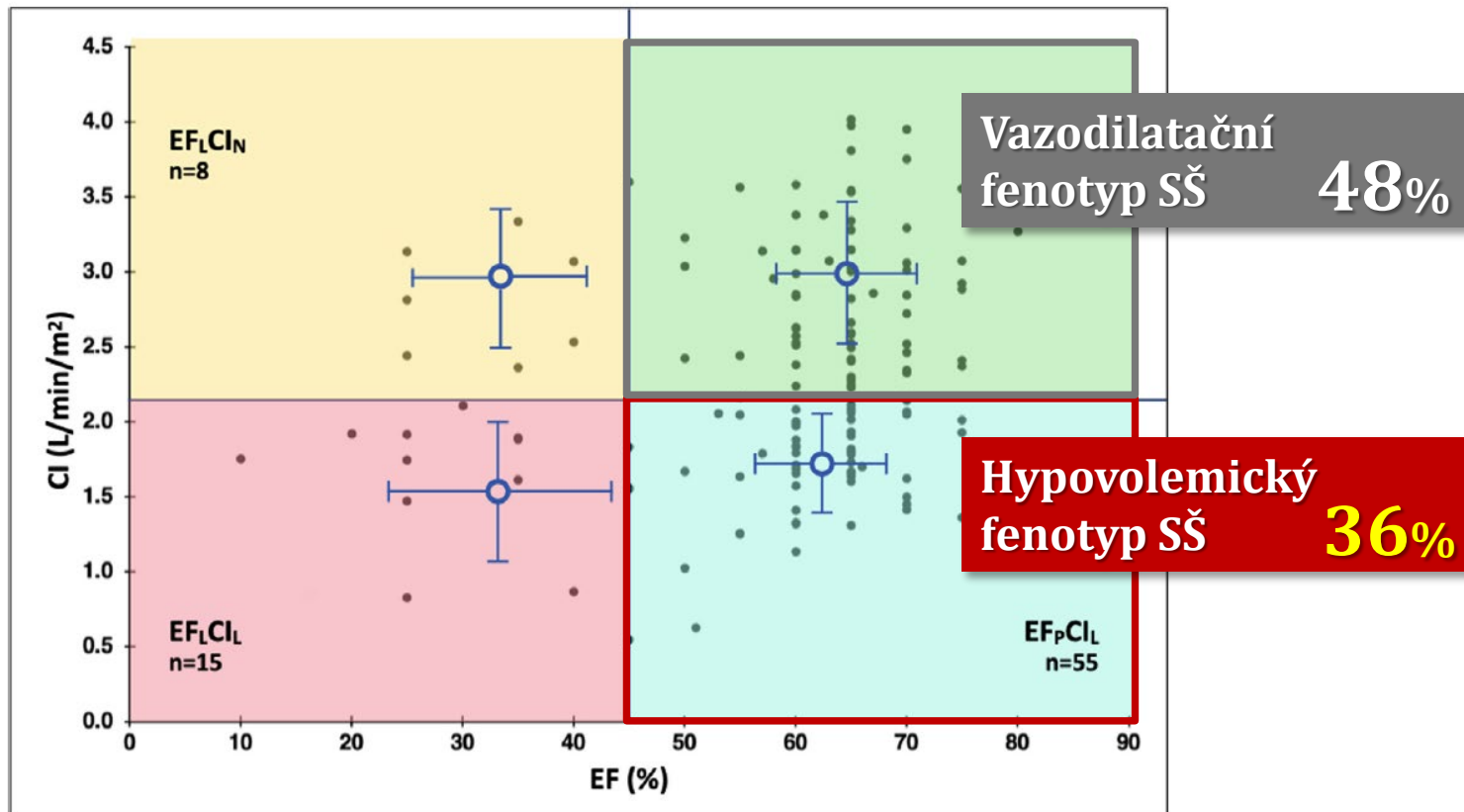


# Epidemiologie fenotypů ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139



# Epidemiologie fenotypů ...



**~ 1 : 1**

# Epidemiologie fenotypů ...



~ 1 : 1

... u 50% pacientů je podání tekutin bez efektu

ONLINE SPECIAL ARTICLE

Crit Care Med 2021;49:e1063-e1143

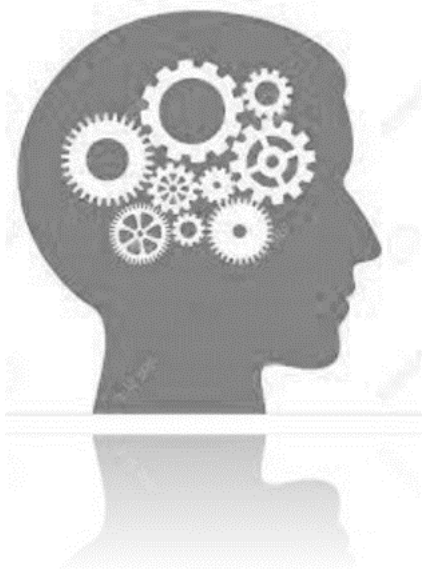
## Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021

**KEY WORDS:** adults; evidence-based medicine; guidelines; sepsis; septic shock

Laura Evans<sup>1</sup>

Andrew Rhodes<sup>2</sup>

... resuscitaci septického šoku **zahájit u každého pacienta PODÁNÍM BOLUSU TEKUTIN**

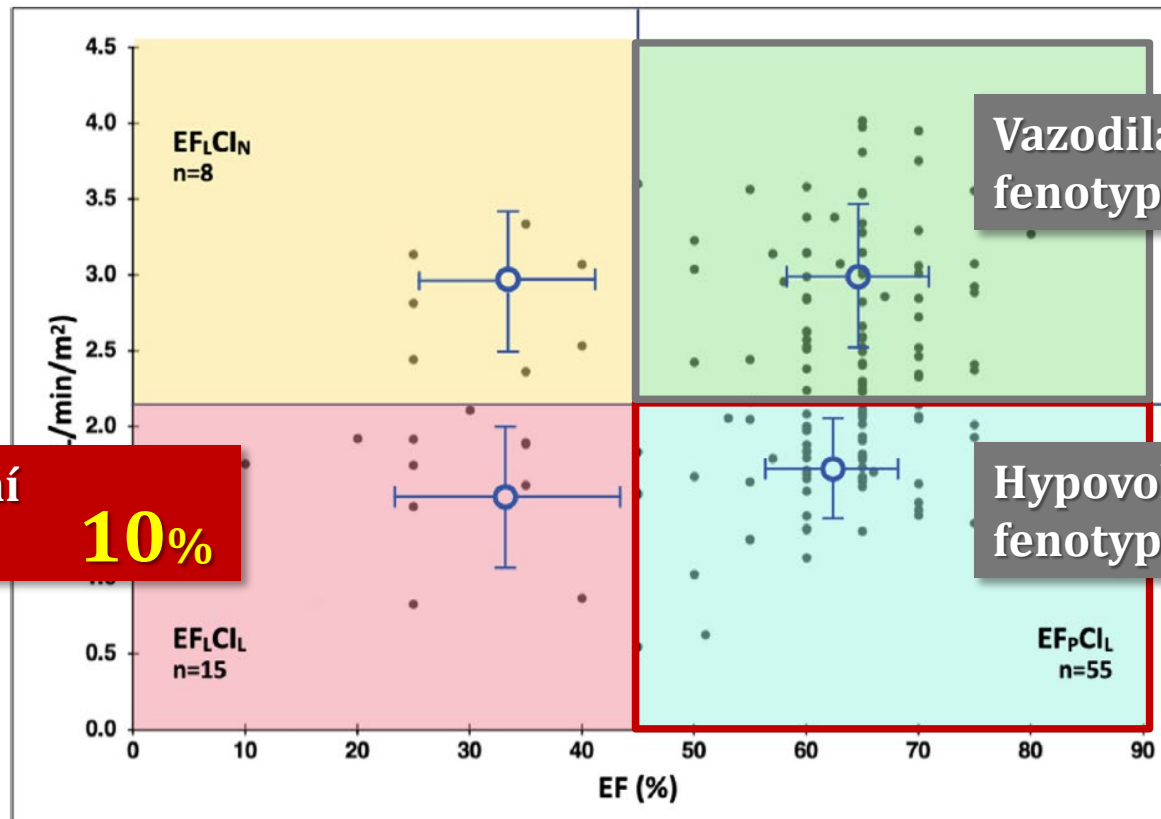


# Epidemiologie fenotypů ...



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Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139

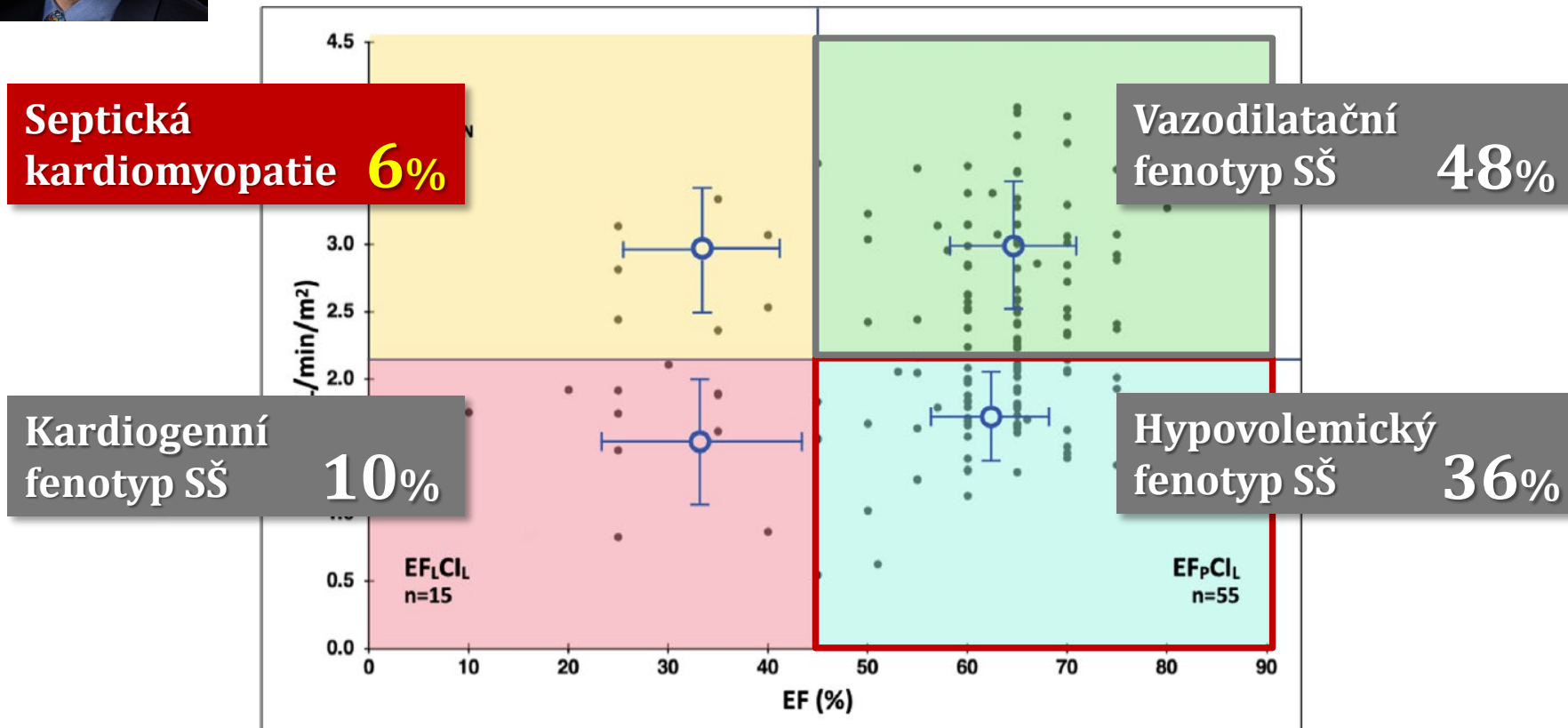


# Epidemiologie fenotypů ...



## Hemodynamic Profiles of Shock in Patients With COVID-19

Steven M. Hollenberg et al. *Am J Cardiol* 2021, 15;153:135-139



# Poznámky k fenotypům ...



# Poznámky k fenotypům ...



## Vazodilatační ...

- existuje celá řada medikamentů, které jsou schopny ovlivnit vazoplegii

# Poznámky k fenotypům ...



## Vazodilatační ...

- existuje celá řada medikamentů, které jsou schopny ovlivnit vazoplegii

- **NORADRENALIN**
- **VASOPRESIN**

Lajoye et al. *Critical Care* (2025) 29:333  
<https://doi.org/10.1186/s13054-025-05540-2>

Critical Care

... ??? ...

REVIEW

Open Access

Vasopressin and its analogues in patients with septic shock: holy Grail or unfulfilled promise?



Quentin Lajoye<sup>1</sup>, Arthur Orieux<sup>1,2</sup>, Alexandre Boyer<sup>1,3</sup>, Renaud Prevel<sup>1,3</sup> and Mathieu Jozwiak<sup>4,5\*</sup>

# Poznámky k fenotypům ...



## Vazodilatační ...

- existuje celá řada medikamentů, které jsou schopny ovlivnit vazoplegii

- **NORADRENALIN**
- **VASOPRESIN**

... panuje shoda že **vasopresin zvyšuje citlivost na NA (=de-katecholaminizae)**

... z mého pohledu **spíše hormonální substituce** než „second-line vazopressor“

... na úvod vhodný **bolus 1 U iv** k otestování jestli bude vazopresin fungovat

# Poznámky k fenotypům ...



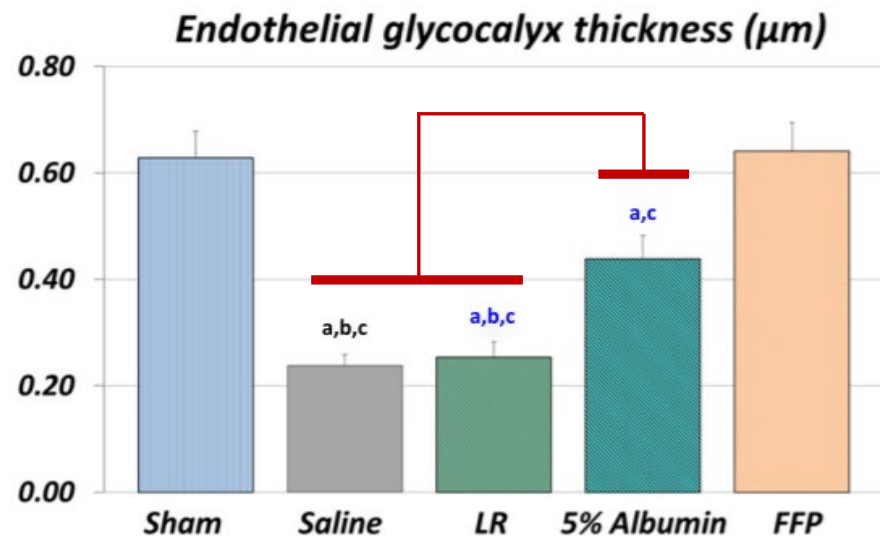
## Hypovolemický ...

- „neverending story“

KRYSTALODY *versus* KOLOIDY

KRYSTALODY *versus* **ALBUMIN**

... ve srovnání s krystaloidy je **po podání albuminu menší alterace GLX**



# Poznámky k fenotypům ...



## Hypovolemický ...

- „neverending story“

KRYSTALODY *versus* KOLOIDY

KRYSTALODY *versus* **ALBUMIN**

... ve srovnání s krystaloidy je **po podání albuminu menší alterace GLX**

... nicméně, studie srovnávající resuscitaci krystaloidy a albuminem mají stejný outcome

... pro resuscitaci albuminem je potřeba najít vhodného pacienta

# Poznámky k fenotypům ...



**Hypovolemický ...**

- „neverending story“

KRYSTALODY *versus* KOLOIDY

KRYSTALODY *versus* **ALBUMIN**

... ve srovnání s krystaloidy je **po podání albuminu menší alterace GLX**

ORIGINAL CONTRIBUTION

**Physiological levels of A-, B- and C-type natriuretic peptide shed the endothelial glycocalyx and enhance vascular permeability**

Matthias Jacob • Thomas Saller • Daniel Chappell •  
Markus Rehm • Ulrich Welsch • Bernhard F. Becker

Basic Res Cardiol (2013) 108:347

# Poznámky k fenotypům ...



SHOCK, Vol. 63, No. 1, pp. 30–32, 2025

OPEN

## Brief Report

### UNDERSTANDING THE ROLE OF NT-proBNP IN SEPTIC SHOCK: BEYOND CARDIAC DYSFUNCTION

Roman Kula,<sup>1,2</sup> Marcin Osuchowski,<sup>3</sup> and Roman Kula, Jr.<sup>4,5</sup>

<sup>1</sup>Department of Anaesthesiology and Intensive Care Medicine, Faculty of Medicine, University of Ostrava, Ostrava, Czech Republic; <sup>2</sup>Department of Anaesthesiology and Intensive Care Medicine, University Hospital Ostrava, Ostrava, Czech Republic; <sup>3</sup>Ludwig Boltzmann Institute for Traumatology, The Research Center in Cooperation with AUVA, Vienna, Austria; <sup>4</sup>Department of Anaesthesiology and Intensive Care, Tomas Bata Regional Hospital, Zlin, Czech Republic; <sup>5</sup>Department of Physiology, Faculty of Medicine, Masaryk University, Brno, Czech Republic

- NT-proBNP **silně koreluje s IL-6** a vůbec nekoreluje s hs-TnT
- NT-proBNP **negativně koreluje s hodnotou sérového albuminu**
- NT-proBNP **silně koreluje s indexem kapilárního leak-u**

... tudíž při hodnotě NT-proBNP nad 4000 ng/L a negativním ECHOKg nálezu **zvažují „switch“ na resuscitaci SS albuminem**

# Poznámky k fenotypům ...



„, a proč NT-proBNP nad 4000 ng/L ?



## Natriuretic Peptides to Predict Short-Term Mortality in Patients With Sepsis: A Systematic Review and Meta-analysis

Saarwaani Vallabhajosyula, MBBS; Zhen Wang, PhD; M. Hassan Murad, MD, MPH;  
Shashaank Vallabhajosyula, MBBS; Pranathi R. Sundaragini, MBBS;  
Kianoush Kashani, MD, MS; Wayne L. Miller, MD, PhD; Allan S. Jaffe, MD;  
and Saraschandra Vallabhajosyula, MD

Mayo Clin Proc Innov Qual Outcomes 2020; 4(1):50-64.

**Cut-off value of NT-proBNP: 4000 ng/L**

# Poznámky k fenotypům ...



## Kardiogenní...

- existuje celá řada medikamentů, které jsou schopny ovlivnit inotropii

# Poznámky k fenotypům ...



## Kardiogenní...

- existuje celá řada medikamentů, které jsou schopny ovlivnit inotropii
  - **ADRENALIN**
  - **DOBUTAMIN**
  - **MILRINON**
  - **LEVOSIMENDAN**
  - **NETRADIČNÍ POSTUPY** (GIK, lipidy, hypotermie)

# Poznámky k fenotypům ...



## Kardiogenní...

- existuje celá řada medikamentů, které jsou schopny ovlivnit inotropii
    - **ADRENALIN**
    - **DOBUTAMIN**
    - **MILRINON**
    - **LEVOSIMENDAN**
    - **NETRADIČNÍ POSTUPY** (GIK, lipidy, hypotermie)
- ... tyto „experimenty“ je však vhodné dělat, když máte „za zády“ ECMO
- ... **jde o nejtěžší fenotyp septického šoku**



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FESTIVAL INTENZIVNÍ MEDICÍNY

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