Zobrazovací metody, které musím umět 24/7

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České kardiologické dny, Top Hotel, Praha, 20. – 21. listopadu 2017

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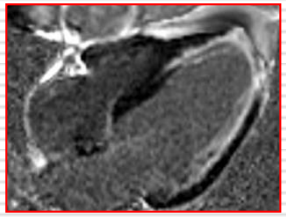
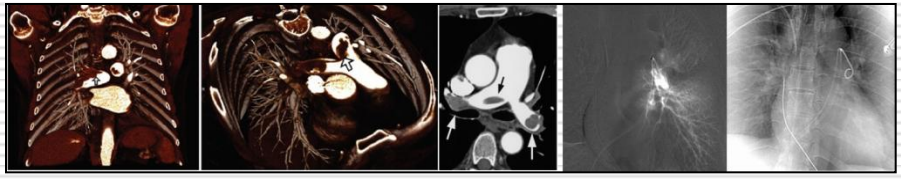
Zobrazovací metody srdce

Magnetická rezonance

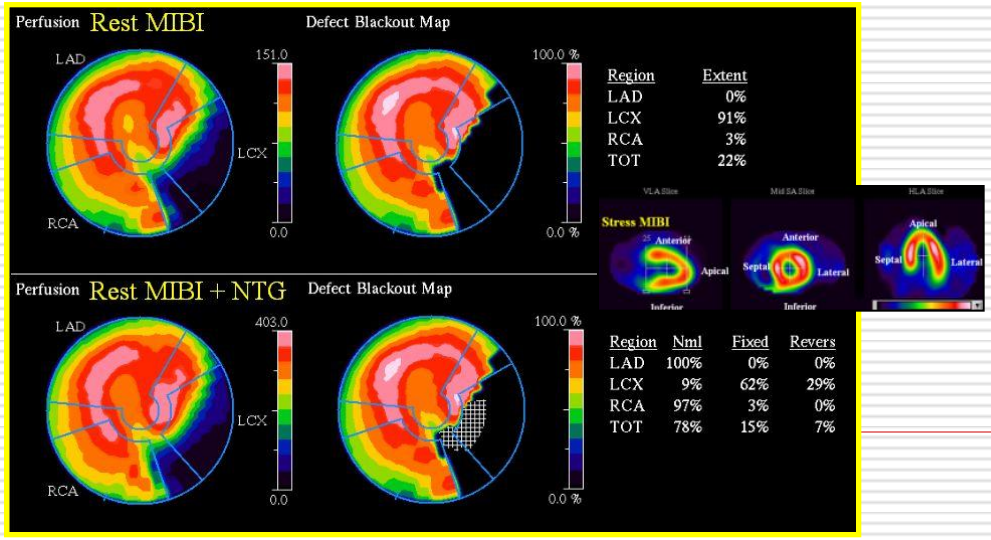


Echokardiografie – TTE, TEE, ICE

CT

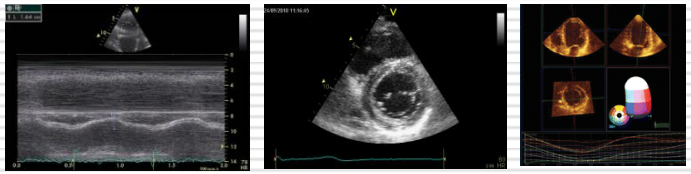


SPECT a PET myokardu

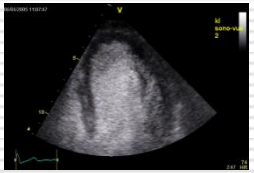


TTE/TEE/ICE a způsoby zobrazení

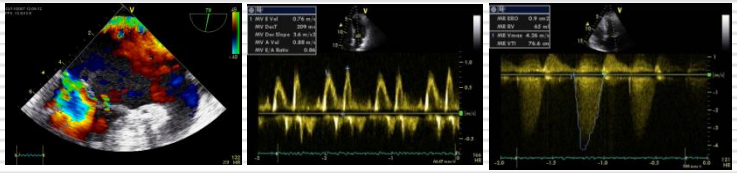
- **MM/2DE/RT 3DE**



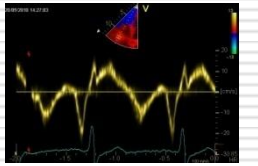
- **CEE**



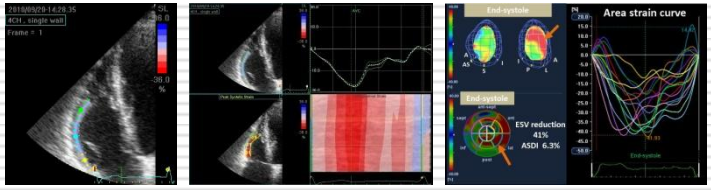
- **Doppler (CFM, PWD, CWD)**



- **Tissue Doppler imaging**



- **2D/3D strain**



UZ vyšetření hrudníku

European Heart Journal (2016) 37, 2097–2104
doi:10.1093/eurheartj/ehw164

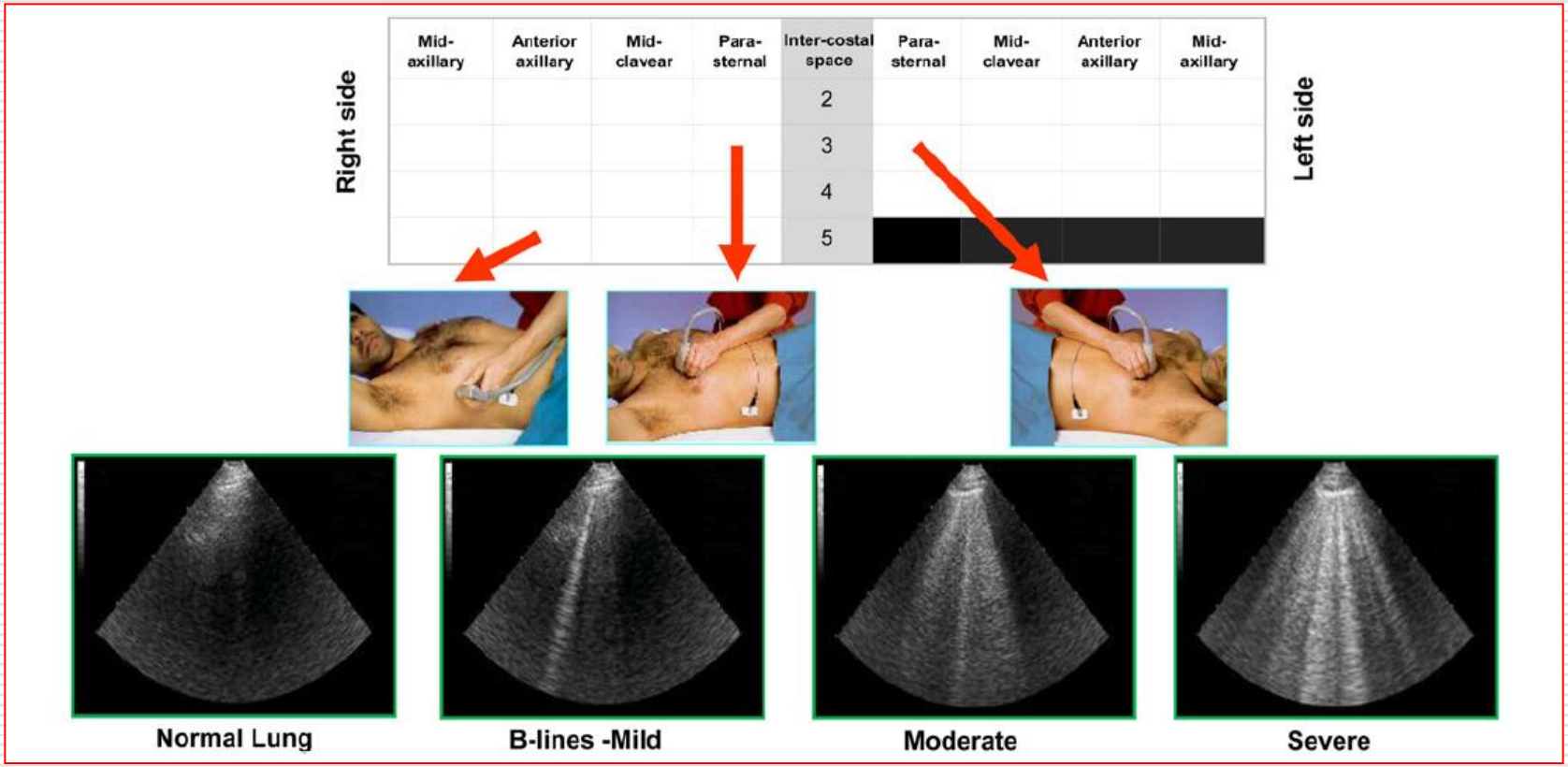
REVIEW

Clinical update

Ultrasound of extravascular lung water: a new standard for pulmonary congestion

Eugenio Picano[1]* and Patricia A. Pellikka[2]

[1]CNR Institute of Clinical Physiology, Italian National Research Council, Pisa 56124, Italy; and [2]Department of Cardiovascular Diseases, Mayo Clinic College of Medicine, Rochester, MN, USA



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Přehledový článek I Review article

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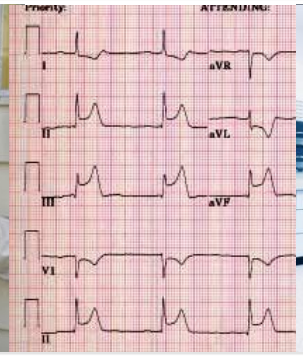
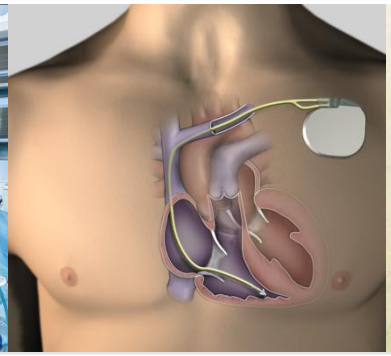
Souhrn dokumentu připravený Českou kardiologickou společností

(The use of echocardiography in acute cardiovascular care.
Summary of the document prepared by the Czech Society of Cardiology)

Martin Hutyra[a], Tomáš Paleček[b], Milan Hromádka[c]

Kdy, komu a proč?





Systolické srdeční selhání	Srdeční selhání se zachovanou ejekční frakcí levé komory	Plicní embolie	Tamponáda[e]
1. EFLK < 45–50 % 2. LVEDD > 55 mm a/nebo > 32 mm/m^2 3. LVESD > 45 mm[a] a/nebo > 25 mm/m^2 4. LVEDV > 97 ml/m^2 5. LVESV > 43 ml/m^2 6. Abnormální kinetika 7. Funkční MiR a/nebo TR 8. Vrcholová rychlost TR > 3 m/s 9. Aortální časově-rychlostní integrál < 15[a] 10. Diastolická dysfunkce (E/A ≥ 2 + DT < 150 ms indikují zvýšené plnicí tlaky LV)[b] 11. Ultrazvukové plicní komety[c]	1. EFLK ≥ 50 % 2. LVEDV < 97 ml/m^2 3. LVESV < 43 ml/m^{2a} 4. E-e´ ≥ 13[b] 5. Ar-A ≥ 30 ms 6. Objem levé síně ≥ 34 ml/m^2 7. Vrcholová rychlost TR > 3 m/s 8. Ultrazvukové plicní komety[c] + známky a symptomy srdečního selhání	1. Trombus v pravostranných srdečních oddílech 2. Abnormální pohyb septa komor 3. Dilatace pravé síně, pravé komory (poměr end--diastolických rozměrů, resp. ploch pravé a levé komory > 0,6, resp. > 1,0) 4. Globální hypokineze pravé komory 5. McConnellovo znamení hyperkineze hrotu pravé komory[d] 6. Lehká až těžká TR 7. Plicní hypertenze přibližně 40–50 mm Hg (> 60 mm Hg v případě preexistující plicní hypertenze)	1. Obvykle velký perikardiální výpotek 2. Obraz „swingujícího" srdce 3. Kolaps pravé síně (zřídka levé síně) 4. Diastolický kolaps volné stěny pravé komory (zřídka levé komory) 5. Dilatace IVC (bez kolapsu v inspiriu) 6. Nárůst transtrikuspidálního toku a pokles transmitrálního toku v průběhu inspiria (opačný děj v exspiriu) 7. Redukce systolických a diastolických toků v systémových žilách a nárůst revezního toku při pravosíňové kontrakci během exspiria

Co lze očekávat od zobrazovacích metod v prostředí IP/ER?

- ✓ Stanovení **diagnózy** s možností volby kauzální terapie
- ✓ Predikci krátkodobé a dlouhodobé **prognózy**
- ✓ Optimalizace **terapie**
  - Hemodynamika
  - Zajištění centrálního žilního a arteriálního vstupu
  - Guiding punkčních výkonů (perikard, pleura,…)

(DIFERENCIÁLNÍ) DIAGNÓZA

I. INTERNÍ KLINIKA
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Bolesti na hrudi

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European Heart Journal (2012) 33, 2551–2567
doi:10.1093/eurheartj/ehs184

EXPERT CONSENSUS DOCUMENT

Third universal definition of myocardial infarction

Kristian Thygesen, Joseph S. Alpert, Allan S. Jaffe, Maarten L. Simoons, Bernard R. Chaitman and Harvey D. White: the Writing Group on behalf of the Joint ESC/ACCF/AHA/WHF Task Force for the Universal Definition of Myocardial Infarction

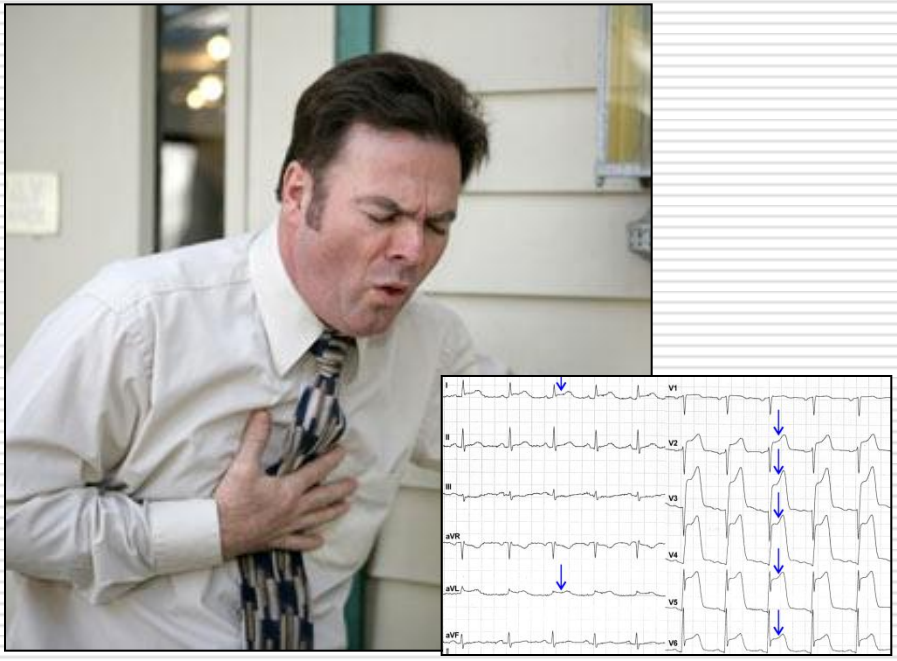
Doporučení pro provedení echokardiografie u nemocných s akutní bolestí na hrudi

Echokardiografické vyšetření je doporučeno:

1. při podezření na myokardiální ischemii, nediagnostickém EKG a markerech myokardiální nekrózy, pokud je možné echokardiografické vyšetření provést při trvající bolesti na hrudi;
2. při známém onemocnění srdce (chlopenní vada, choroba myokardu či perikardu);
3. při hemodynamické nestabilitě neodpovídající na jednoduchá léčebná opatření;
4. při podezření na akutní aortální syndrom, myokarditidu, perikarditidu či plicní embolii.

Echokardiografické vyšetření není doporučeno:

1. při zjevné nekardiální příčině bolesti na hrudi;
2. při trvající bolesti na hrudi u nemocného s potvrzenou diagnózou ischemie/infarktu myokardu.



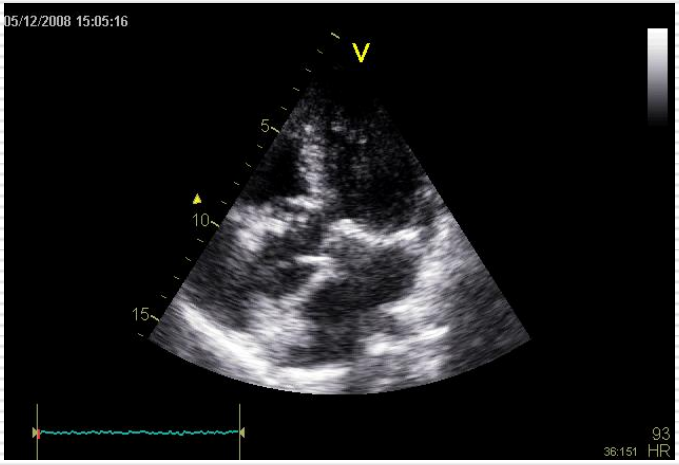
Definition of myocardial infarction

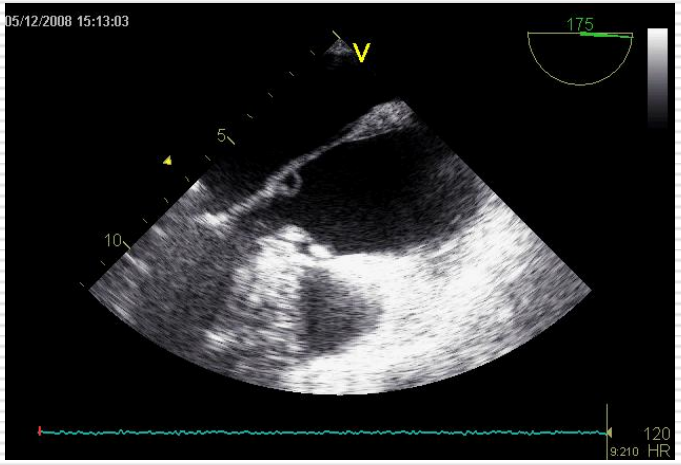
Criteria for acute myocardial infarction

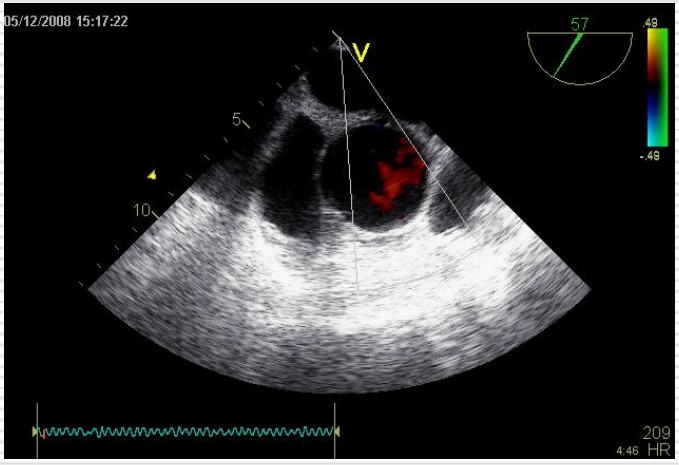
The term acute myocardial infarction (MI) should be used when there is evidence of myocardial necrosis in a clinical setting consistent with acute myocardial ischaemia. Under these conditions any one of the following criteria meets the diagnosis for MI:

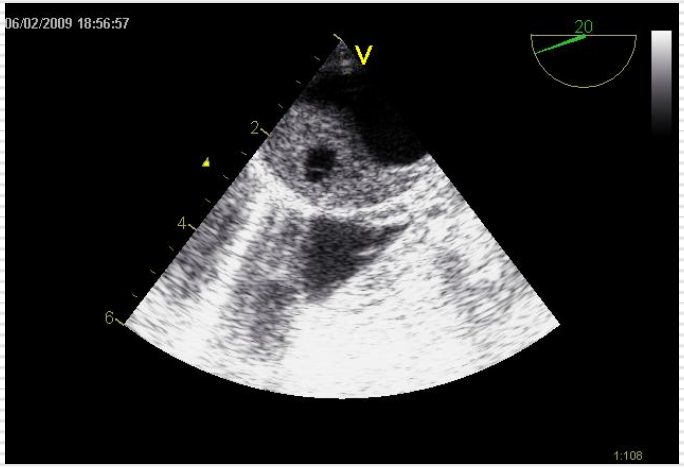
- Detection of a rise and/or fall of cardiac biomarker values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile upper reference limit (URL) and with at least one of the following:
  - Symptoms of ischaemia.
  - New or presumed new significant ST-segment–T wave (ST–T) changes or new left bundle branch block (LBBB).
  - Development of pathological Q waves in the ECG.
  - Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.
  - Identification of an intracoronary thrombus by angiography or autopsy.

Aortální disekce prox.









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Dušnost a oběhová nestabilita

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Martin Hutyra[a], Tomáš Paleček[b], Milan Hromádka[c]

Doporučení pro provedení echokardiografie u pacientů prezentujících se šokem

Echokardiografické vyšetření je doporučeno:

1. Pro diferenciální diagnostiku příčiny hypotenze nebo šoku detekcí srdečních nebo nekardiálních příčin oběhové nestability.
2. V rámci rozlišení různých srdečních příčin kardiogenního šoku a podpory léčebných postupů včetně chirurgické intervence.

Doporučení pro provedení echokardiografie u nemocných s akutní dušností

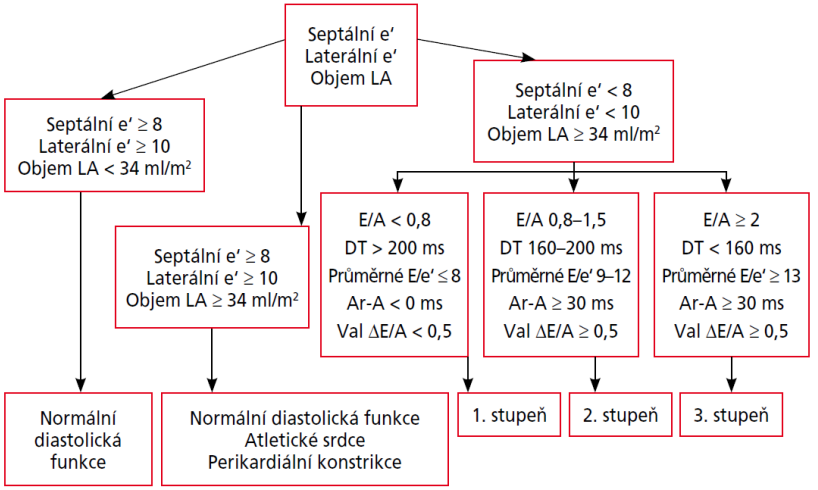
Echokardiografické vyšetření je doporučeno:

1. pro odlišení kardiální vs. nekardiální etiologie dušnosti u nemocných s nejednoznačnými klinickými a laboratorními nálezy;
2. pro zhodnocení velikosti a funkce levé komory u nemocných se suspektní klinickou diagnózou srdečního selhání;
3. při určování příčiny selhání odpojení od umělé plicní ventilace.

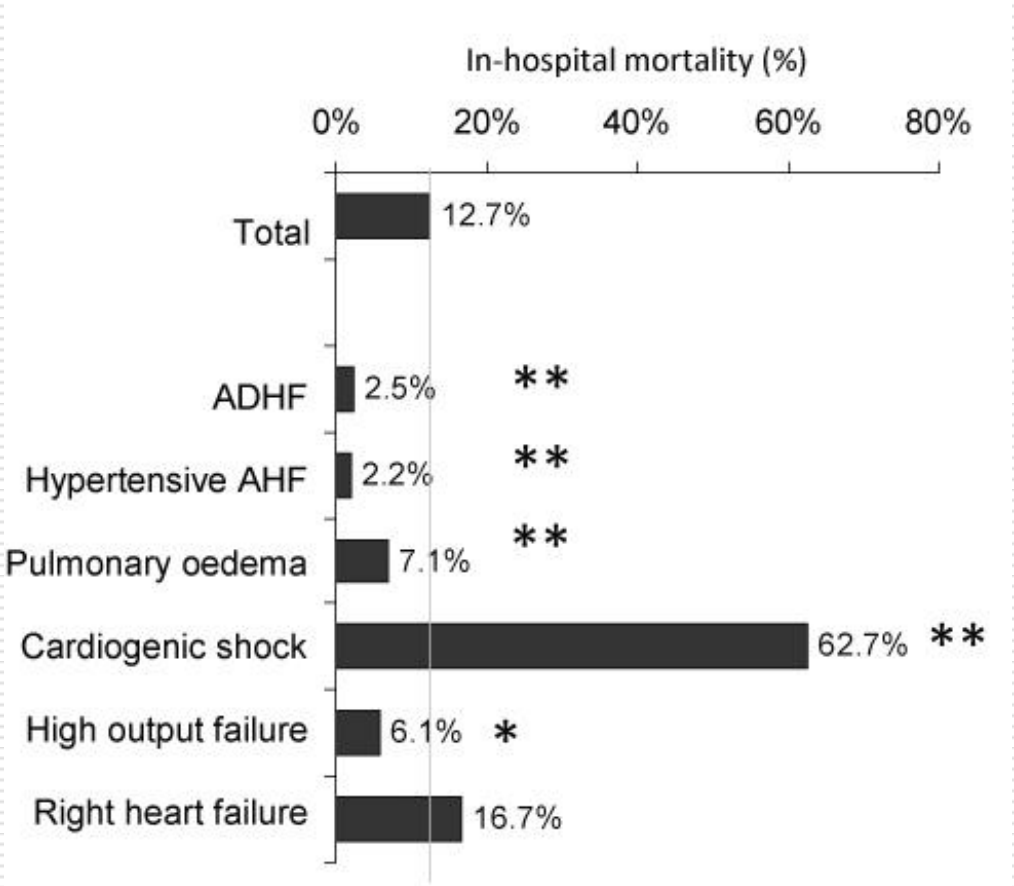
Echokardiografické vyšetření není doporučeno:

1. při zjevné nekardiální příčině dušnosti.

Praktický přístup k hodnocení diastolické dysfunkce levé komory pomocí echokardiografie



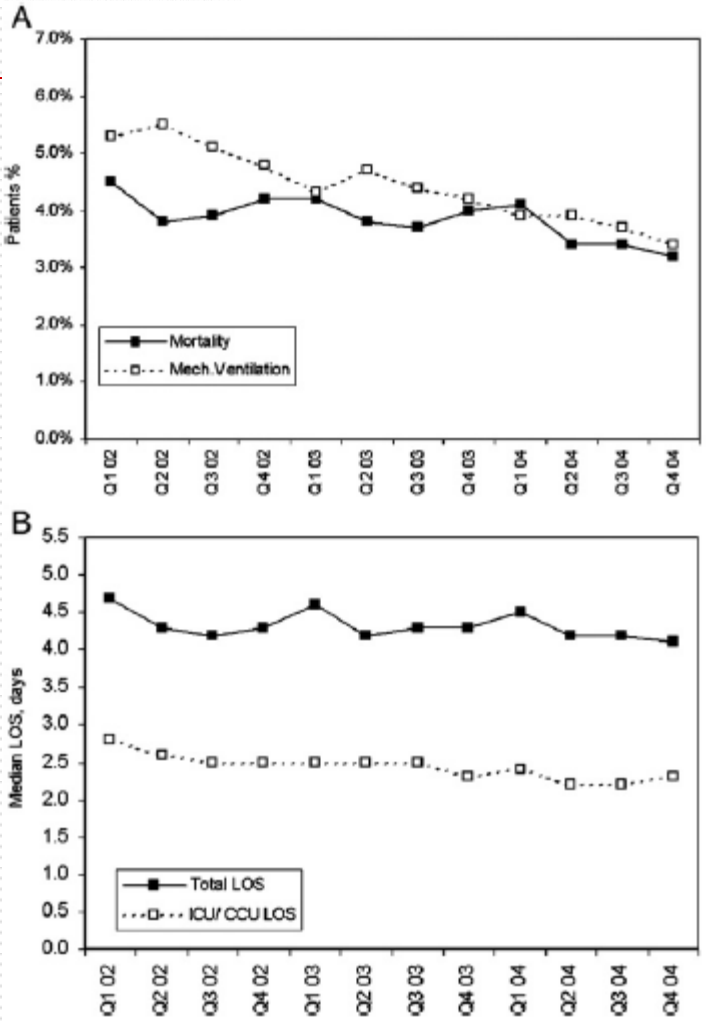
Kardiogenní šok



Congestive Heart Disease

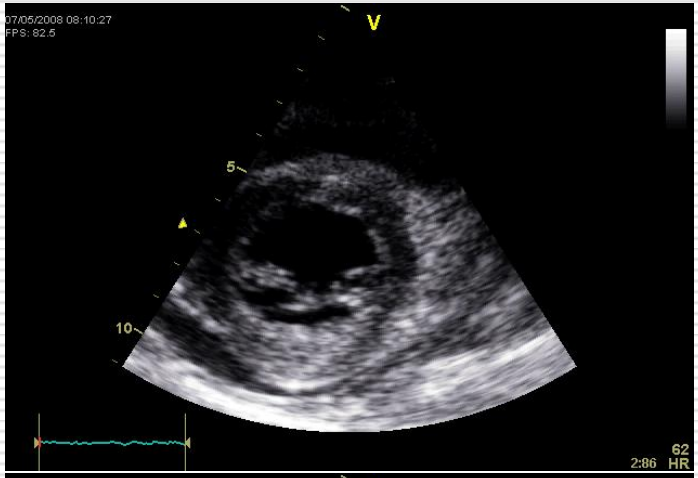
Temporal trends in clinical characteristics, treatments, and outcomes for heart failure hospitalizations, 2002 to 2004: findings from Acute Decompensated Heart Failure National Registry (ADHERE)

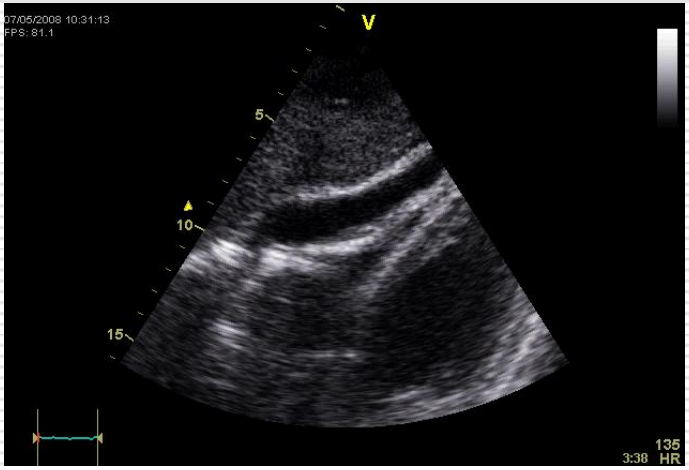
Gregg C. Fonarow, MD,[a] J. Thomas Heywood, MD,[b] Paul A. Heidenreich, MD, MS,[c] Margarita Lopatin, MS,[d] and Clyde W. Yancy, MD,[e] for the ADHERE Scientific Advisory Committee and Investigators *Los Angeles, La Jolla, Palo Alto, and Fremont, CA; and Dallas, TX*

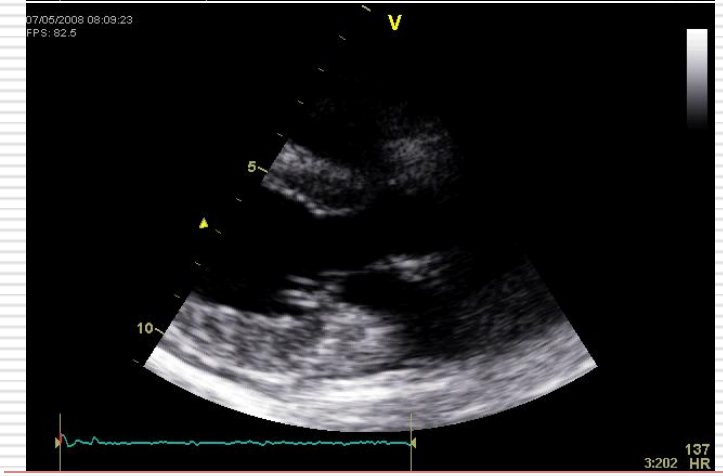


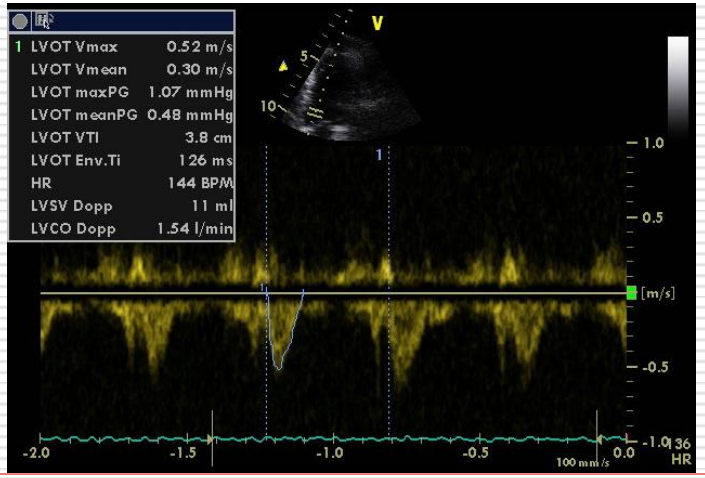
Spinar *et al. Critical Care* 2011 **15**:R291 doi:10.1186/cc10584

Akutní myokarditida

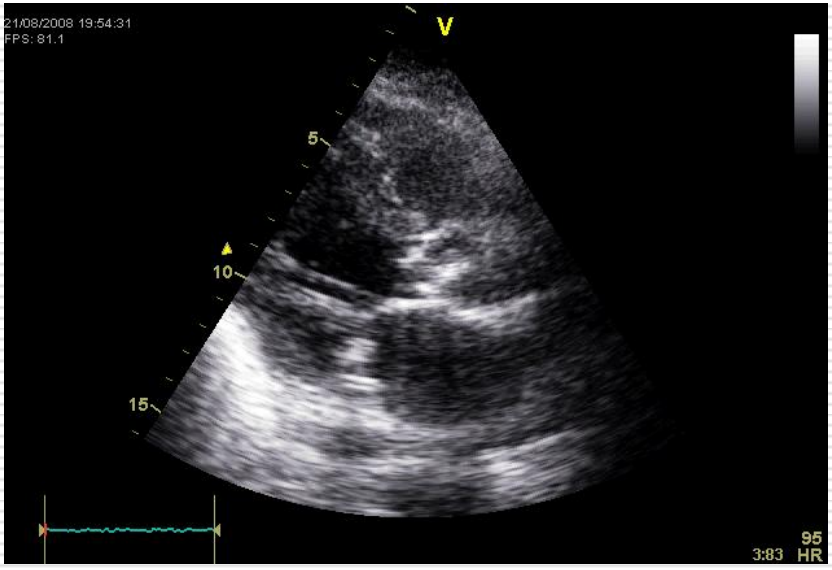


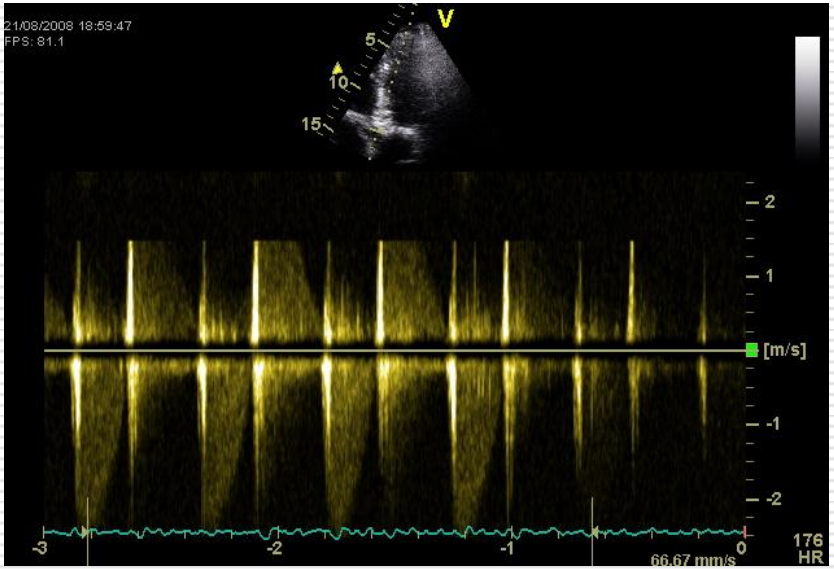




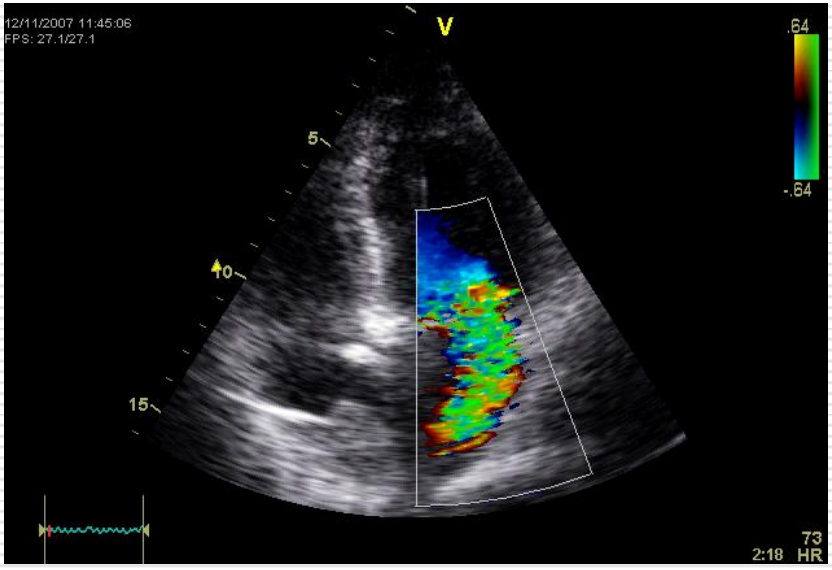


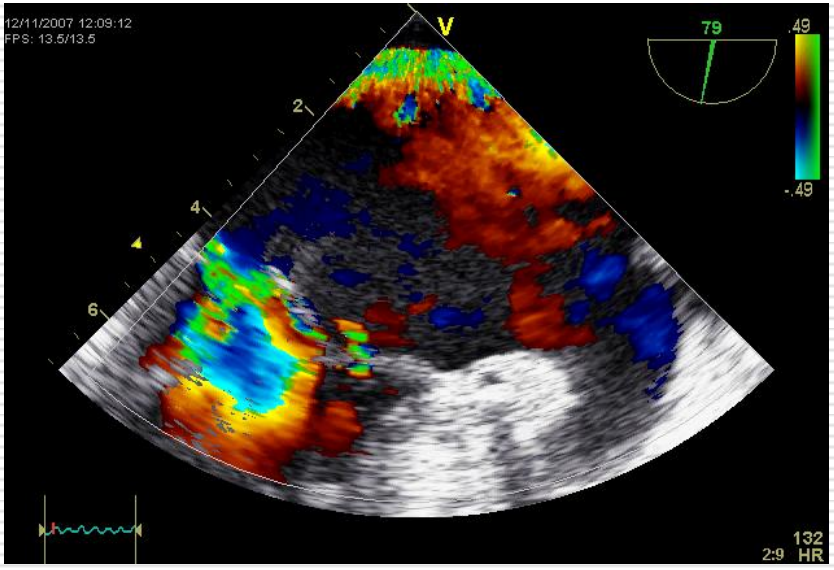
Akutní aortální regurgitace, destrukce chlopně infekční endokarditidou



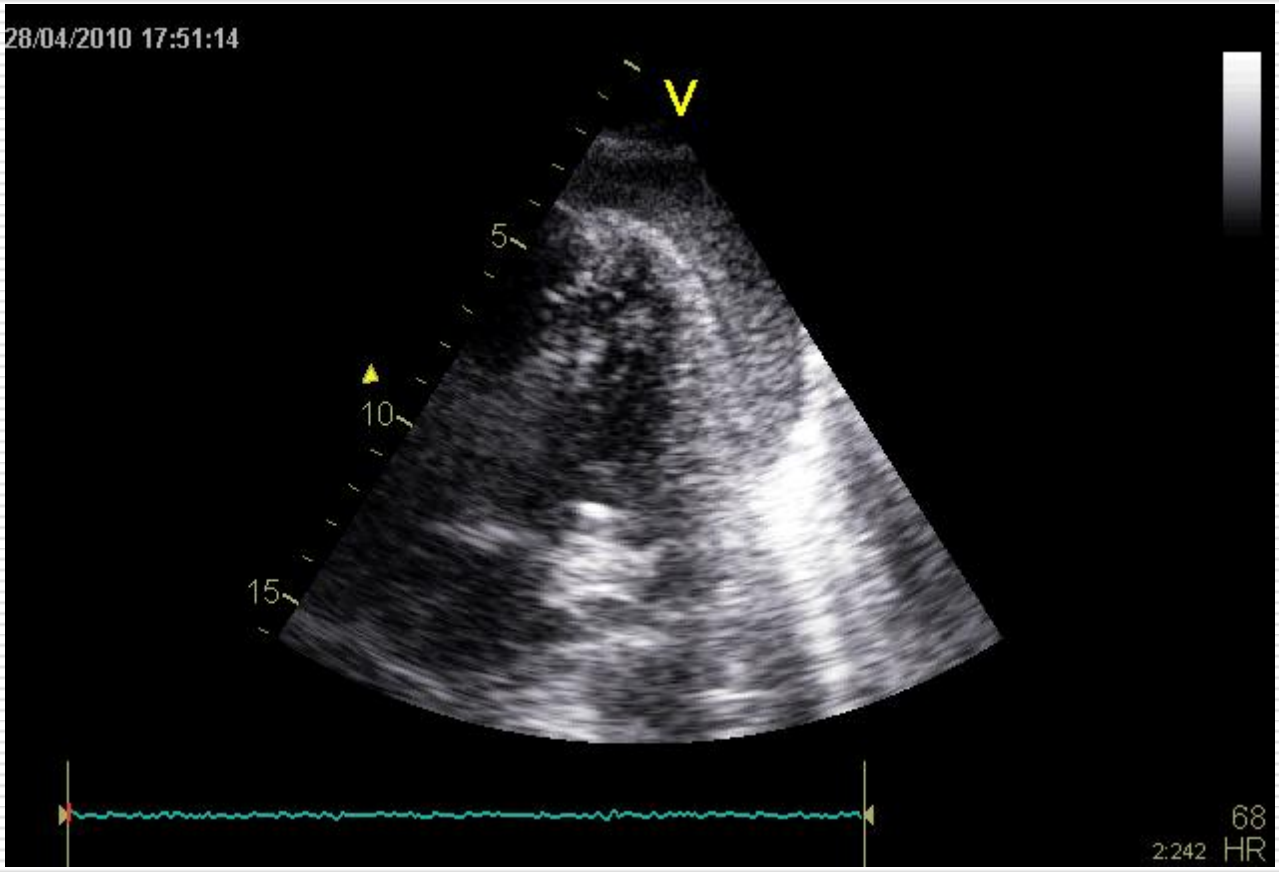


Akutní ischemická mitrální reg.

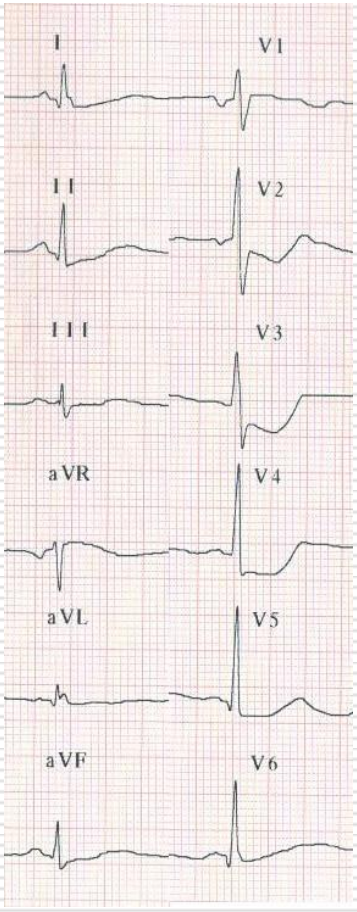


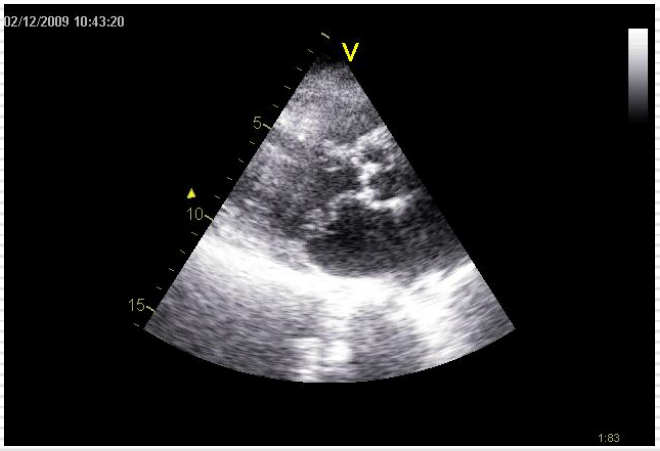


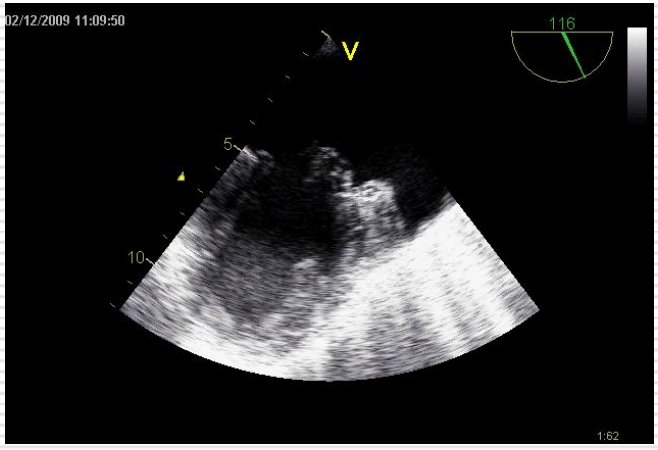
Akutní srdeční tamponáda, ruptura stěny LK

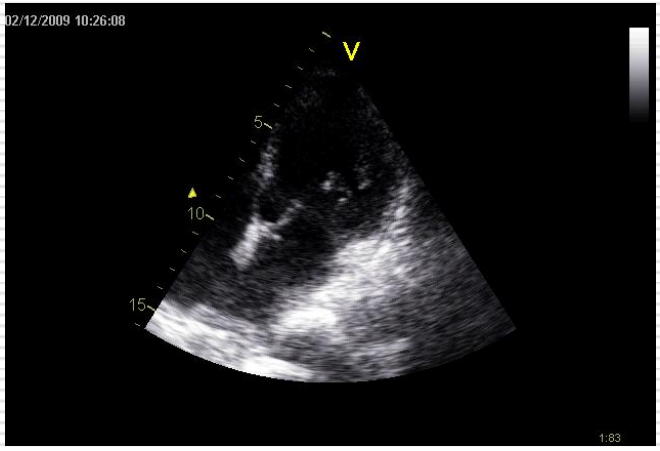


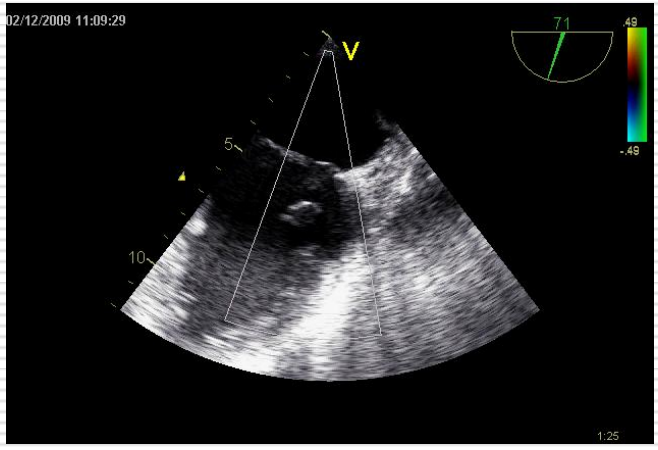
Ruptura papilárního svalu



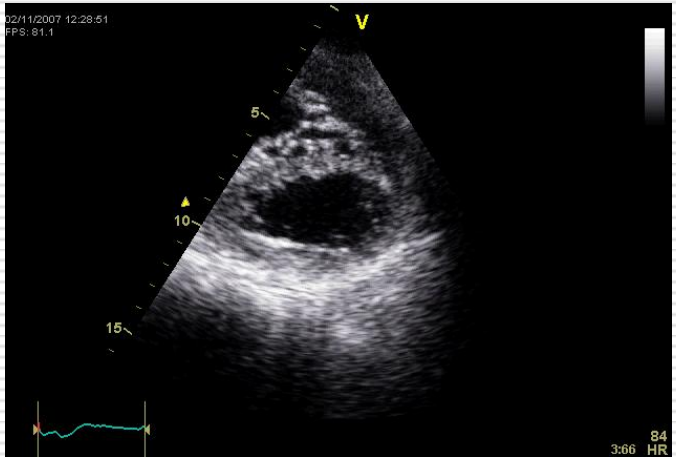


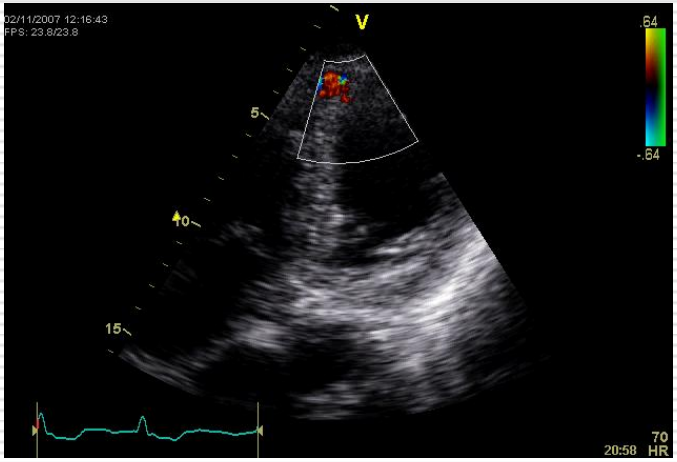


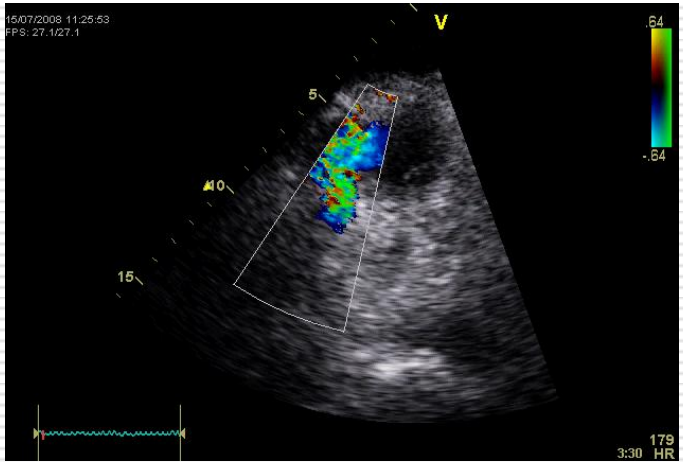


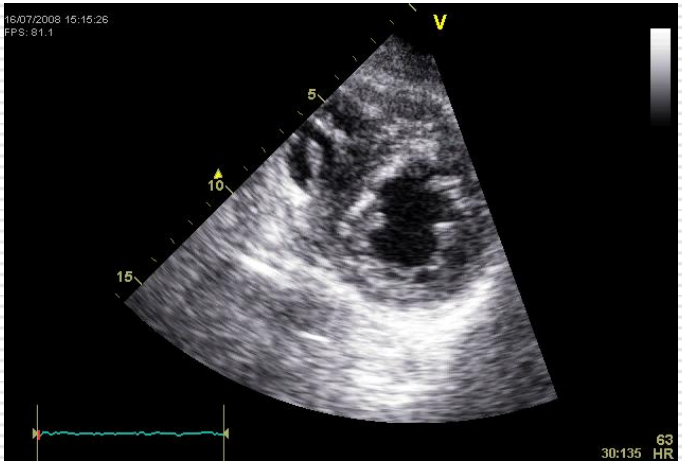


Ruptura komorového septa



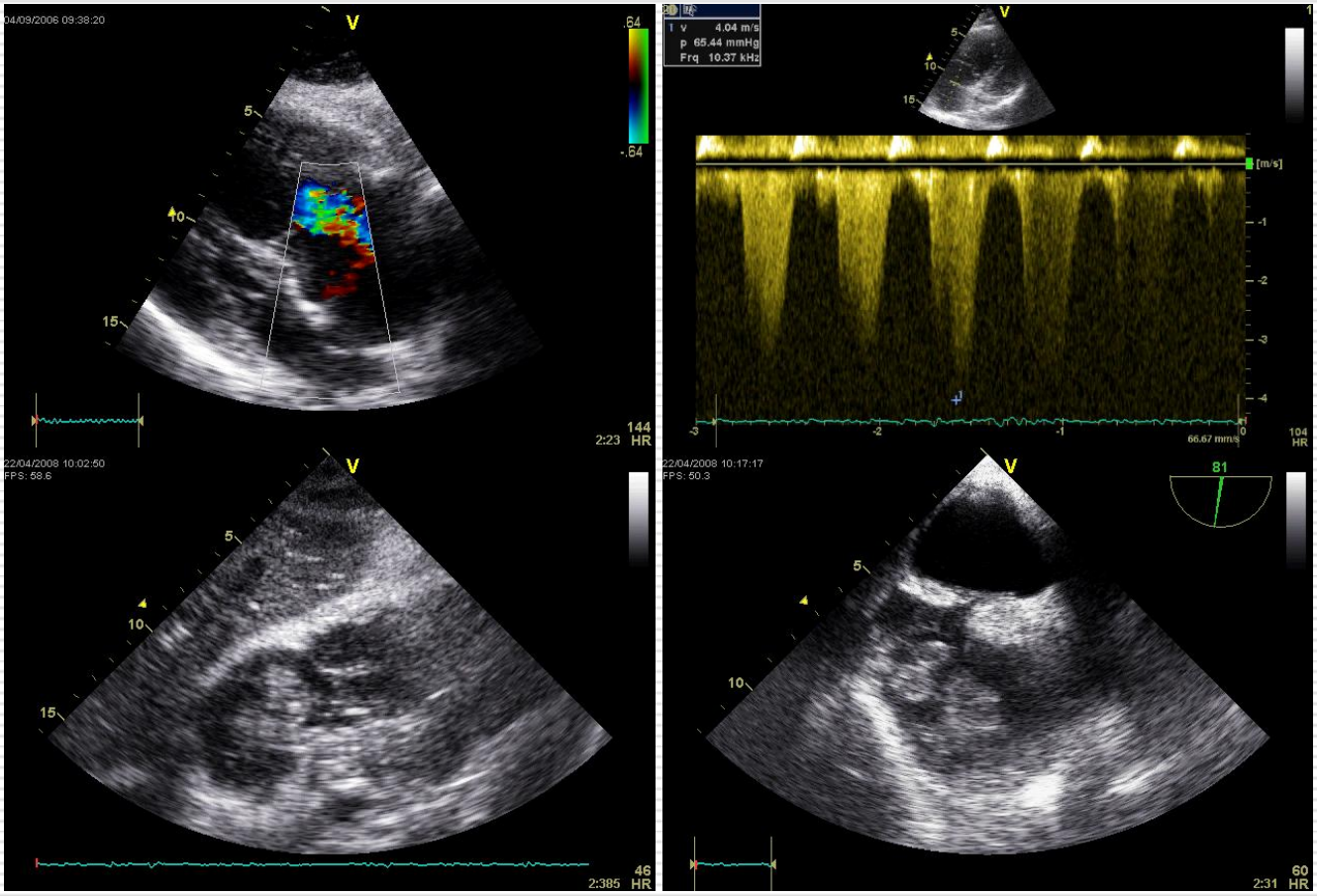




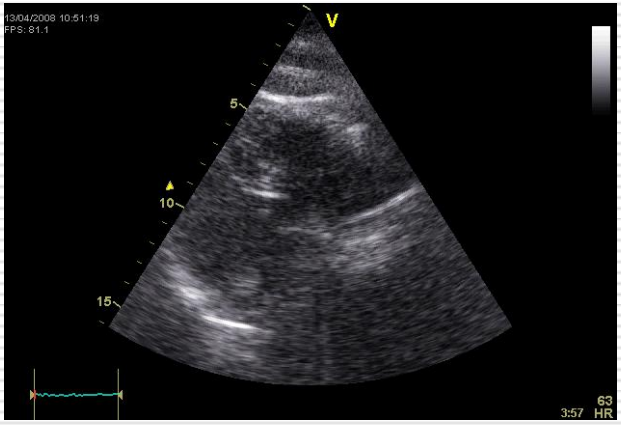


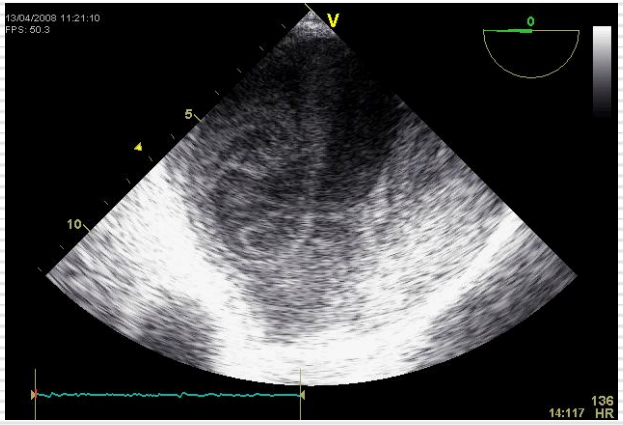
I. INTERNÍ KLINIKA
KARDIOLOGIE
FAKULTNÍ NEMOCNICE OLOMOUC

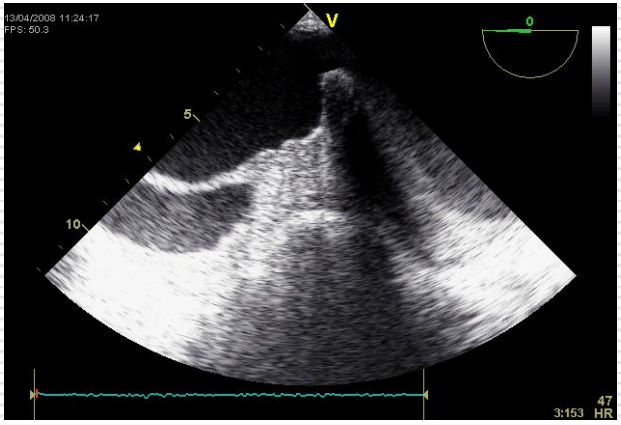
Obstrukční šok
(masivní plicní embolie)

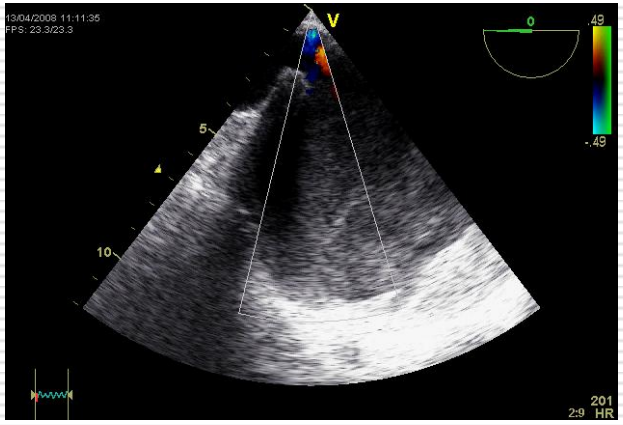


Hypovolemický šok
(ruptura aneuryzmatu aorty)



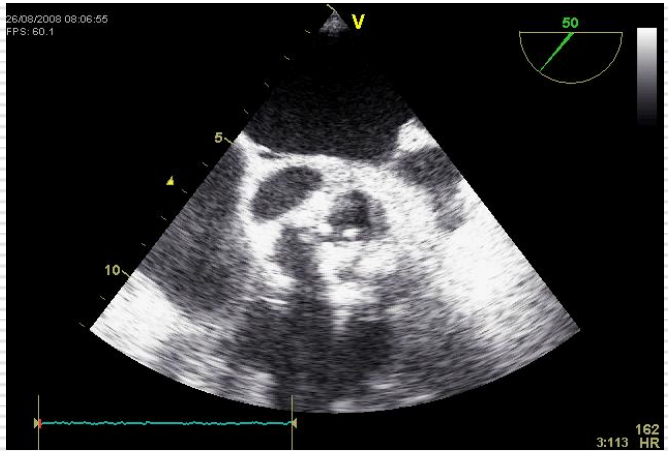


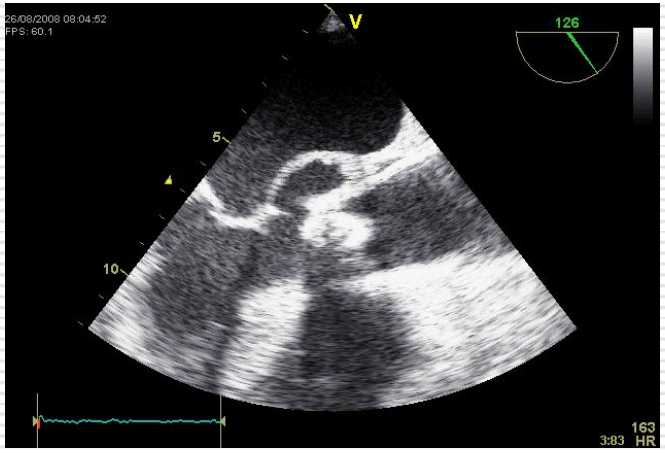


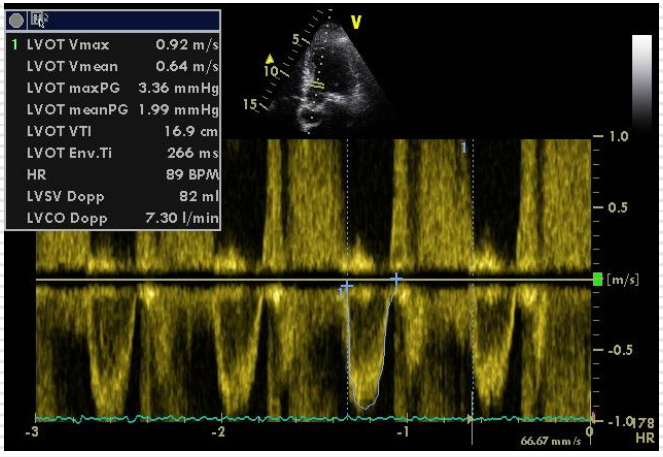


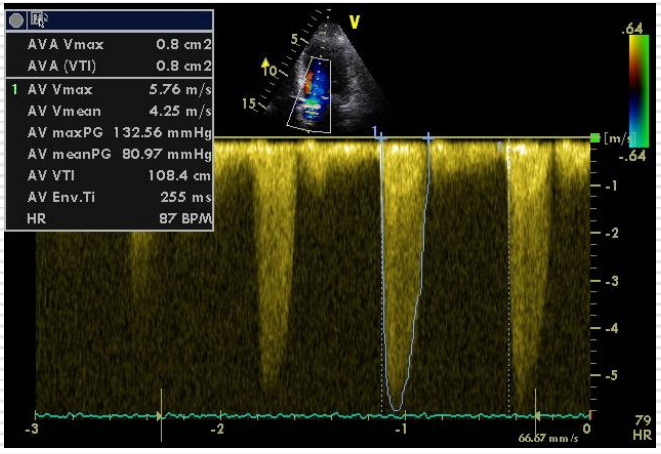
I. INTERNÍ KLINIKA
KARDIOLOGIE
FAKULTNÍ NEMOCNICE OLOMOUC

Septický šok
(infekční endokarditida)









62-letý muž RLP přivezen pro srdeční selhání

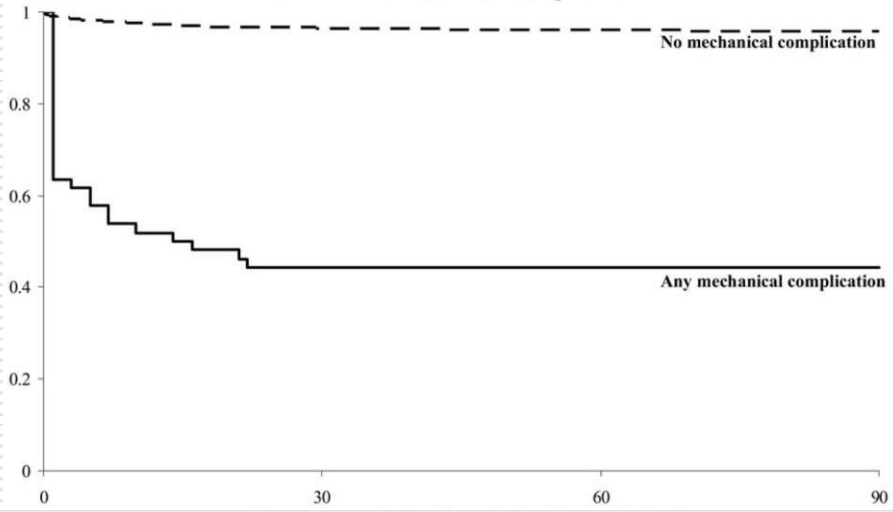
TTE s nálezem těžké aortální stenózy, pro rozvoj teplot, laboratorního obrazu sepse a postupně vznikajícícího septického šoku (nadnormální srdeční výýdej) doplněno TEE s nálezem velkého paravalvulárního abscesu

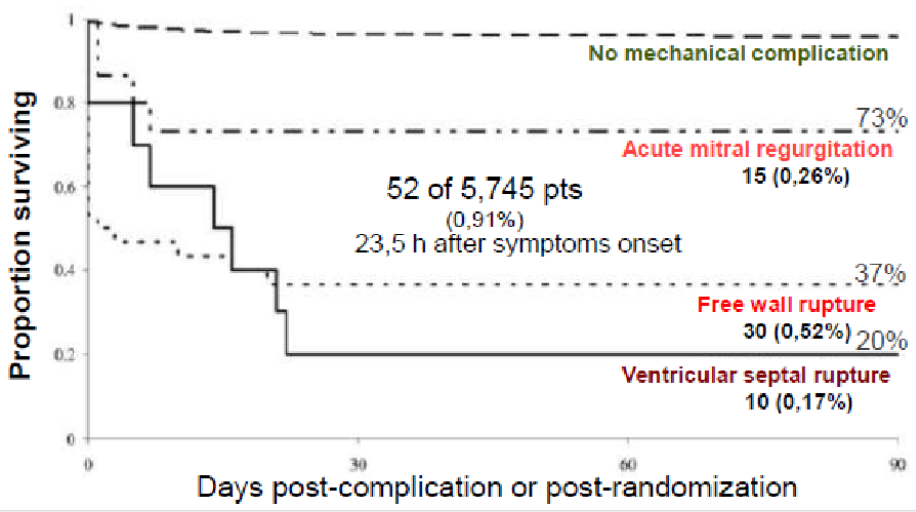
Indikace k akutní náhradě aortální chlopně, v pooperační mobdobí rozvoj refrakterního septického šoku

PROGNÓZA

Prognóza STEMI s mechanickou komplikací

	No Mechanical Complications (n = 5,693)	Cardiac FWR (n = 30)	Acute MR (n = 15)	VSR (n = 10)
Primary angioplasty	5,331 (94%)	25 (83%)	12 (80%)	8 (80%)
In-hospital survival	5,545 (97%)	13* (43%)	11* (73%)	6* (60%)
Further procedure	691 (12%)	13* (43%)	7* (47%)	5* (50%)
30-d survival	5,491 (96%)	11* (37%)	11* (73%)	2* (20%)
90-d survival	5,438 (96%)	11* (37%)	11* (73%)	2* (20%)
Patients with cardiogenic shock/heart failure	427	8	11	6
30-d survival	324 (76%)	5 (63%)	7 (64%)	1* (17%)
90-d survival	305 (71%)	5 (63%)	7 (64%)	1* (17%)



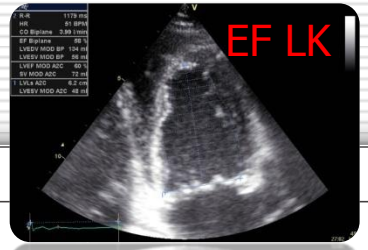


French et. al., Am J Cardiol 2010

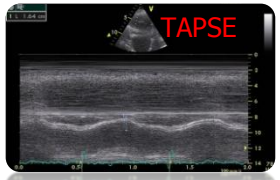
Dg.: STEMI 29%/NSTEMI 49%/NAP 22%
TTE: 1.-12. hod. od přijetí
Parametry: EF LK, TAPSE, ULC
EP: MCE
FU: medián 5 měsíců

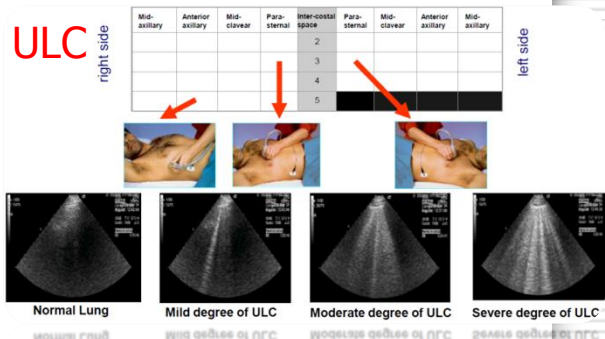
Comparison of Prognostic Value of Echocardiacgraphic Risk Score With the Thrombolysis In Myocardial Infarction (TIMI) and Global Registry In Acute Coronary Events (GRACE) Risk Scores in Acute Coronary Syndrome

Gigliola Bedetti, MD[a,*], Luna Gargani, MD[b], Rosa Sicari, MD, PhD[b], Maria Luisa Gianfaldoni, MD[c], Sabrina Molinaro, BSc[b], and Eugenio Picano, MD, PhD[b]



Variable	HR (95% CI)	p Value	HR (95% CI)	p Value
Ejection fraction	1.86 (1.58–2.19)	<0.0001	1.45 (1.02–2.08)	0.040
Wall motion score index	1.75 (1.39–2.20)	<0.0001		
Mitral annular plane systolic excursion	2.09 (1.60–2.73)	<0.0001		
Left ventricular end-diastolic diameter	1.14 (0.88–1.49)	0.312		
Left ventricular end-systolic diameter	1.36 (1.13–1.65)	0.001		
Left ventricular end-diastolic diameter/body surface area	1.26 (1.00–1.58)	0.048		
Left ventricular end-diastolic volume	1.22 (1.02–1.47)	0.033		
Left ventricular end-systolic volume	1.33 (1.15–1.54)	<0.0001		
Left atrium	1.37 (1.14–1.65)	0.001		
Mitral regurgitation	1.96 (1.59–2.41)	<0.0001		
Left ventricular mass index	1.40 (1.19–1.66)	<0.0001		
Diastolic dysfunction	2.03 (1.65–2.50)	<0.0001		
Tricuspid annular plane systolic excursion	2.54 (2.01–3.22)	<0.0001	1.66 (1.13–2.45)	0.010
Right ventricular end-diastolic diameter	1.37 (0.96–1.95)	0.085		
Pulmonary artery systolic pressure	1.60 (1.30–1.96)	<0.0001		
Ultrasound lung comets	1.97 (1.66–2.33)	<0.0001	1.69 (1.25–2.27)	0.001





Bedetti G et al. Comparison of Prognostic Value of Echocardiacgraphic Risk Score With the Thrombolysis In Myocardial Infarction (TIMI) and Global Registry In Acute Coronary Events (GRACE) Risk Scores in Acute Coronary Syndrome. Am J Cardiol 2010;106:1709 –1716

Dg.: STEMI 29%/NSTEMI 49%/NAP 22%
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Gigliola Bedetti, MD[a,*], Luna Gargani, MD[b], Rosa Sicari, MD, PhD[b], Maria Luisa Gianfaldoni, MD[c], Sabrina Molinaro, BSc[b], and Eugenio Picano, MD, PhD[b]

Univariační a multivariační analýza rizikových prediktorů

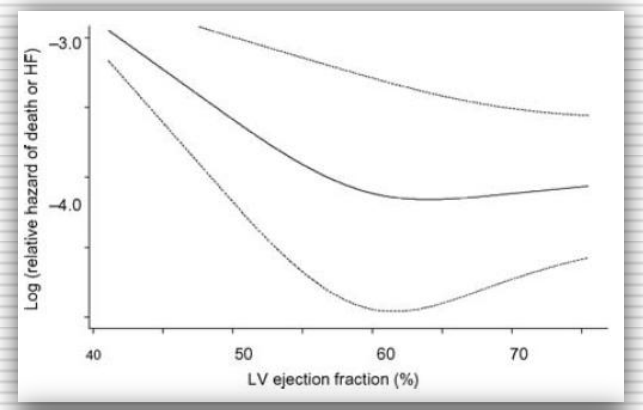
Variable	HR (95% CI)	p Value	HR (95% CI)	p Value
Men*	0.8 (0.5–1.2)	0.214		
New York Heart Association class on admission†	1.7 (1.4–1.9)	<0.0001		
Canadian Cardiovascular Society angina class in previous 6 weeks†	0.964 (0.853–1.1)	0.558		
Previous heart failure*	1.78 (0.9–3.5)	0.099		
Peripheral arterial disease*	1.0 (0.57–1.76)	0.992		
Hemoglobin (g/dl)†	0.8 (0.7–0.8)	<0.0001	0.87 (0.79–0.95)	0.003
Glucose (mg/dl)†	1.0 (1.0–1.0)	<0.0001		
Global Registry in Acute Coronary Events‡	2.84 (1.97–4.09)	<0.0001	1.59 (1.07–2.36)	0.023
Thrombolysis In Myocardial Infarction‡	1.99 (1.54–2.59)	<0.0001		
Echocardiographic score‡	3.15 (2.45–4.04)	<0.0001	2.55 (1.91–3.40)	<0.0001

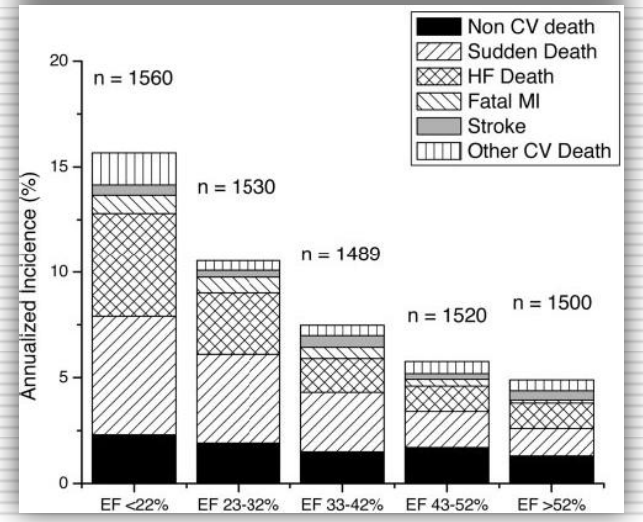
Bedetti G et al. Comparison of Prognostic Value of Echocardiacgraphic Risk Score With the Thrombolysis In Myocardial Infarction (TIMI) and Global Registry In Acute Coronary Events (GRACE) Risk Scores in Acute Coronary Syndrome. Am J Cardiol 2010;106:1709 –1716

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association
Learn and Live

Results of the Predictors of Response to CRT (PROSPECT) Trial
Eugene S. Chung, Angel R. Leon, Luigi Tavazzi, Jing-Ping Sun, Petros Nihoyannopoulos, John Merlino, William T. Abraham, Stefano Ghio, Christophe Leclercq, Jeroen J. Bax, Cheuk-Man Yu, John Gorcsan, III, Martin St John Sutton, Johan De Sutter and Jaime Murillo
Circulation 2008;117;2608-2616; originally published online May 5, 2008;

2D parametry ?





***PROSPECT* závěry:**

1. Interindividuální **variabilita měření ESV** (CV 14.5%) a **EF LK** (průměrná EF LK 23.6±7%, corlab 29.3±10%)
2. 20% zařazených pacientů mělo **EF LK>35%**
3. 1/3 vyšetření neadekvátní **kvalita zobrazení** pro měření ESV
4. Žádná **QC** z centrální laboratoře
5. 3 typy **přístrojů**: 37% GE, 50% Philips, 12% Siemens
6. 40%: staré přístroje

Nicolosi JL. Et al. Effects of perindopril on cardiac remodelling and prognostic value of pre-discharge quantitative echocardiographic parameters in elderly patients after acute myocardial infarction: the PREAMI echo sub-studyEuropean Heart Journal (2009) 30, 1656–1665

Solomon SD et al. Influence of Ejection Fraction on Cardiovascular Outcomes in a Broad Spectrum of Heart Failure Patients Circ 2005; 112; 3738-44

Chung, E. S. et al. Circulation 2008;117:2608-2616

RT-3D EF LK

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doi:10.1016/j.jacc.2004.05.050

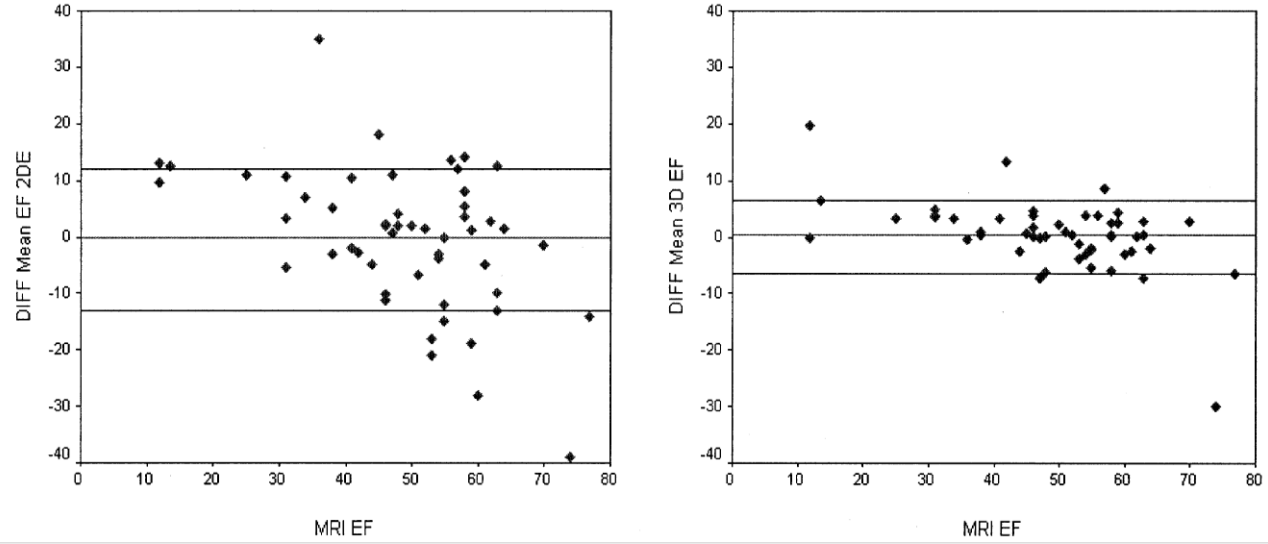
Echocardiography

Reproducibility and Accuracy of Echocardiographic Measurements of Left Ventricular Parameters Using Real-Time Three-Dimensional Echocardiography

Carly Jenkins, BS, Kristen Bricknell, BS, Lizelle Hanekom, MD, Thomas H. Marwick, MD, PHD, FACC

Table 5. Mean Difference Between Echocardiographic and MRI Measurements (n = 50)

	RT-3DE		2DE		Difference in Variance Between MRI and RT-3DE or 2DE	
End-diastolic volume (172 ± 53 ml)	−4 ± 29	p = 0.31	−54 ± 33	p < 0.01	F = 1.31	p = 0.17
End-diastolic volume (91 ± 53 ml)	−3 ± 18	p = 0.23	−28 ± 28	p < 0.01	F = 2.38	p = 0.001
Ejection fraction (50 ± 14%)	0 ± 7	p = 0.74	−1 ± 13	p = 0.76	F = 3.82	p < 0.0001
LV mass (183 ± 50 g)	0 ± 38	p = 0.94	16 ± 57	p = 0.04	F = 2.25	p < 0.003



Jenkins C. et al. Reproducibility and Accuracy of Echocardiographic Measurements of Left Ventricular Parameters Using Real-Time Three-Dimensional Echocardiography. J Am Coll Cardiol 2004;44:878–86

Dg.: 1. NSTE-ACS
TTE: během hospitalizace pro ACS
Parametry: MiR
EP: mortalita
FU: průměr 14±6 m

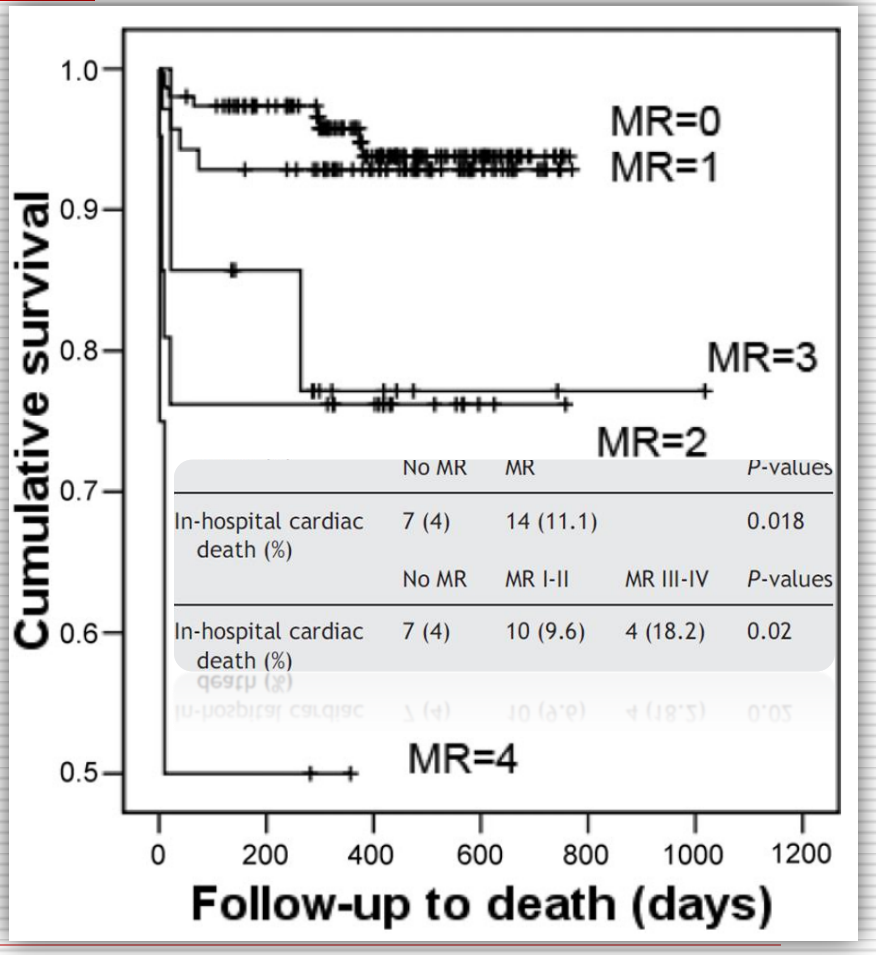
European Heart Journal (2006) 27, 2655–2660
doi:10.1093/eurheartj/ehl287

Clinical research
Coronary heart disease

Prognostic significance of functional mitral regurgitation after a first non-ST-segment elevation acute coronary syndrome

Leopoldo Perez de Isla, Jose Zamorano*, Maribel Quezada, Carlos Almería, José Luis Rodrigo, Viviana Serra, Juan Carlos García Rubira, Antonio Fernandez Ortiz, and Carlos Macaya

	No MR	MR	*P*-values
n(%)	174 (58)	126 (42)	
Mean age (years)	63.9 ± 14	71.3 ± 11	<0.001
Male, *n* (%)	127 (73)	88 (70)	0.6
Hypertension, *n* (%)	107 (61.5)	91 (72.2)	0.06
DM, *n* (%)	42 (24.1)	49 (38.9)	0.006
DM on insulin treatment, *n* (%)	18 (10.3)	17 (13.5)	0.4
Dyslipidaemia, *n* (%)	63 (36.2)	49 (38.9)	0.6
Smoking, *n* (%)	100 (57.5)	61 (48.4)	0.1
AF, *n* (%)	35 (20.1)	29 (23)	0.54
Renal insufficiency, *n* (%)	12 (7)	23 (18.3)	0.002
Previous diagnosis of CAD (%)	22 (12.6)	22 (17.5)	0.2
Previous coronary revascularization (%)	23 (13.2)	26 (20.6)	0.09
Non-permanent ST-segment elevation during acute phase (%)	39 (22.4)	24 (19)	0.5
Q-wave development during or immediately after acute phase (%)	19 (11)	17 (13.5)	0.5
Myocardial markers			
Peak CK	582.2 ± 659	691.4 ± 772	0.24
Peak troponin I	16.2 ± 23	20 ± 24	0.18



	No MR	MR	*P*-values
In-hospital cardiac death (%)	7 (4)	14 (11.1)	0.018

	No MR	MR I-II	MR III-IV	*P*-values
In-hospital cardiac death (%)	7 (4)	10 (9.6)	4 (18.2)	0.02

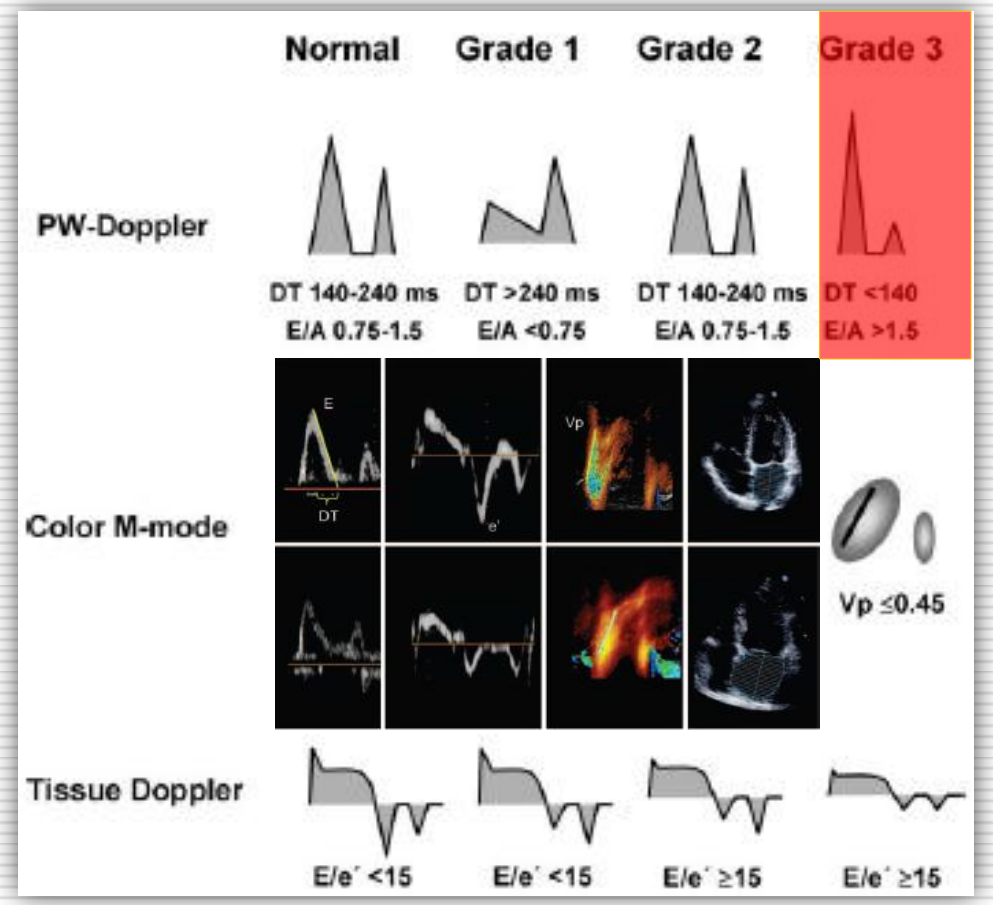
De Isla LP et al. Prognostic significance of functional mitral regurgitation after a first non-ST-segment elevation acute coronary syndrome. European Heart Journal (2006) 27, 2655–2660

Dg.: AIM bez AF
TTE: hospitalizace
Parametry: restriktivní plnění LK
EP: mortalita
FU: ?

Independent Prognostic Importance of a Restrictive Left Ventricular Filling Pattern After Myocardial Infarction

An Individual Patient Meta-Analysis: Meta-Analysis Research Group in Echocardiography Acute Myocardial Infarction

Meta-Analysis Research Group in Echocardiography (MeRGE) AMI Collaborators*



Characteristic	Nonrestrictive (n=2726)	Restrictive (n=670)	*P*
Age, y	64.2 (12.0)	63.2 (13.3)	0.09
Risk factors, n (%)			
Male gender	2010 (74)	502 (75)	0.51
Current smoker (n=1574)	609 (47)	134 (50)	0.26
Hypertension (n=2177)	610 (34)	147 (36)	0.43
Diabetes (n=1946)	265 (17)	84 (24)	0.002
Prior AMI (n=2384)	313 (16)	84 (20)	0.06
Hyperlipidemia (n=1299)	179 (17)	50 (22)	0.04
Anterior AMI (n=2442)	938 (47)	275 (62)	<0.0001
Killip class (n=1746), %			
I	984 (70)	133 (39)	
II	326 (23)	124 (37)	<0.0001
III/IV	99 (7)	80 (24)	
LV ejection fraction, %	47 (10)	40 (11)	<0.0001
LV ESVi (n=1575), mL/m^2	35 (15)	46 (19)	<0.0001
LV end-diastolic volume index (n=1575), mL/m^2	66 (21)	76 (24)	<0.0001
E deceleration time, ms	203 (52)	120 (16)	<0.0001
E/A ratio (n=3311)	1.03 (0.44)	1.71 (0.95)	<0.0001
Length of follow-up, median, d	1060	1072	...
Deaths, n (%)	307 (11.3)	192 (28.7)	<0.0001

Meta-Analysis Research Group in Echocardiography (MeRGE) AMI Collaborators. Independent Prognostic Importance of a Restrictive Left Ventricular Filling Pattern After Myocardial Infarction An Individual Patient Meta-Analysis: Meta-Analysis Research Group in Echocardiography Acute Myocardial Infarction. Circulation. 2008;117:2591-2598
Moeller JE et al. Prognostic Importance of Diastolic Function and Filling Pressure in Patients With Acute MI. Circulation 2006;114;438-444

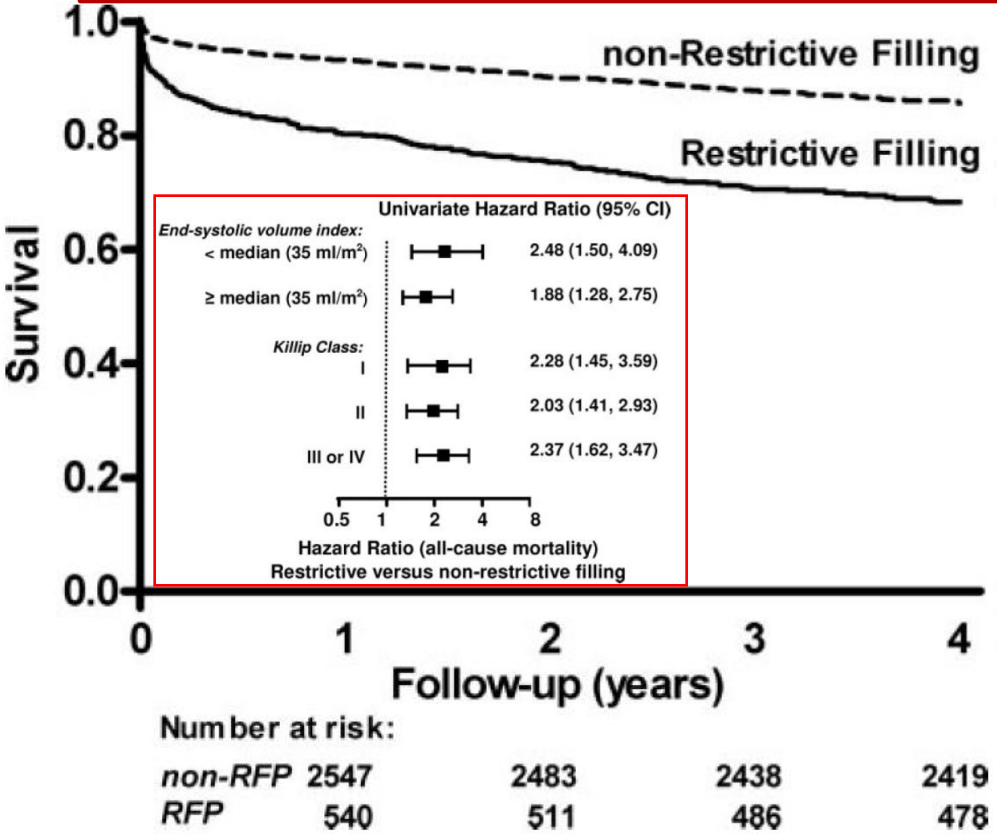
Dg.: AIM bez AF
TTE: hospitalizace
Parametry: restriktivní plnění LK
EP: mortalita
FU: ?

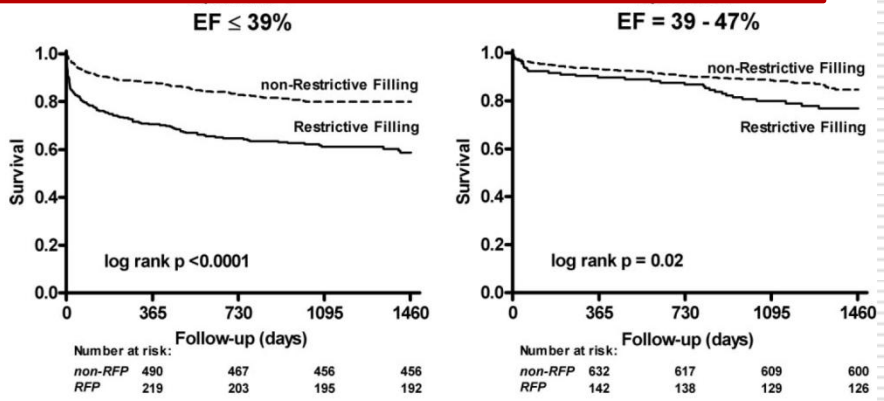
Independent Prognostic Importance of a Restrictive Left Ventricular Filling Pattern After Myocardial Infarction

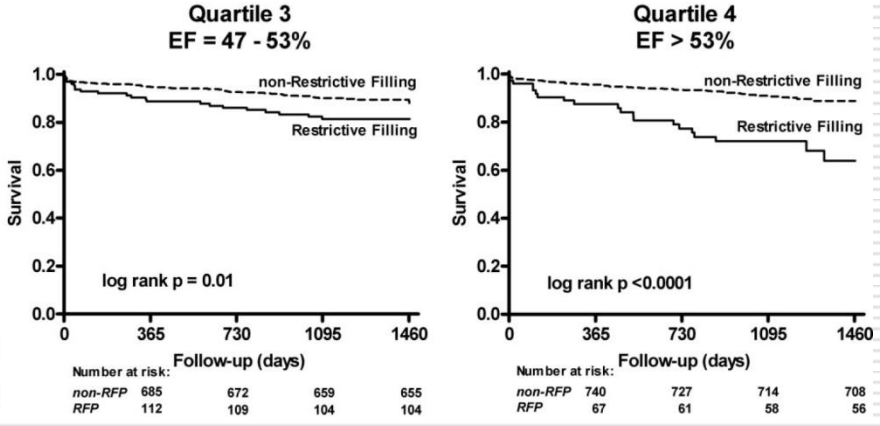
An Individual Patient Meta-Analysis: Meta-Analysis Research Group in Echocardiography Acute Myocardial Infarction

Meta-Analysis Research Group in Echocardiography (MeRGE) AMI Collaborators*

Restriktivní plnění LK u pacientů po AIM je nezávislý prognostický parametr bez ohledu na EF, volumy LK a klinické známky srdečního selhání.



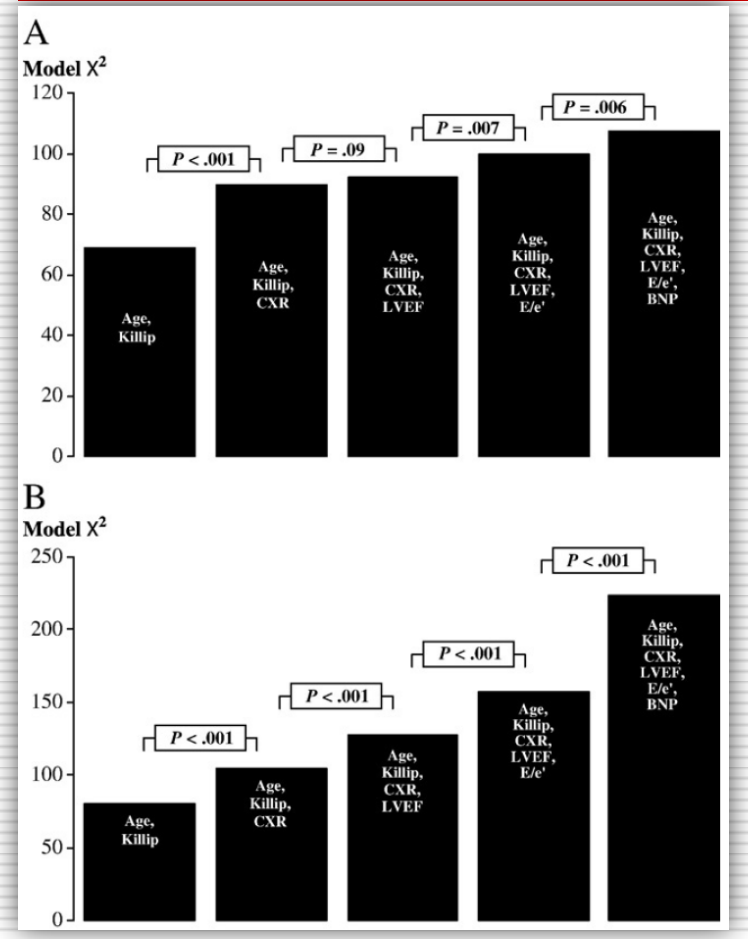




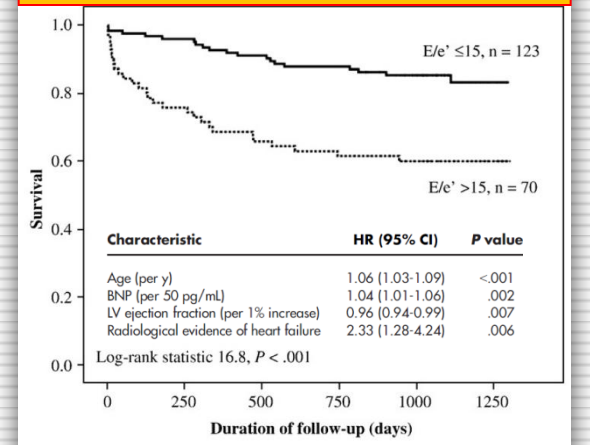
Dg.: neselektovaná populace AIM
TTE: medián 1d od IM
Parametry: E/Em + …
EP: mortalita, reIM, HF
FU: medián 2,9r

Noninvasive assessment of left ventricular filling pressure after acute myocardial infarction: A prospective study of the relative prognostic utility of clinical assessment, echocardiography, and B-type natriuretic peptide

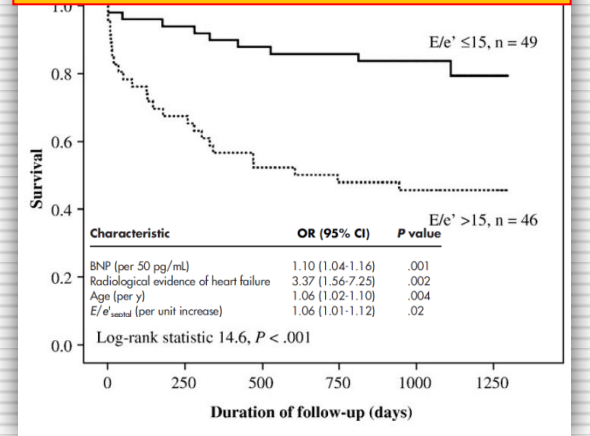
Kirsten Kruszewski, MBChB,[a] Anne E. Scott, MBChB,[a] Justin L. Barclay, MBChB,[a] Gary R. Small, MBBCh, PhD,[a] Bernard L. Croal, MBChB, MD,[b] Jacob E. Møller, MD, DMSc,[c] Jae K. Oh, MD,[d] and Graham S. Hillis, MBChB, PhD[a] *Aberdeen, United Kingdom; Copenhagen, Denmark; and Rochester, MN*



NT-proBNP **nad mediánem** (151 pg/mL)



NT-proBNP **ve 4. kvartilu** (>286 pg/mL)

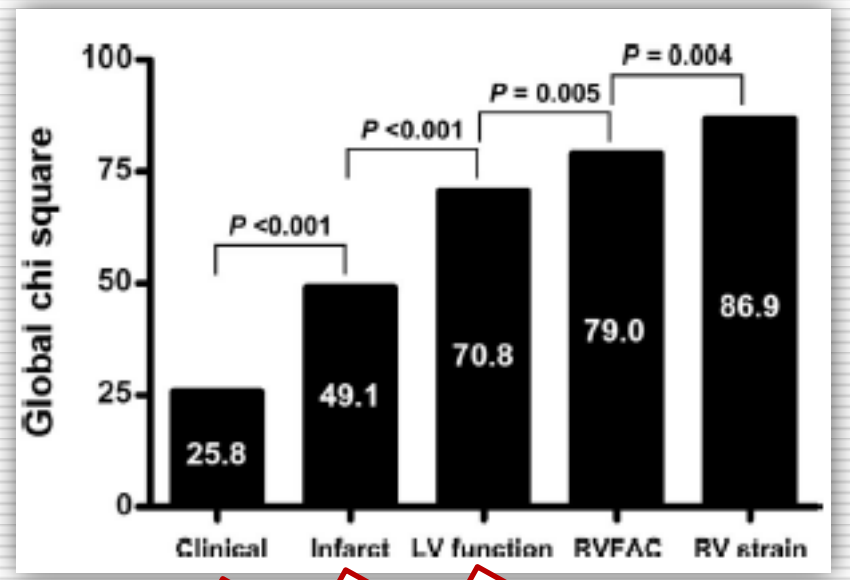


Kruszewski K. et al. Noninvasive assessment of left ventricular filling pressure after acute myocardial infarction: A prospective study of the relative prognostic utility of clinical assessment, echocardiography, and B-type natriuretic peptide. Am Heart J 2010;159:47-54.

Dg.: AIM
TTE: do 2d od AIM/PCI
Parametry: RVFAC, TAPSE, RV strain
EP: mortalita a rehospitalizace pro HF
FU: 24mc

Prognostic Value of Right Ventricular Function in Patients After Acute Myocardial Infarction Treated With Primary Percutaneous Coronary Intervention

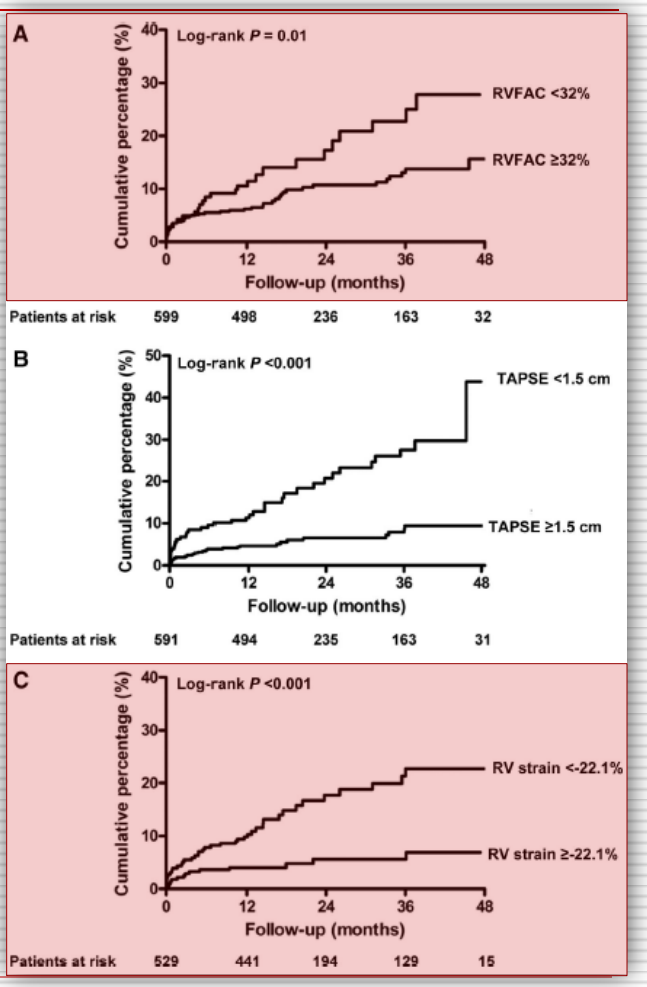
M. Louisa Antoni, MD; Roderick W.C. Scherptong, MD; Jael Z. Atary, MD; Eric Boersma, PhD; Eduard R. Holman, MD, PhD; Ernst E. van der Wall, MD, PhD; Martin J. Schalij, MD, PhD; Jeroen J. Bax, MD, PhD



Věk, Killip ≥2

ACD culprit, MVD, cTnT

EF, WMSI, E/Em, MR ≥ +2

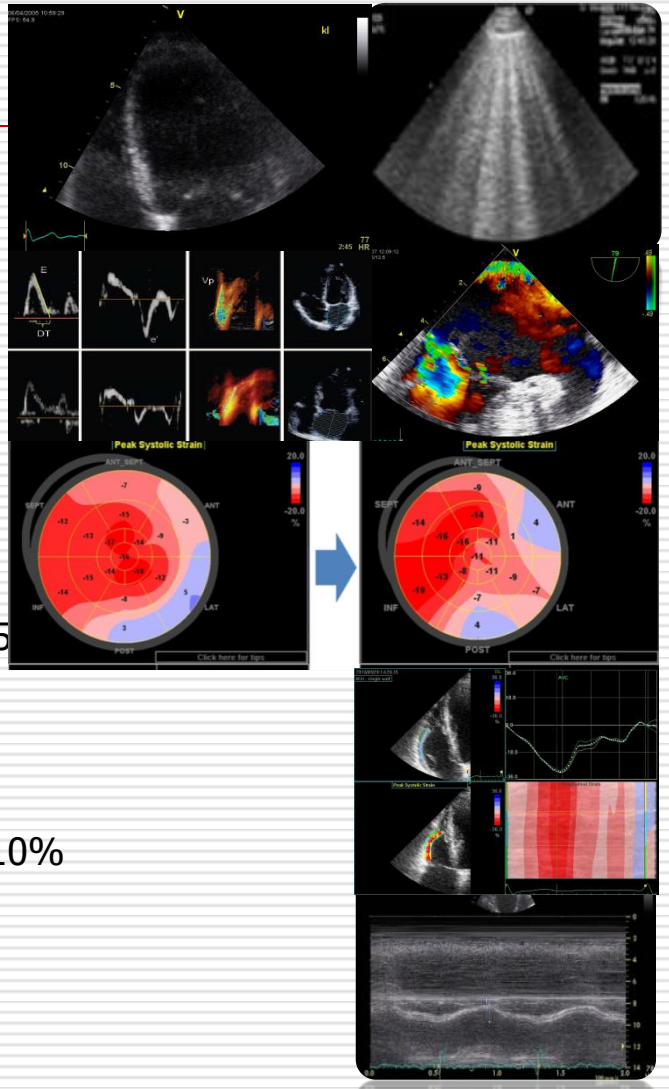


Antoni ML. et al. Prognostic Value of Right Ventricular Function in Patients After Acute Myocardial Infarction Treated With Primary Percutaneous Coronary Intervention. *Circ Cardiovasc Imaging. 2010;3:264-271.)*

I. INTERNÍ KLINIKA KARDIOLOGIE
FAKULTNÍ NEMOCNICE OLOMOUC

Akutní koronární syndromy

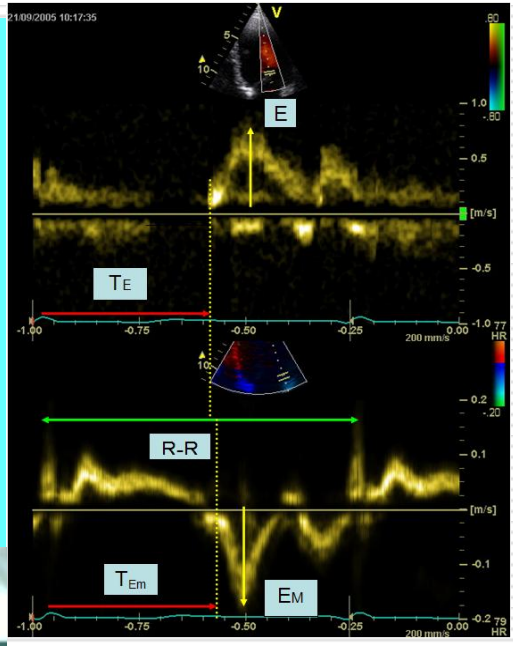
Příznivá prognóza	Špatná prognóza
EF LK > 50%	Mechanická komplikace IM
ULC < 5	EF LK < 30%
Bez mitrální regurgitace	WMSI > 1,5
Normální typ plnění LK	ULC > 30
E/Em < 15	CSI > 1,68
Bez fibrilace síní	Mitrální regurgitace > III, IV
RVFAC > 32%	Restriktivní typ plnění LK, E/Em > 15
RV globální long. S < -22,1%	Fibrilace síní
TAPSE > 20 mm	Long. glob. S STE > -15,1
	Long. glob. SR STE > -1,06
	↓ long. glob. S STE 3. den hosp. > 10%
	RVFAC < 32%
	RV globální long. S > -22,1%
	TAPSE < 10 mm
	Mechanická asynchronie LK VVI



PODPORA TERAPIE

TTE/TEE – neinvazivní hemodynamický monitor

- Hemodynamická monitorace pomocí Swan-Ganzova katetru není spojena se zlepšením prognózy. Invazivní vyšetření – komplikace.
- Náhrada rutinně prováděné pravostranné srdeční katetrizace – (PiCCO, LiDCO) nebo **neinvazivní echokardiografické přístupy**.
- Poměr E/Em – přesný prediktor PCWP (korelace s PCWP r=0,833; p≤0,0001).
- Cut-off hodnota E/Em>14 v predikci PCWP>15 mmHg – senzitivita 93,3%, specificita 90,9%, pozitivní prediktivní hodnota 93%, negativní prediktivní hodnota 90,9%.*



Hutyra M, Skála T, Ostřanský et al. Predikce plnících tlaků levé komory srdeční pomocí tkáňové dopplerovské echokardiografie v intenzivní péči. *Cor Vasa 2006;48(5):180-185*

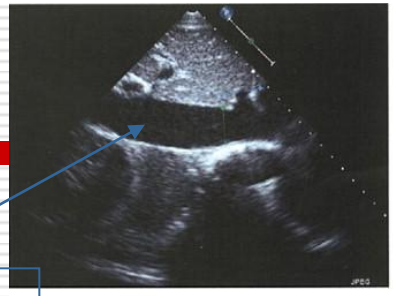
Maximální gradient regurgitace na pulmonální chlopni (PR) predikuje střední tlak v plicnici **(MAP)** . Endiastolický gradient pulmonální regurgitace predikuje diastolický tlak v plicnici **(DAP)** .

Dolní dutá žíla **(IVC)** , její rozměr a stupeň inspiračního kolapsu predikují tlak v pravé síni **(RAP resp. CVT)**:
IVC <1.2 cm a kolaps 100% = RAP 0 mmHg

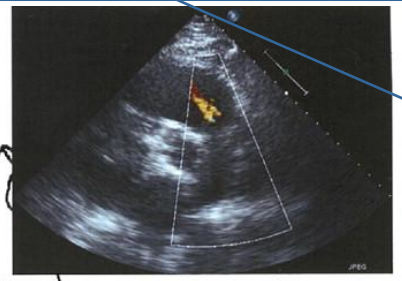
IVC 1.2-1.7 cm s >50% kolapsem = RAP 0-5 mmHg

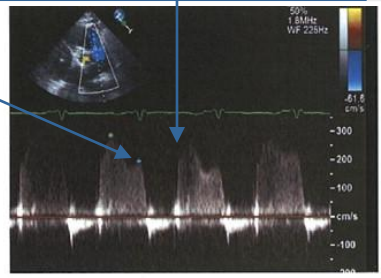
IVC >1.7 cm s >50% kolapsem = RAP 6-10 mmHg; <50% kolapsem = RAP 10-15 mmHg

IVC >1.7 cm s 0% kolapsem = RAP >15 mmHg

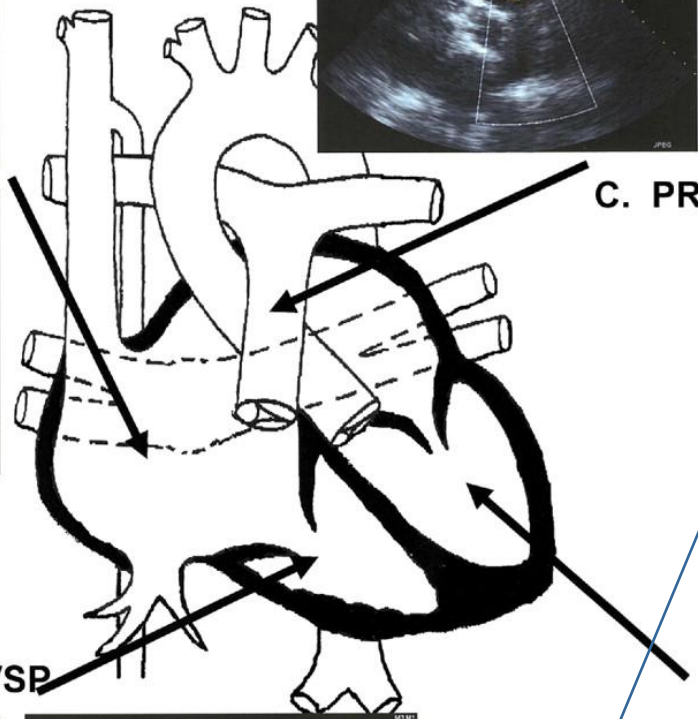


A. IVCCI--RAP



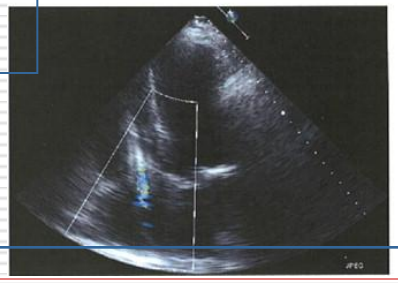


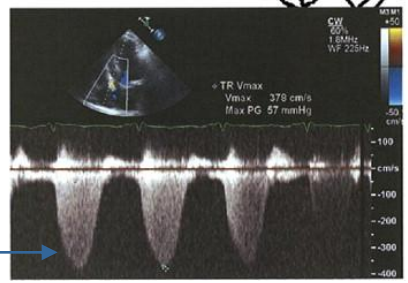
C. PR Vel.--PAPm, PAPd



D. E/E'--PCWP

B. TR Vel.--RVSP

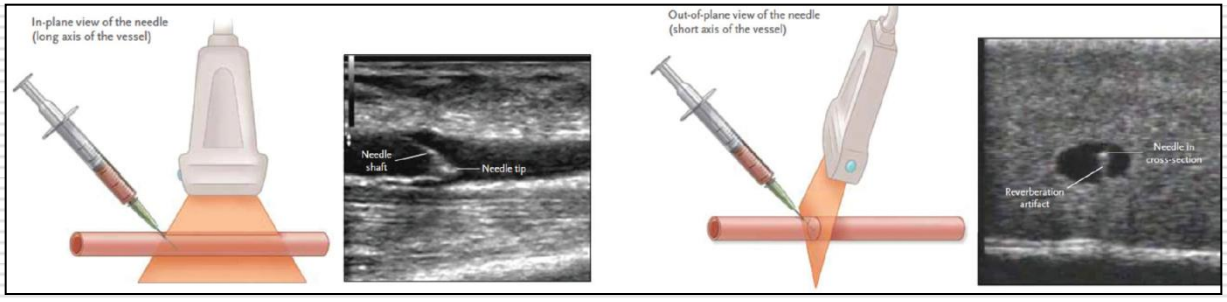




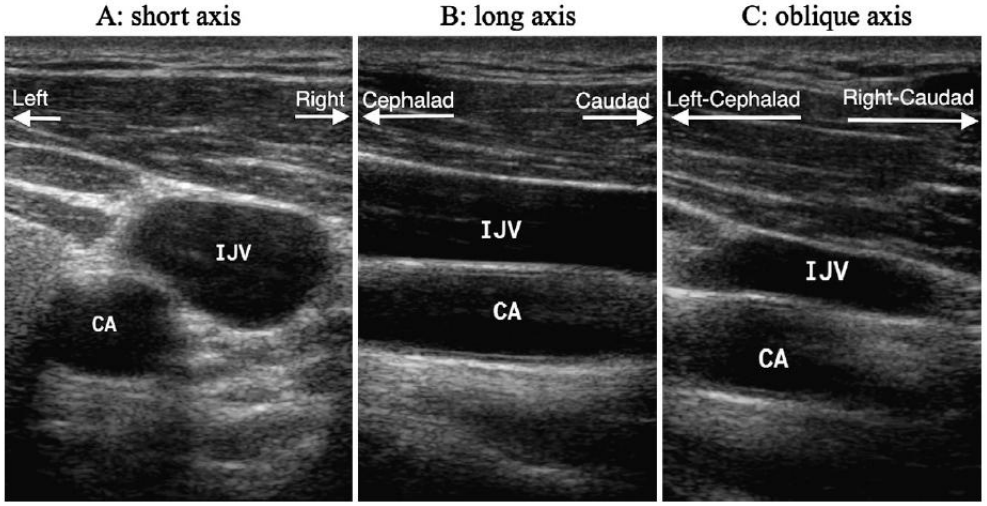
Vrcholová systolická rychlost jetu trikuspidální regurgitace **(TR)** predikuje systolický tlak v plicnici **(SAP)**:

Poměr vrcholové systolické rychlosti časného mitrálního toku (E)/časná diastolická rychlost mitrálního anulu Em **(E/Em)** <8 nebo >15 přesně predikuje **PCWP** <15 mmHg resp. >15 mm Hg.

Podpora kanylačních výkonů



Kumar A. et al. Ultrasound guided vascular access: efficacy and safety. Best Practice & Research Clinical Anaesthesiology Volume 23, Issue 3 2009 299 – 311, http://dx.doi.org/10.1016/j.bpa.2009.02.006



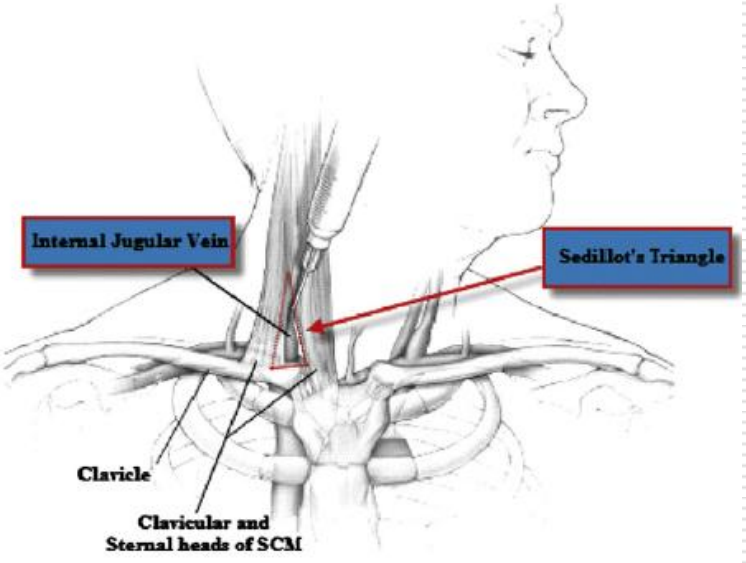
GUIDELINES AND STANDARDS

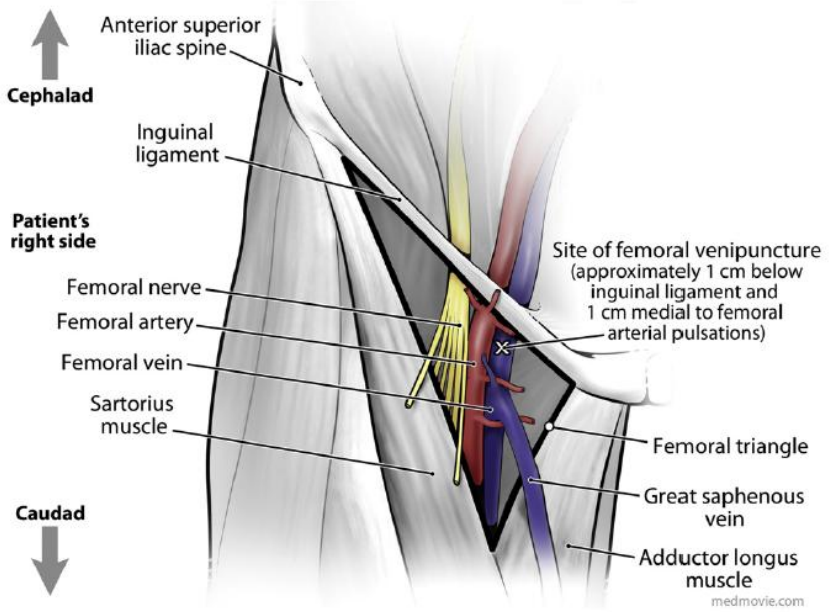
Guidelines for Performing Ultrasound Guided Vascular Cannulation: Recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists

Christopher A. Troianos, MD, Gregg S. Hartman, MD, Kathryn E. Glas, MD, MBA, FASE, Nikolaos J. Skubas, MD, FASE, Robert T. Eberhardt, MD, Jennifer D. Walker, MD, and Scott T. Reeves, MD, MBA, FASE, for the Councils on Intraoperative Echocardiography and Vascular Ultrasound of the American Society of Echocardiography, *Pittsburgh, Pennsylvania; Lebanon, New Hampshire; Atlanta, Georgia; New York, New York; Boston, Massachusetts; and Charleston, South Carolina*

(J Am Soc Echocardiogr 2011;24:1291-318.)

Keywords: Anatomy, Artery, Cannulation, Femoral, Guidelines, Internal jugular, Pediatric, Peripheral, Subclavian, Ultrasound, Vascular, Venous

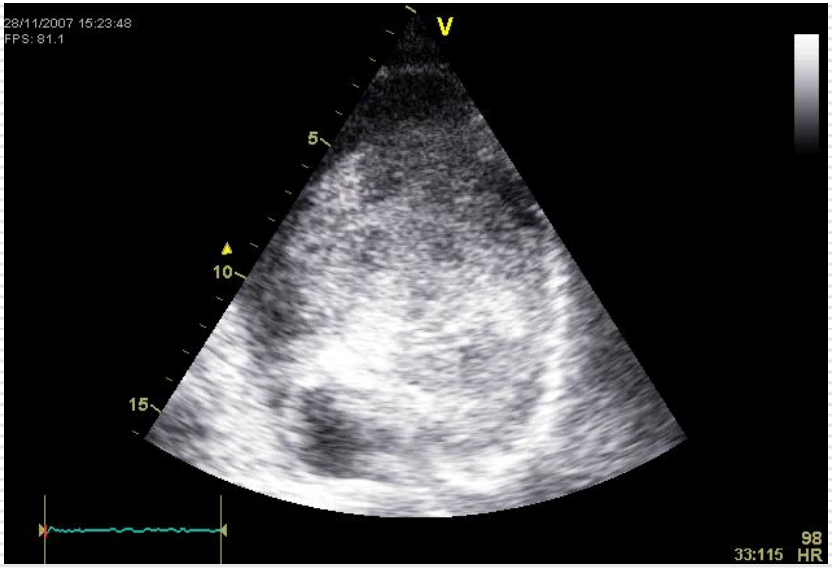


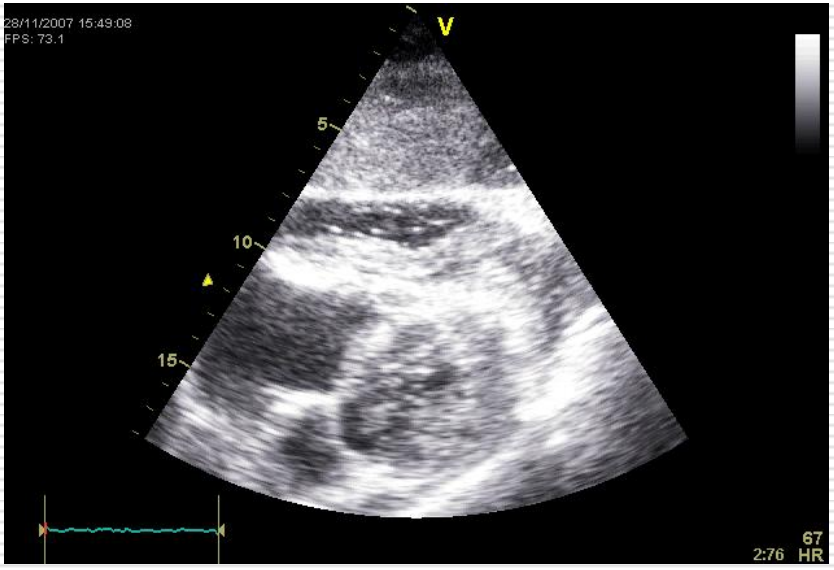


UpToDate 10/2017

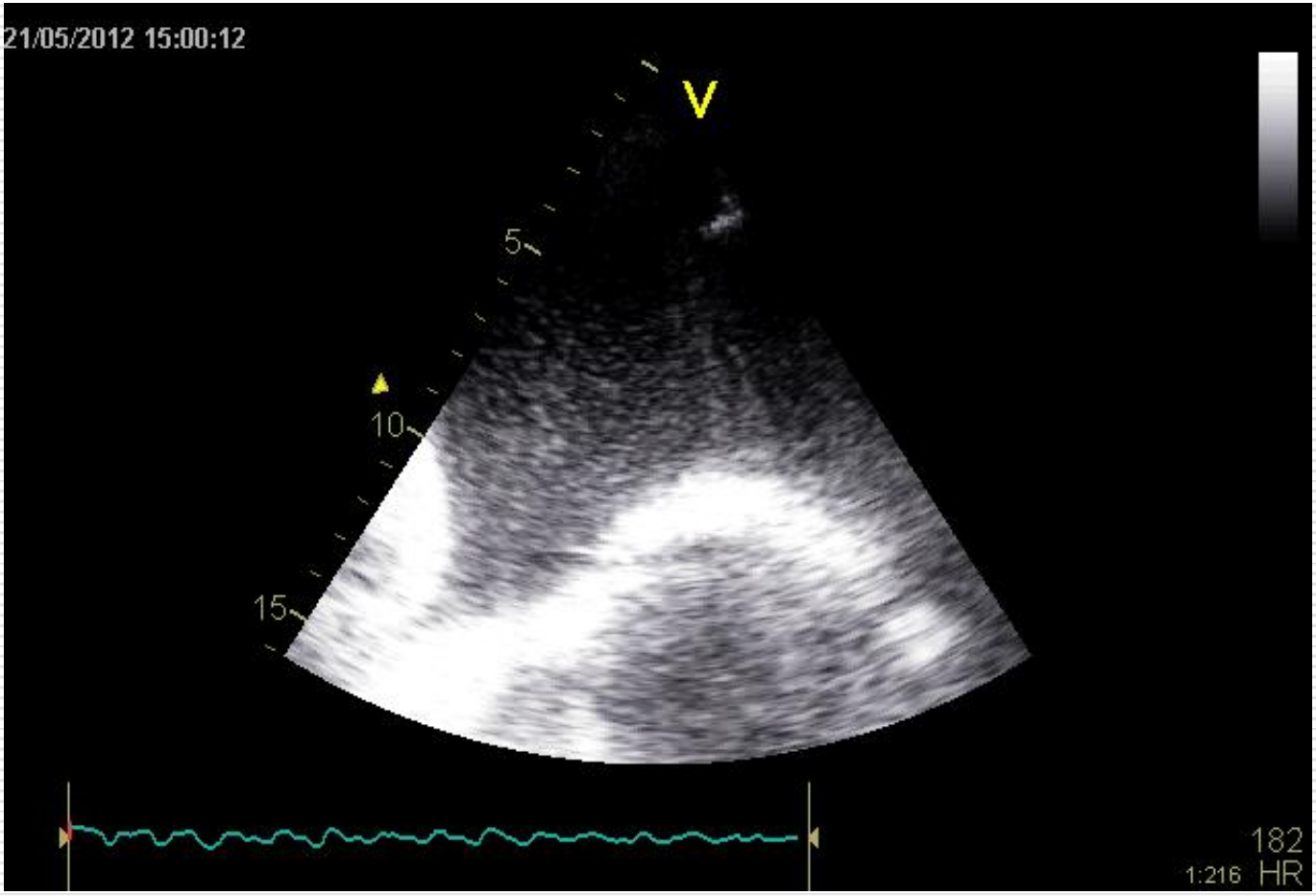
1. Troianos CA, Hartman GS, Glas KE, et al. Special articles: guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society Of Cardiovascular Anesthesiologists. Anesth Analg 2012; 114:46.
2. Levy JA, Noble VE. Bedside ultrasound in pediatric emergency medicine. Pediatrics 2008; 121:e1404.
3. Lalu MM, Fayad A, Ahmed O, et al. Ultrasound-Guided Subclavian Vein Catheterization: A Systematic Review and Meta-Analysis. Crit Care Med 2015; 43:1498.
4. Byon HJ, Lee GW, Lee JH, et al. Comparison between ultrasound-guided supraclavicular and infraclavicular approaches for subclavian venous catheterization in children--a randomized trial. Br J Anaesth 2013; 111:788.
5. Hind D, Calvert N, McWilliams R, et al. Ultrasonic locating devices for central venous cannulation: meta-analysis. BMJ 2003; 327:361.
6. Rabindranath KS, Kumar E, Shail R, Vaux E. Use of real-time ultrasound guidance for the placement of hemodialysis catheters: a systematic review and meta-analysis of randomized controlled trials. Am J Kidney Dis 2011; 58:964.
7. Rabindranath KS, Kumar E, Shail R, Vaux EC. Ultrasound use for the placement of haemodialysis catheters. Cochrane Database Syst Rev 2011; :CD005279.
8. Sigaut S, Skhiri A, Stany I, et al. Ultrasound guided internal jugular vein access in children and infant: a meta-analysis of published studies. Paediatr Anaesth 2009; 19:1199.
9. Stolz LA, Stolz U, Howe C, et al. Ultrasound-guided peripheral venous access: a meta-analysis and systematic review. J Vasc Access 2015; 16:321.
10. Rothschild, JM. Ultrasound guidance of central vein catheterization. In: Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidence Report/Technology Assessment, No. 43, Shojania, KG, Duncan, BW, McDonald, KM, et al (Eds). Agency for Healthcare Research and Quality. Rockville, MD 2001. p.245. http://www.ahrq.gov/clinic/ptsafety/chap21.htm (Accessed on September 26, 2009).
11. Keyes LE, Frazee BW, Snoey ER, et al. Ultrasound-guided brachial and basilic vein cannulation in emergency department patients with difficult intravenous access. Ann Emerg Med 1999; 34:711.
12. Doniger SJ, Ishimine P, Fox JC, Kanegaye JT. Randomized controlled trial of ultrasound-guided peripheral intravenous catheter placement versus traditional techniques in difficult-access pediatric patients. Pediatr Emerg Care 2009; 25:154.
13. Bruzoni M, Slater BJ, Wall J, et al. A prospective randomized trial of ultrasound- vs landmark-guided central venous access in the pediatric population. J Am Coll Surg 2013; 216:939.
14. Mehta N, Valesky WW, Guy A, Sinert R. Systematic review: is real-time ultrasonic-guided central line placement by ED physicians more successful than the traditional landmark approach? Emerg Med J 2013; 30:355.
15. Shime N, Hosokawa K, MacLaren G. Ultrasound Imaging Reduces Failure Rates of Percutaneous Central Venous Catheterization in Children. Pediatr Crit Care Med 2015; 16:718.
16. Sofocleous CT, Schur I, Cooper SG, et al. Sonographically guided placement of peripherally inserted central venous catheters: review of 355 procedures. AJR Am J Roentgenol 1998; 170:1613.
17. Metz RI, Lucking SE, Chaten FC, et al. Percutaneous catheterization of the axillary vein in infants and children. Pediatrics 1990; 85:531.
18. Donaldson JS, Morello FP, Junewick JJ, et al. Peripherally inserted central venous catheters: US-guided vascular access in pediatric patients. Radiology 1995; 197:542.
19. Calvert N, Hind D, McWilliams RG, et al. The effectiveness and cost-effectiveness of ultrasound locating devices for central venous access: a systematic review and economic evaluation. Health Technol Assess 2003; 7:1.
20. Fragou M, Kouraklis G, Dimitriou V, Karakitsos D. Risk factors for acute adverse events during ultrasound-guided central venous cannulation in the emergency department. Acad Emerg Med 2011; 18:443.
21. Hilty WM, Hudson PA, Levitt MA, Hall JB. Real-time ultrasound-guided femoral vein catheterization during cardiopulmonary resuscitation. Ann Emerg Med 1997; 29:331.
22. Kwon TH, Kim YL, Cho DK. Ultrasound-guided cannulation of the femoral vein for acute haemodialysis access. Nephrol Dial Transplant 1997; 12:1009.
23. Aouad MT, Kanazi GE, Abdallah FW, et al. Femoral vein cannulation performed by residents: a comparison between ultrasound-guided and landmark technique in infants and children undergoing cardiac surgery. Anesth Analg 2010; 111:724.
24. Griswold-Theodorson S, Farabaugh E, Handly N, et al. Subclavian central venous catheters and ultrasound guidance: policy vs practice. J Vasc Access 2013; 14:104.
25. Abboud PA, Kendall JL. Ultrasound guidance for vascular access. Emerg Med Clin North Am 2004; 22:749.
26. Fragou M, Gravvanis A, Dimitriou V, et al. Real-time ultrasound-guided subclavian vein cannulation versus the landmark method in critical care patients: a prospective randomized study. Crit Care Med 2011; 39:1607.
27. O'Leary R, Ahmed SM, McLure H, et al. Ultrasound-guided infraclavicular axillary vein cannulation: a useful alternative to the internal jugular vein. Br J Anaesth 2012; 109:762.
28. Gualtieri E, Deppe SA, Sipperly ME, Thompson DR. Subclavian venous catheterization: greater success rate for less experienced operators using ultrasound guidance. Crit Care Med 1995; 23:692.
29. Pirotte T, Veyckemans F. Ultrasound-guided subclavian vein cannulation in infants and children: a novel approach. Br J Anaesth 2007; 98:509.
30. Pittiruti M, Hamilton H, Biffi R, et al. ESPEN Guidelines on Parenteral Nutrition: central venous catheters (access, care, diagnosis and therapy of complications). Clin Nutr 2009; 28:365.
31. Costantino TG, Parikh AK, Satz WA, Fojtik JP. Ultrasonography-guided peripheral intravenous access versus traditional approaches in patients with difficult intravenous access. Ann Emerg Med 2005; 46:456.
32. Brannam L, Blaivas M, Lyon M, Flake M. Emergency nurses' utilization of ultrasound guidance for placement of peripheral intravenous lines in difficult-access patients. Acad Emerg Med 2004; 11:1361.
33. Aponte H, Acosta S, Rigamonti D, et al. The use of ultrasound for placement of intravenous catheters. AANA J 2007; 75:212.
34. Kerforne T, Petitpas F, Frasca D, et al. Ultrasound-guided peripheral venous access in severely ill patients with suspected difficult vascular puncture. Chest 2012; 141:279.
35. Stein J, George B, River G, et al. Ultrasonographically guided peripheral intravenous cannulation in emergency department patients with difficult intravenous access: a randomized trial. Ann Emerg Med 2009; 54:33.
36. Egan G, Healy D, O'Neill H, et al. Ultrasound guidance for difficult peripheral venous access: systematic review and meta-analysis. Emerg Med J 2013; 30:521.
37. Heinrichs J, Fritze Z, Vandermeer B, et al. Ultrasonographically guided peripheral intravenous cannulation of children and adults: a systematic review and meta-analysis. Ann Emerg Med 2013; 61:444.
38. Bair AE, Rose JS, Vance CW, et al. Ultrasound-assisted peripheral venous access in young children: a randomized controlled trial and pilot feasibility study. West J Emerg Med 2008; 9:219.
39. Benkhadra M, Collignon M, Fournel I, et al. Ultrasound guidance allows faster peripheral IV cannulation in children under 3 years of age with difficult venous access: a prospective randomized study. Paediatr Anaesth 2012; 22:449.
40. Shokoohi H, Boniface K, McCarthy M, et al. Ultrasound-guided peripheral intravenous access program is associated with a marked reduction in central venous catheter use in noncritically ill emergency department patients. Ann Emerg Med 2013; 61:198.
41. Schnadower D, Lin S, Perera P, et al. A pilot study of ultrasound analysis before pediatric peripheral vein cannulation attempt. Acad Emerg Med 2007; 14:483.
42. Curtis SJ, Craig WR, Logue E, et al. Ultrasound or near-infrared vascular imaging to guide peripheral intravenous catheterization in children: a pragmatic randomized controlled trial. CMAJ 2015; 187:563.
43. Stone MB, Teismann NA, Wang R. Ultrasonographic confirmation of intraosseous needle placement in an adult unembalmed cadaver model. Ann Emerg Med 2007; 49:515.
44. Ball RD, Scouras NE, Orebaugh S, et al. Randomized, prospective, observational simulation study comparing residents' needle-guided vs free-hand ultrasound techniques for central venous catheter access. Br J Anaesth 2012; 108:72.
45. Stone MB, Moon C, Sutijono D, Blaivas M. Needle tip visualization during ultrasound-guided vascular access: short-axis vs long-axis approach. Am J Emerg Med 2010; 28:343.
46. Tokumine J, Lefor AT, Yonei A, et al. Three-step method for ultrasound-guided central vein catheterization. Br J Anaesth 2013; 110:368.
47. Kost, SI. Ultrasound-assisted venous access. In: Textbook of Pediatric Emergency Procedures, 2nd edition, King, C, Henretig, FM (Eds), Lippincott Williams and Wilkins, Philadelphia 2008. p.1255.
48. Hebard S, Hocking G. Echogenic technology can improve needle visibility during ultrasound-guided regional anesthesia. Reg Anesth Pain Med 2011; 36:185.
49. Deam RK, Kluger R, Barrington MJ, McCutcheon CA. Investigation of a new echogenic needle for use with ultrasound peripheral nerve blocks. Anaesth Intensive Care 2007; 35:582.
50. Ortega R, Song M, Hansen CJ, Barash P. Videos in clinical medicine. Ultrasound-guided internal jugular vein cannulation. N Engl J Med 2010; 362:e57.
51. Joing S, Strote S, Caroon L, et al. Videos in clinical medicine. Ultrasound-guided peripheral i.v. placement. N Engl J Med 2012; 366:e38.

Guiding perikardiální punkce





Guiding pleurální punkce



Co lze očekávat od zobrazovacích metod v prostředí IP/ER?

- ✓ Stanovení **diagnózy** s možností volby kauzální terapie
- ✓ Predikci krátkodobé a dlouhodobé **prognózy**
- ✓ Optimalizace **terapie**
  - Hemodynamika
  - Zajištění centrálního žilního a arteriálního vstupu
  - Guiding punkčních výkonů (perikard, pleura,…)

Co bych měl umět 24/7?

- ✓ Při stanovení **diagnózy** získat kategorický nález pomocí (zpravidla) 2D zobrazení.
- ✓ Pro predikci **prognózy** je kompetentně zhodnotit kvantitativní parametry jednotlivých zobrazovacích modalit.
- ✓ Pro optimalizaci **terapie** (zpravidla v rámci guidingu kanylací a punkcí) s podporou UZ si vzpomenout na užitečnost této metody.

European Heart Journal – Cardiovascular Imaging (2015) **16**, 119–146
doi:10.1093/ehjci/jeu210

The use of echocardiography in acute cardiovascular care: Recommendations of the European Association of Cardiovascular Imaging and the Acute Cardiovascular Care Association

Patrizio Lancellotti[1]*, Susanna Price[2]*, Thor Edvardsen[3], Bernard Cosyns[4], Aleksandar N. Neskovic[5], Raluca Dulgheru[1], Frank A. Flachskampf[6], Christian Hassager[7], Agnes Pasquet[8], Luna Gargani[9], Maurizio Galderisi[10], Nuno Cardim[11], Kristina H. Haugaa[3], Arnaud Ancion[1], Jose-Luis Zamorano[12], Erwan Donal[13], Héctor Bueno[14], and Gilbert Habib[15]

GUIDELINES AND STANDARDS

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Keywords: Anatomy, Artery, Cannulation, Femoral, Guidelines, Internal jugular, Pediatric, Peripheral, Subclavian, Ultrasound, Vascular, Venous

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Přehledový článek | Review article

Využití echokardiografie v akutní kardiovaskulární péči.

Souhrn dokumentu připravený Českou kardiologickou společností

(The use of echocardiography in acute cardiovascular care.
Summary of the document prepared by the Czech Society of Cardiology)

Martin Hutyra[a], Tomáš Paleček[b], Milan Hromádka[c]

European Heart Journal (2016) **37**, 2097–2104
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REVIEW

Clinical update

Ultrasound of extravascular lung water: a new standard for pulmonary congestion

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