



Stresová kardiomyopatie

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Definice – Tako-Tsubo Syndrome (TTS)

- **Potenciálně smrtící přechodný výpadek myokardiální funkce bez kardiální anamnézy**
- **Spouštěče (nemusí být identifikován)**
 - emocionální: primární TTS
 - fyzické: sekundární TTS (sepsa, neurochir, SAH, ikty, pheochromocytom, ARDS, chirurgie, trauma)
- **EKG ST elevace v prekordiu, echokardiografie, Tnl/CKMBmass, negat SKG, absence infekční myokarditidy**

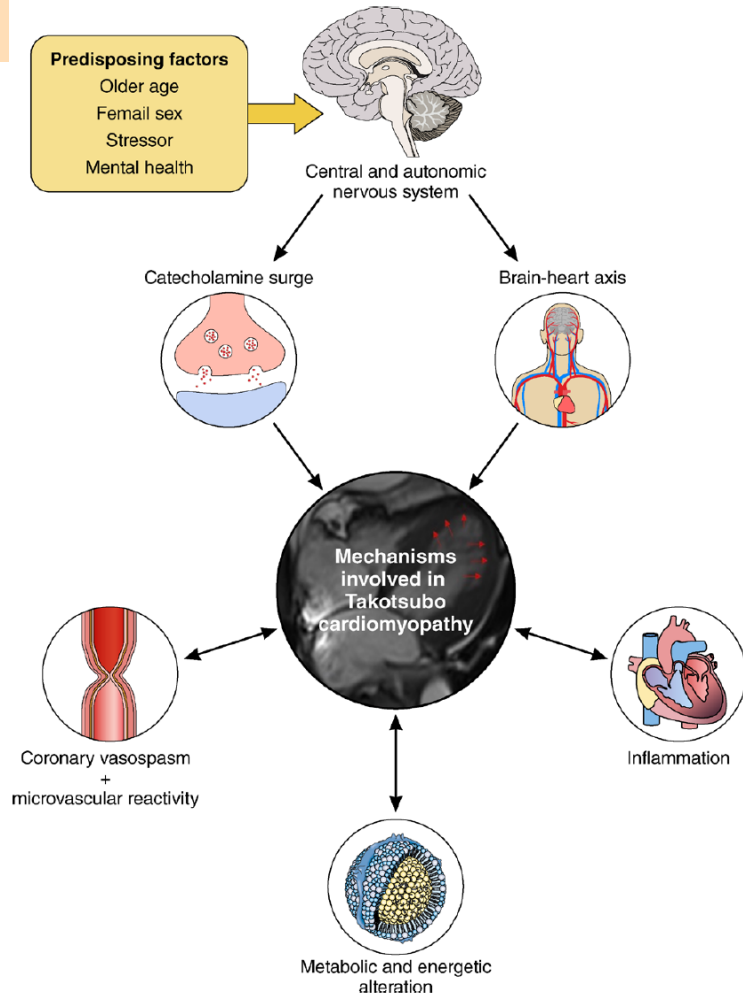
Patofyziologie TTS: implikace pro ICU

IN DEPTH

Takotsubo Syndrome: Pathophysiology, Emerging Concepts, and Clinical Implications

Trisha Singh , BM; Hilal Khan , MB BCH BAO, MRCP; David T. Gamble, MPharm, MBBS; Caroline Scally, MBChB; David E. Newby , DM, PhD; Dana Dawson , MD, DPhil

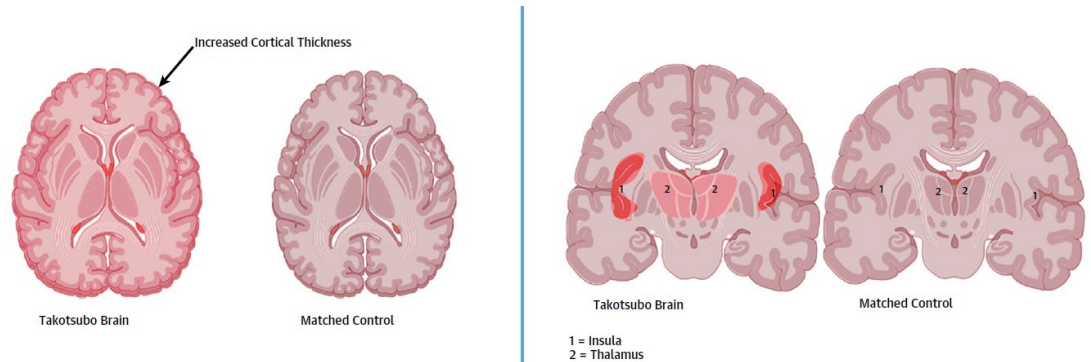
- Katecholaminy endo a exogenní
- Inflammatorní a trombofilní stav
- Zvýšená vazoreaktivita – koronární spazmy
- Alterace metabolismu železa a utilizace substrátů v kardiomyocytech



- 25 pac (68y) do 5 dní od nástupu (24 ženy), LV_EF $45 \pm 8\%$ vs 25(24) matched controls (65y)
- 40% emoční, 28% fyzický, 32% idiopatický TTS
- Functional MRI mapping incl. structural connectivity

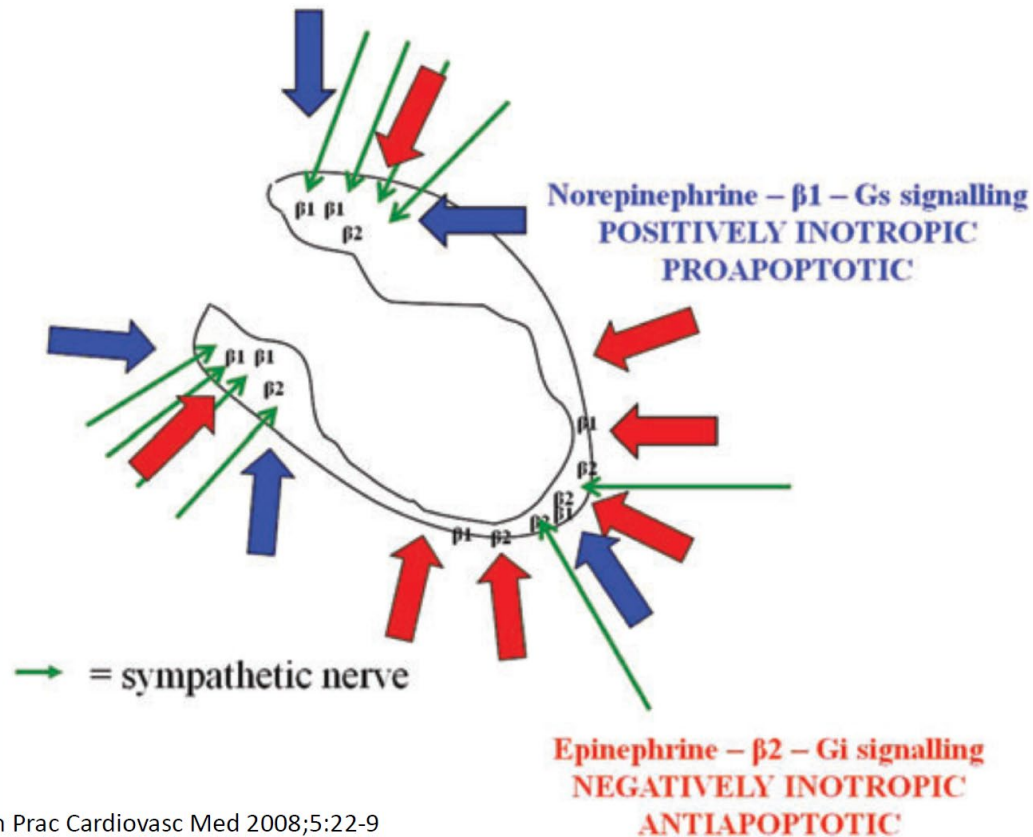
Structural and Functional Brain Changes in Acute Takotsubo Syndrome

Hilal Khan, MB BCh, BAO,^a David T. Gamble, MBChB,^a Amelia Rudd, RDCS, BSE,^a Alice M. Mezincescu, MD, PhD,^a



- Zvýšená tloušťka mozkové kůry, menší plocha
- Výraznější thalamus, insula a amygdala
- Absence small vessel disease
- Funkční hypokonektivita thalamus-amygdala-insula-bazální ganglia
- Zvýšená funkční konektivita korových oblastí

Distribuce adrenergických receptorů v myokardu

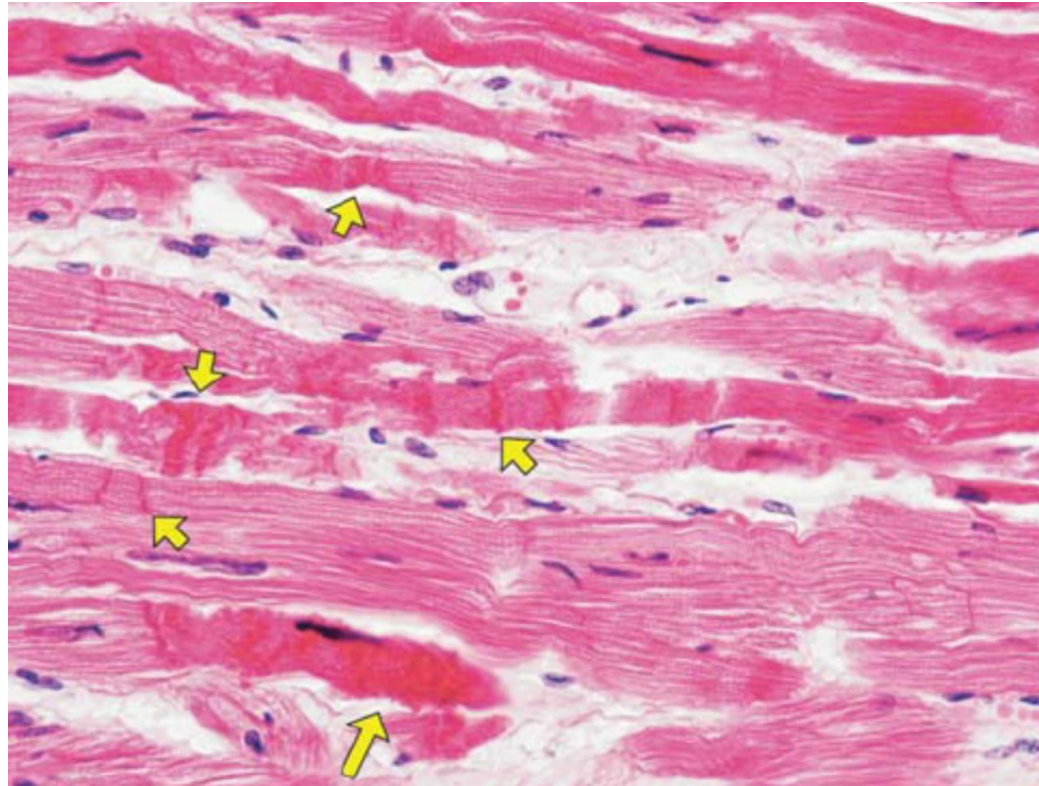


Lyon et al. Nat Clin Prac Cardiovasc Med 2008;5:22-9

- Efekt signálních membránových G proteinů

Contraction band necrosis....

- **sympathetic nervous system overstimulation**
- plasma katecholaminy a stresové peptidy násobně více než u STEMI
- cAMP mediated calcium overload-excessive contraction
- contraction band necrosis (x thrombosis related necrosis in myocardial infarction)



courtesy of Prof. Michelle Chew, Linköping University, Sweden

International Expert Consensus Document on Takotsubo Syndrome (Part I): Clinical Characteristics, Diagnostic Criteria, and Pathophysiology

Table I International Takotsubo Diagnostic Criteria (InterTAK Diagnostic Criteria)

1. Patients show transient^a left ventricular dysfunction (hypokinesia, akinesia, or dyskinesia) presenting as apical ballooning or midventricular, basal, or focal wall motion abnormalities. Right ventricular involvement can be present. Besides these regional wall motion patterns, transitions between all types can exist. The regional wall motion abnormality usually extends beyond a single epicardial vascular distribution; however, rare cases can exist where the regional wall motion abnormality is present in the subtended myocardial territory of a single coronary artery (focal TTS).^b
2. An emotional, physical, or combined trigger can precede the takotsubo syndrome event, but this is not obligatory.
3. Neurologic disorders (e.g. subarachnoid haemorrhage, stroke/transient ischaemic attack, or seizures) as well as pheochromocytoma may serve as triggers for takotsubo syndrome.
4. New ECG abnormalities are present (ST-segment elevation, ST-segment depression, T-wave inversion, and QTc prolongation); however, rare cases exist without any ECG changes.
5. Levels of cardiac biomarkers (troponin and creatine kinase) are moderately elevated in most cases; significant elevation of brain natriuretic peptide is common.
6. Significant coronary artery disease is not a contradiction in takotsubo syndrome.
7. Patients have no evidence of infectious myocarditis.^b
8. Postmenopausal women are predominantly affected.



European Journal of Heart Failure (2017) 19, 1036–1042
doi:10.1002/ehfj.683

RESEARCH ARTICLE

A novel clinical score (InterTAK Diagnostic Score) to differentiate takotsubo syndrome from acute coronary syndrome: results from the International Takotsubo Registry

Vedlejší efekty betamimetik

- Down regulace betareceptorů
- Fibrotizace myokardu se ztrátou kontraktility
- Brouri F, Eu J Pharmacol: Krysí model ligace koron tepny a 15 dní trvající zátěži Isoprenalinem



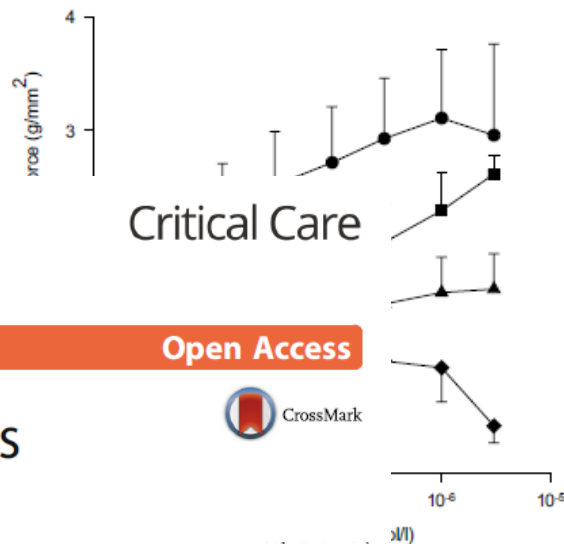
European Journal of Pharmacology 456 (2002) 69–75

ejp

www.elsevier.com/locate/ejphar

Toxic cardiac effects of catecholamines:
role of β -adrenoceptor downregulation

Fazia Brouri^a, Laurent Findji^a, Odile Mediani^a, Nathalie Mougnot^a, Naima Hanoun^b,
Gilles Le Naour^c, Michel Hamon^b, Philippe Lechat^{a,*}



Rudiger and Singer *Critical Care* (2016) 20:309
DOI 10.1186/s13054-016-1488-x

EDITORIAL

Open Access

Decatecholaminisation during sepsis

Alain Rudiger^{1*} and Mervyn Singer²

EGDT: demonstrate limitů betastimulace

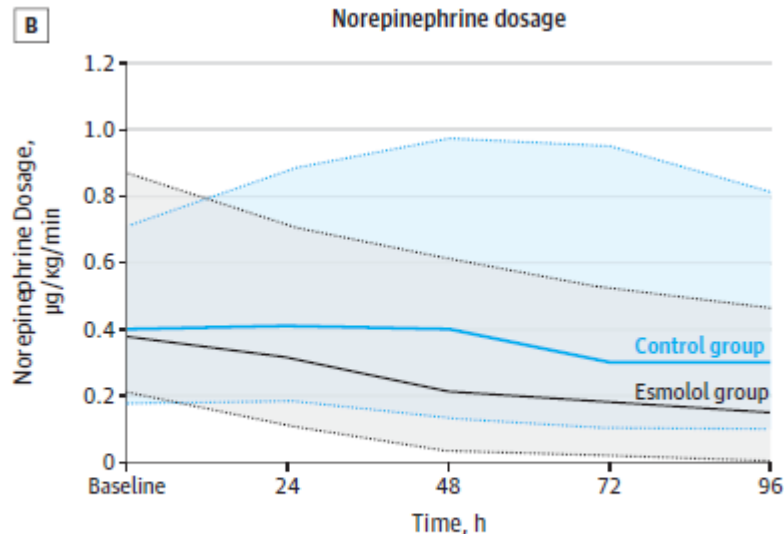
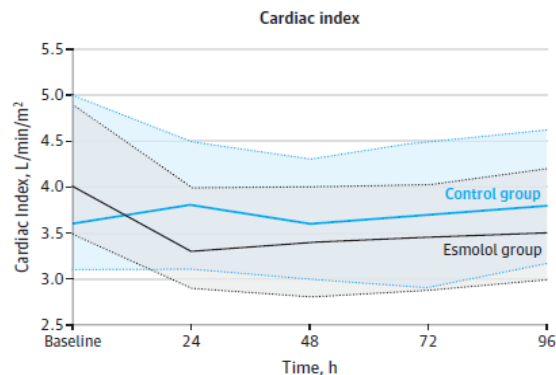
TABLE 5. Recommendations: Initial Resuscitation and Infection Issues

A. Initial Resuscitation	Surviving Sepsis Guidelines: Crit Care Med 2013
1. Protocolized, quantitative resuscitation of patients with sepsis-induced tissue hypoperfusion (defined in this document as hypotension persisting after initial fluid challenge or blood lactate concentration ≥ 4 mmol/L). Goals during the first 6 hrs of resuscitation: <ul style="list-style-type: none">a) Central venous pressure 8–12 mm Hgb) Mean arterial pressure (MAP) ≥ 65 mm Hgc) Urine output ≥ 0.5 mL/kg/hrd) Central venous (superior vena cava) or mixed venous oxygen saturation 70% or 65%, respectively (grade 1C).	
2. In patients with elevated lactate levels targeting resuscitation to normalize lactate (grade 2C).	

- Metaanalysis of EGDT shows ZERO IMPACT on MORTALITY, **2.7-3 x higher use of dobutamine**, red-cell transfusions (SE !). Gu WJ et al: Crit Care 2014
- ARISE (ANZICS CCgroup): NEJM 2014: 51 centers, 1600 pts: Fluid (1964 \pm 1415 ml vs. 1713 \pm 1401 ml), vasopressor (66.6% vs. 57.8%), red-cell transfusions (13.6% vs. 7.0%), **dobutamine (15.4% vs. 2.6%)** (P<0.001 for all comparisons). NO EFFECT on MORTALITY !

Effect of Heart Rate Control With Esmolol on Hemodynamic and Clinical Outcomes in Patients With Septic Shock A Randomized Clinical Trial

Surviving Sepsis Guidelines (EGDT)
+ ...median esmolol 100 mg/h: HR



($P < .001$; eTable 1 in the Supplement), the need for levosimendan rescue therapy did not differ between groups (49.4% of esmolol patients vs 40.3% control patients; $P = .39$). Fluid

Outcome	No. (%)		P Value
	Esmolol (n = 77)	Control (n = 77)	
Mortality			
28 d	38 (49.4)	62 (80.5)	<.001
ICU	44 (57.1)	68 (88.3)	<.001
Hospital	52 (67.5)	70 (90.9)	<.001
Length of ICU stay, d			
Median (IQR)	19 (11-27)	14 (7-25)	.03
Survivors', median (IQR)	17 (9-28)	21 (11-34)	.70
Cause of death, No./total, (%)			
Multiple organ failure	15/52 (28.8)	26/70 (37.1)	.71
Refractory hypotension	32/52 (61.6)	44/70 (62.9)	
Unknown cause	5/52 (9.6%)		

- NO echo
- EGDT static parameters
- Z betastimulace do betablokády!
- Very low dosage esmolol
- Fluid balance sig.positive

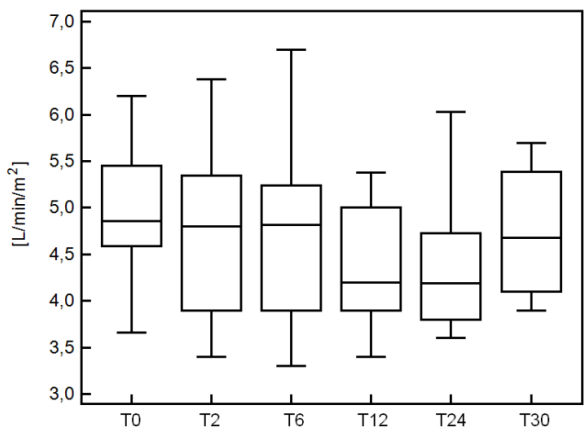
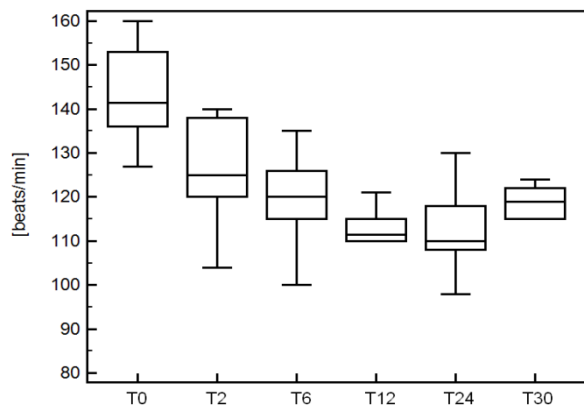
Echo guided betablockers in septic shock

Wien Klin Wochenschr
DOI 10.1007/s00508-012-0209-y

Wiener klinische Wochenschrift
The Central European Journal of Medicine

Concomitant use of beta-1 adrenoreceptor blocker and norepinephrine in patients with septic shock

Martin Balik, Jan Rulisek, Pavel Leden, Michal Zakharchenko, Michal Otahal, Hana Bartakova, Josef Korinek



Cardiac output
Stroke volume

HR × SV
(if SV unchanged)

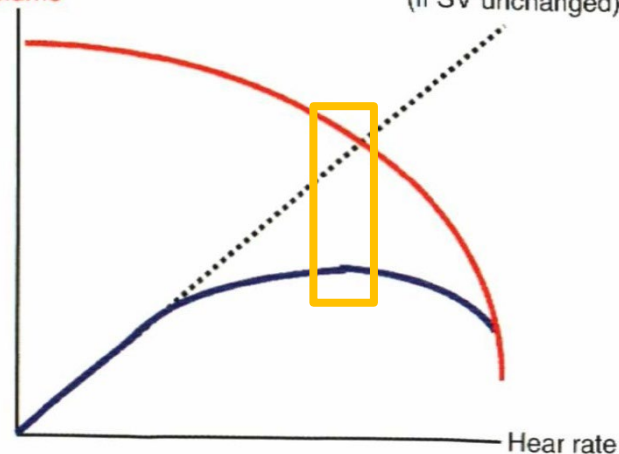


Fig. 9.1 Relationship between heart rate (HR) and stroke volume (SV) or cardiac output

Maizel J, Slama M: Haemodynamic Evaluation in the Patient with Arrhythmias. In: De Backer D, et al (eds) Hemodynamic Monitoring Using Echocardiography in the Critically Ill, Springer 2011, pp 89-95.

Esmolol: 213±64 mg/h - 273±90 mg/h (ve 24h)

Wien Klin Wochenschr
DOI 10.1007/s00508-013-0487-z

Wiener klinische Wochenschrift
The Central European Journal of Medicine

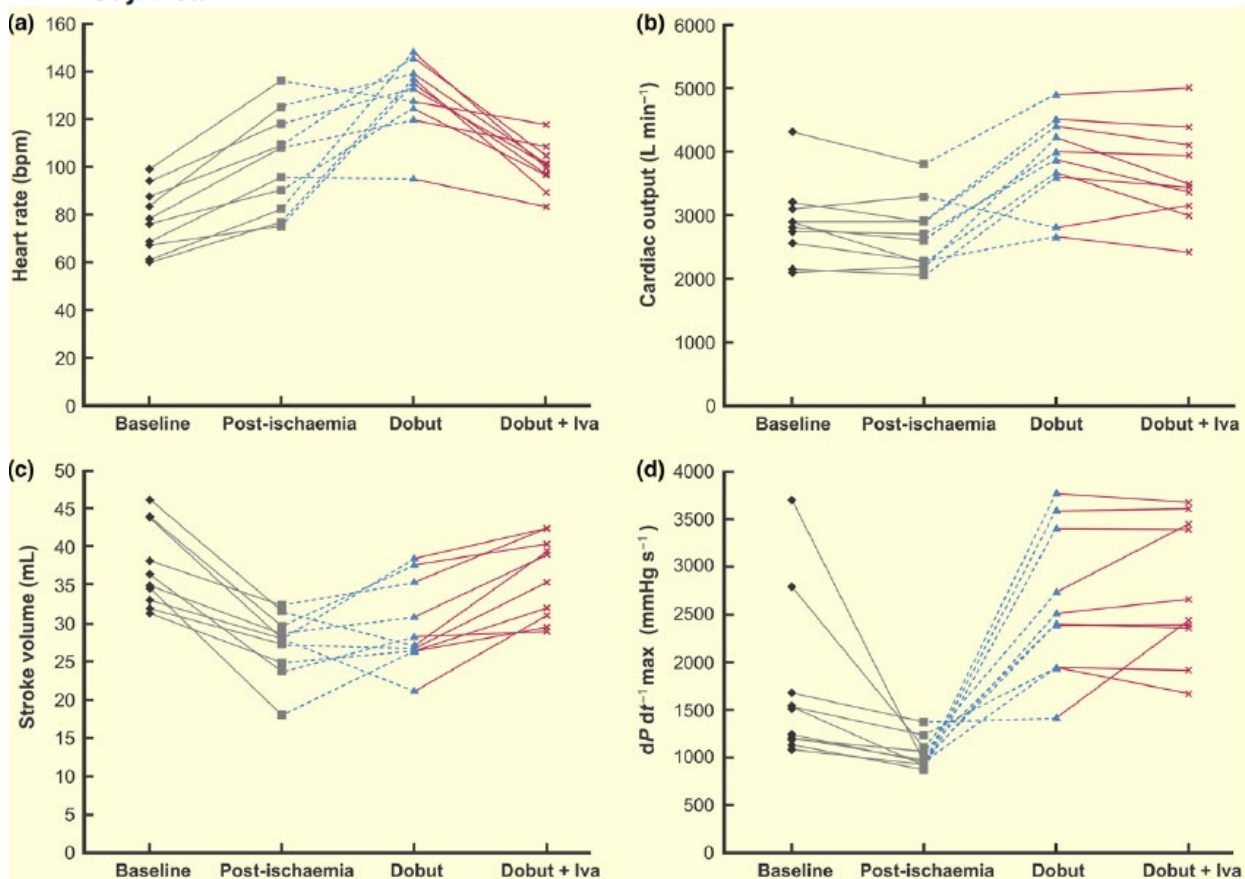
Concomitant use of beta-1 adrenoreceptor blocker and norepinephrine in patients with septic shock. Reply to a letter to the authors

Martin Balik · Jan Rulisek · Pavel Leden · Michal Zakharchenko · Michal Otahal · Hana Bartakova · Josef Korinek

No need for rescue levosimendan !

Reversing dobutamine-induced tachycardia using ivabradine increases stroke volume with neutral effect on cardiac energetics in left ventricular post-ischaemia dysfunction

J. P. Bakkehaug,¹ T. Næsheim,² E. Torgersen Engstad,¹ A. B. Kildal,¹ T. Myrnes^{2,3} and O.-J. How¹



- 12 pigs

- 5 $\mu g/kg \cdot min$
Dobutamine

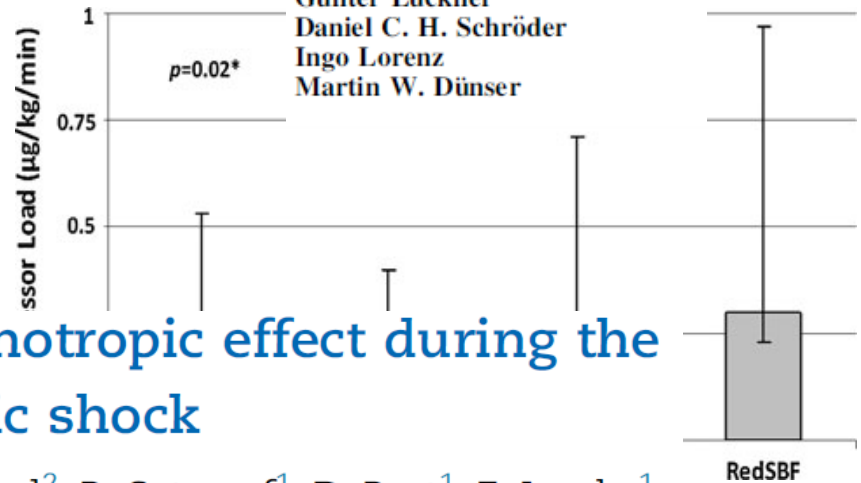
- Přidán
ivabradine 0.5
mg/kg

- Snížení HR
bez vlivu na
hemodynamiku
=
kardioprotekce

Vedlejší efekty „vazopresoru“

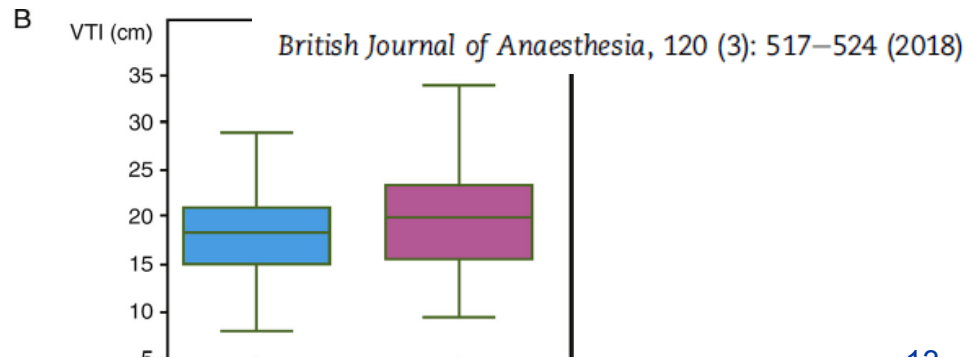
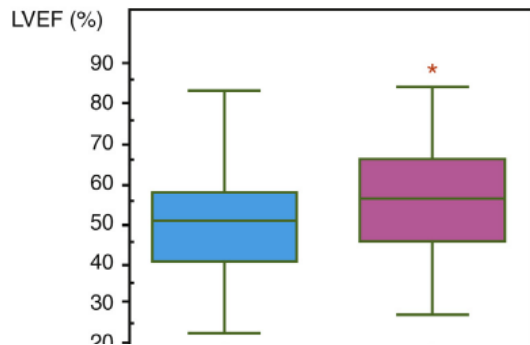
- 54 ze 112 surgical ICU (48%)
- 49% tachyarytmie (TA)
- 24% tachykardie (PEHR)
- 17% pozitivita TnT (AMI)

Christian A. Schmittinger
Christian Torgersen
Günter Luckner
Daniel C. H. Schröder
Ingo Lorenz
Martin W. Dünser



Norepinephrine exerts an inotropic effect during the early phase of human septic shock

O. Hamzaoui^{1,*}, M. Jozwiak², T. Geffriaud², B. Sztrymf¹, D. Prat¹, F. Jacobs¹, X. Monnet², P. Trouiller¹, C. Richard² and J.L. Teboul²



- distribuce katecholamin. receptorů ($\beta_1:\beta_2 = 60:40 \dots 50:50$, α_1 až polovina)

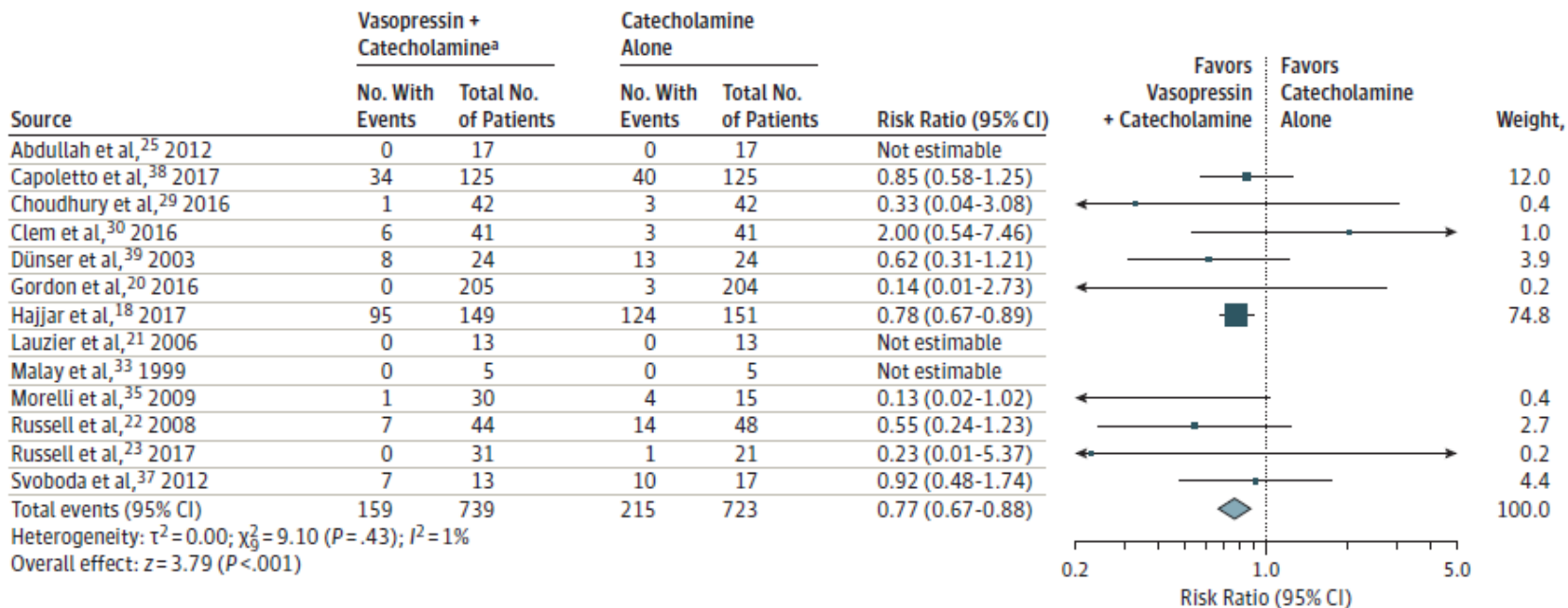
Association of Vasopressin Plus Catecholamine Vasopressors vs Catecholamines Alone With Atrial Fibrillation in Patients With Distributive Shock

A Systematic Review and Meta-analysis

William F. McIntyre, MD; Kevin J. Um, BA; Waleed Alhazzani, MD, MSc; Alexandra P. Lengyel; Ludhmila Hajjar, MD; Anthony C. Gordon, MD; François Lamontagne, MD, MSc; Jeff S. Healey, MD, MSc; Richard P. Whitlock, MD, PhD; Emilie P. Belley-Côté, MD, MSc

- 23 PRCTs, 3088 pts
- OR 0.77 for AF in AVP+NAD

A Atrial fibrillation



Preload+afterload+anatomická predispozice..... Dynamická LVOT obstrukce

- LVOT gradient > 30 mmHg při zátěži (Nistri S, et al: Am J Cardiol 2012)
- Septum sigmoideum - angulace subaortálně >15 mm s normální midseptální tloušťkou
- ESLV axis úhel k LVOT $> 60^\circ$
- Prominentní papilární sval okluduje $> \frac{1}{2}$ LVESD
- Koncentrická hypertrofie

Cha et al. Cardiovascular Ultrasound 2014, 12:23
<http://www.cardiovascularultrasound.com/content/12/1/23>



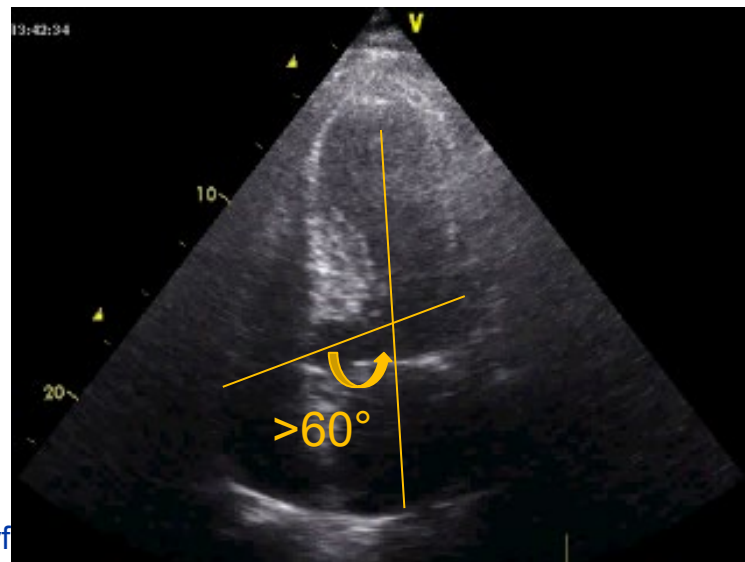
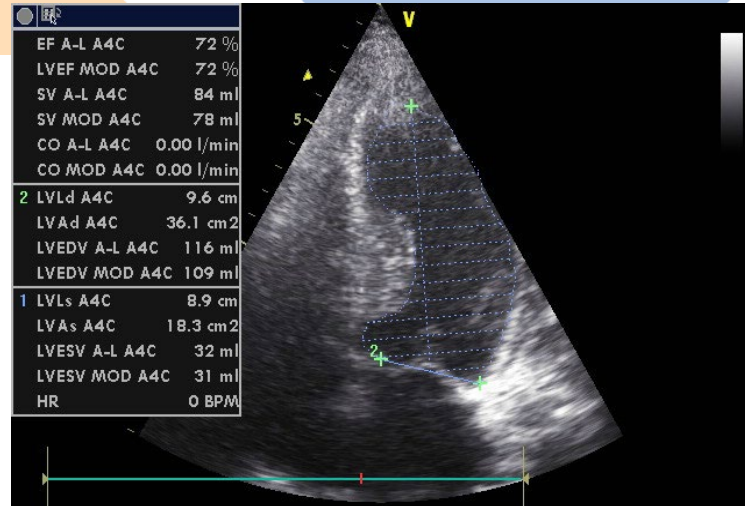
CARDIOVASCULAR
ULTRASOUND

RESEARCH

Open Access

Diverse geometric changes related to dynamic left ventricular outflow tract obstruction without overt hypertrophic cardiomyopathy

Jung-Joon Cha[†], Hyemoun Chung[†], Young Won Yoon^{*}, Ji Hyun Yoon, Jong-Youn Kim, Pil-Ki Min, Byoung-Kwon Lee, Bum-Kee Hong, Se-Joong Rim, Hyuck Moon Kwon and Eui-Young Choi^{*}



-vf

LVOTO jako primární indikace k vasopressinu

LVOTO

1.8-1.9% septických šoků

Cardiovascular Drugs and Therapy
<https://doi.org/10.1007/s10557-020-06998-8>

SHORT COMMUNICAITON



Vasopressin in Patients with Septic Shock and Dynamic Left Ventricular Outflow Tract Obstruction

Martin Balik¹ · Adam Novotny¹ · Daniel Suk¹ · Vojtech Matousek¹ · Michal Maly¹ · Tomas Brozek¹ · Guido Tavazzi²

Chauvet *et al. Critical Care* (2015) 19:262
DOI 10.1186/s13054-015-0980-z

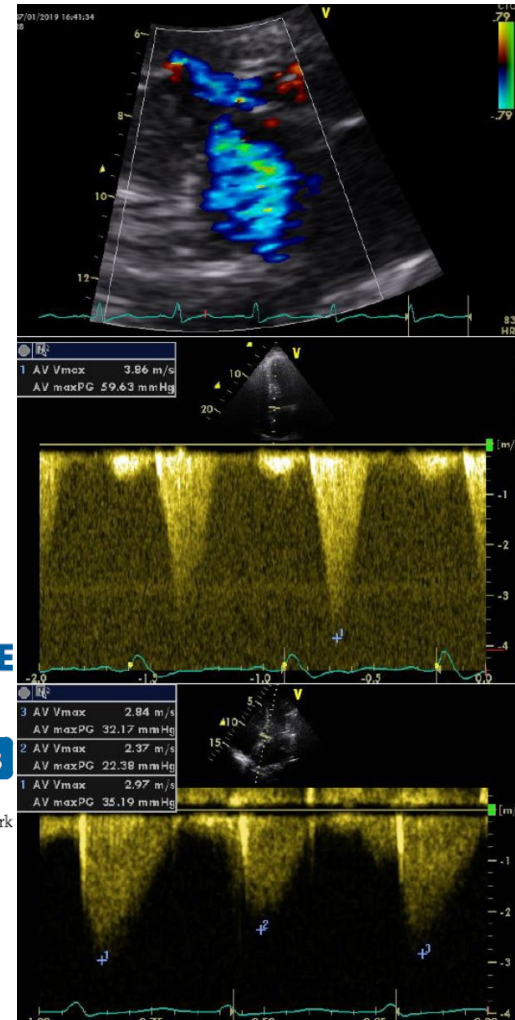


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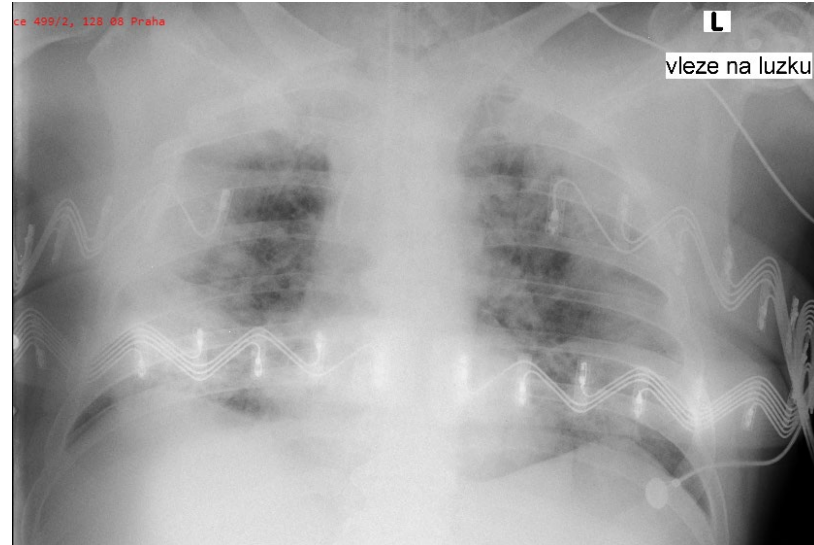
Early dynamic left intraventricular obstruction is associated with hypovolemia and high mortality in septic shock patients

1.LF UK A VFN V PRAZE



Dekatecholaminizace: The basics

- Muž 56 let, obezita, HT, SARS-CoV-2 ARDS
- Horowitz 50-60, agresivní UPV, ΔP_{aw} 28....20, PCT trvale nad 10
- Po týdnu propad CI na 1.9-2.1 l/min.m²
- Nasazen dobutamin 3-7 ug, bez většího efektu – arytmie
- NAD 0.8-1.0 ug/kg.min
- TTE a TEE (AR...)



Th: AAI 100/min, dobutamin EX, AVP, titrace preload

TTE +24h:

- EFLK 45%, SV 60 ml, CI nad 2.5 l/min.m²
- AR max středně významná
- PK se zlepšením
- NAD 0.45 ug/kg.min, AVP 4 IU/h
- VA-ECMO back up
- 14.3.: dimise, rehabilitující



Severe Covid-19 ARDS: risk of biventricular stress cardiomyopathy

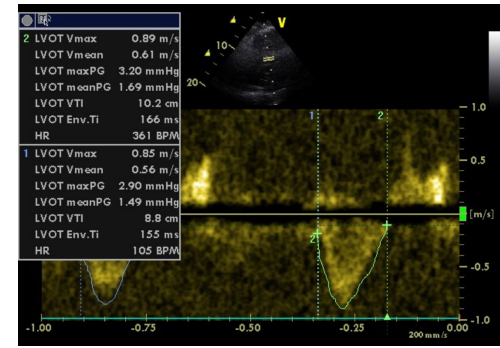
- RV on IPPV / ARDS / PE
- stress cardiomyopathy (...hypoxia, arrhythmias, catecholamines)
- septic cardiomyopathy in superinfections
- coronary endothelium, microembolisations

JACC REVIEW TOPIC OF THE WEEK

Pathological Evidence for SARS-CoV-2 as a Cause of Myocarditis

JACC Review Topic of the Week

Rika Kawakami, MD,^{a,*} Atsushi Sakamoto, MD,^{a,*} Kenji Kawai, MD,^a Andrea Gianatti, MD,^b Dario Pellegrini, MD,^b myocarditis only 4.5% of heart failures



VA-ECMO in septic shock – substituting CO and chasing SVR.....(MAP = CO x SVR)

Septic cardiomyopathy 15-60%
(Vieillard-Baron A: Crit Care 2013)

VA or VAV-ECMO according to „inadequate cardiac output“

Venoarterial Extracorporeal Membrane Oxygenation Support for Refractory Cardiac Dysfunction During Severe Bacterial Septicemia

Nicolas Bréchet, MD, PhD¹; Charles-Edouard Luyt, MD, PhD¹; Matthieu Schmidt, MD, PhD²; Pascal Leprince, MD, PhD²; Jean-Louis Trouillet, MD¹; Philippe Léger, MD²; Alain Jean Chastre, MD¹; Alain Combes, MD, PhD¹

Original Paper

Perfusion

Veno-arterio-venous ECMO for septic cardiomyopathy: a single-centre experience

Perfusion
2018, Vol. 33(15) 57-64
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sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/0267659118766833
journals.sagepub.com/home/prf
SAGE

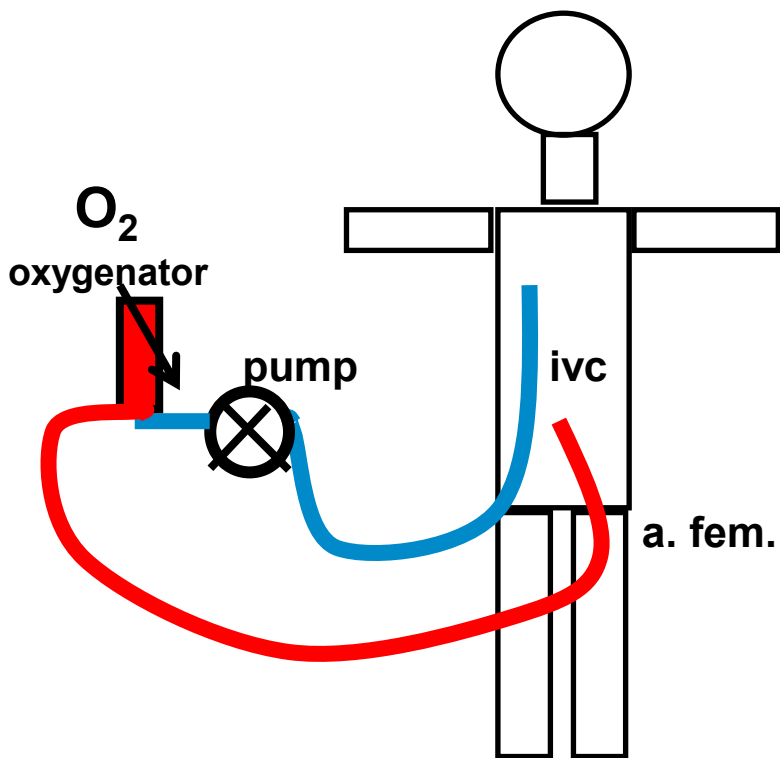
Dominik J. Vogel,¹ Josie Murray,¹ Adam Z. Czapan,¹ Luigi Camporota,¹ Nicholas Ioannou,¹ Chris I. S. Meadows,¹ Peter B. Sherrin,¹ Kathleen Daly,¹ Nigel Gooby² and Nicholas Barrett¹

Time on VAV ECMO (days)	4 (3.0-5.3)
Total time on ECMO (days)	9 (7.5 to 15.5)
Time until LVEF normal (days)	9 (4 to 12)
Time on ventilator (days)	15 (6.5 to 32.5)
Time on renal-replacement-therapy (days)	5 (2.5 to 22.5)
Length of ICU stay (days)	21 (11 to 38)
Length of hospital stay (days)	62 (36.5 to 67.5)
Predicted hospital survival by SAVE score risk class	30% (30 to 42)
Discharged alive from ICU	9/12 (75%)
Discharged alive from hospital	9/12 (75%)
Alive at follow-up	9/12 (75%)



Successful Use of Extra-corporeal Membrane Oxygenation in a Patient with Streptococcal Sepsis: A Case Report and Review of Literature
Pořízka M.¹, Kopecký P.¹, Prskavec T.², Kunstýř J.¹., Rulíšek J.¹, Balík M.¹
Prague Medical Report 2015, 116(1):57-63.

Heart and lung replacement: Femoro-femoral V-A ECMO



TTS outcome

- acute phase complications similar to ACS (19.1%), 4% inhospital mortality, 5.6% mortality per year, 5% recurrence
- long term follow up – missing for ICU patients
- 147 patients, 33.3% (47) died within 126 months

Wien Klin Wochenschr (2022) 134:261–268
<https://doi.org/10.1007/s00508-021-01925-9>

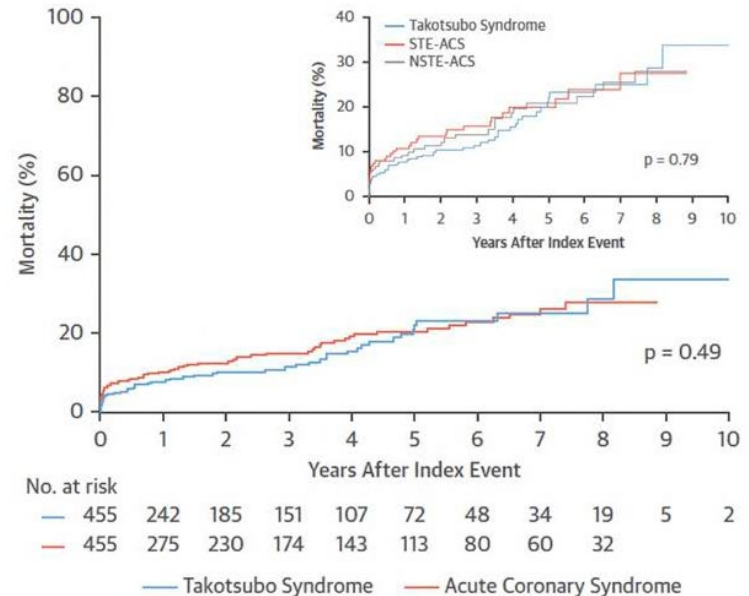
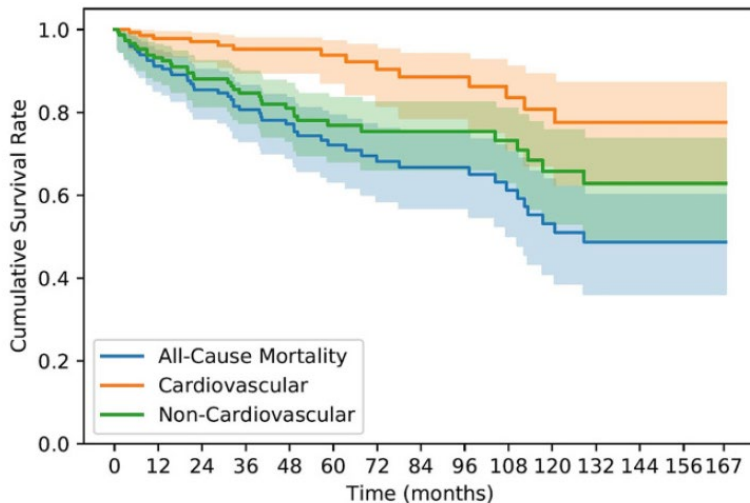


Wiener klinische Wochenschrift
 The Central European Journal of Medicine

Long-term outcome in patients with takotsubo syndrome

A single center study from Vienna

Edita Pogranj · Ahmed Abd El-Razek · Laura Gargiulo · Valerie Weihs · Christoph Kaufmann · Samuel Horváth · Alexander Geppert · Michael Nürnberg · Emil Wessely · Peter Smetana · Kurt Huber



IN DEPTH

Takotsubo Syndrome: Pathophysiology, Emerging Concepts, and Clinical Implications

Trisha Singh, BM; Hilal Khan, MB BCh BAO, MRCP; David T. Gamble, MPharm, MBBS; Caroline Scally, MBChB; David E. Newby, DM, PhD; Dana Dawson, MD, DPhil

Děkuji za pozornost !



**XVI. kongres České společnosti intenzivní medicíny
s mezinárodní účastí
18.6.-20.6.2023, Hotel Galant, Mikulov
www.csim.cz/kongres**



**ČSKA SPOLEČNOST
INTENZIVNÍ MEDICÍNY**