Zobrazovací metody u srdečního selhání a nová ESC doporučení

Role magnetické rezonance

Júlia Borová

ESC European Society of Cardiology
European Heart Journal (2026) 00, 1–112
https://doi.org/10.1093/eurheartj/ehag100

2026 ESC Guidelines for the management of heart failure

Developed by the task force for the management of heart failure of the European Society of Cardiology (ESC)

With the special contribution of the Heart Failure Association (HFA) of the ESC

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS)

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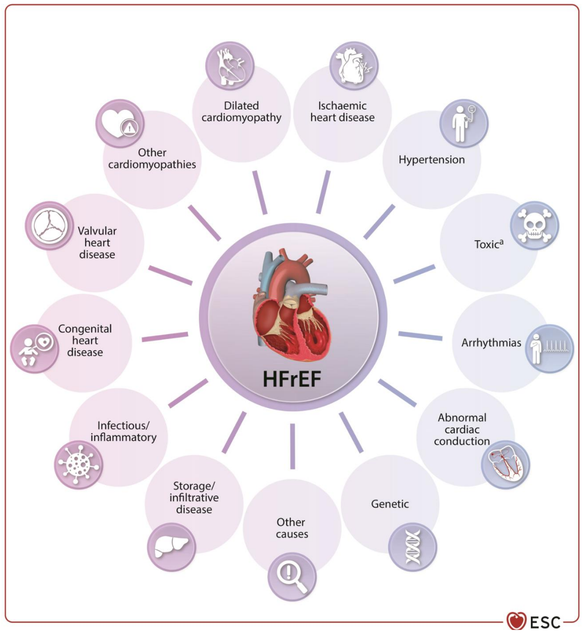
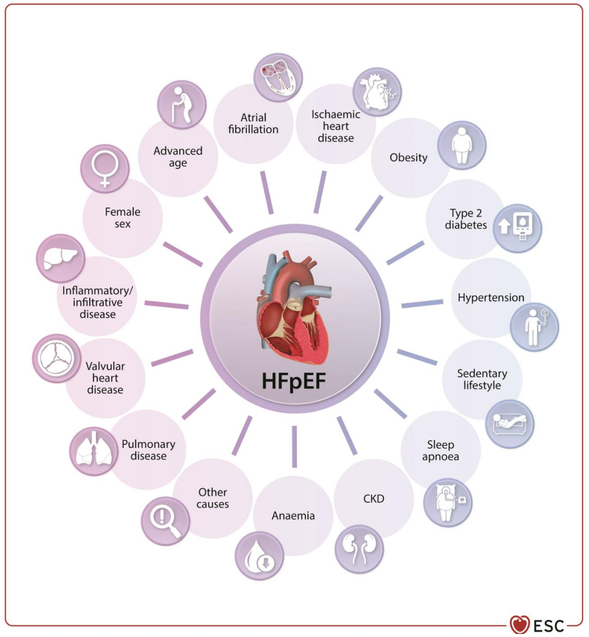
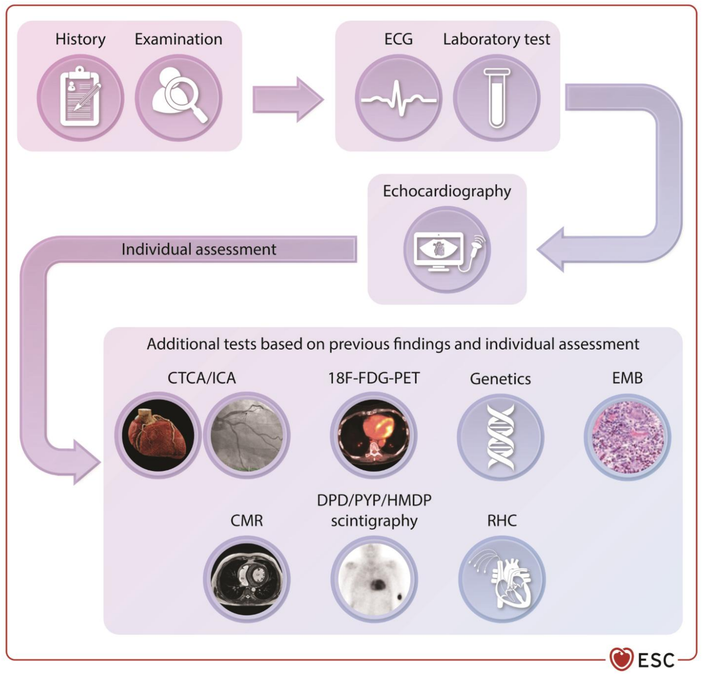
Recommendations in 2021 version	Class [a]	Level [b]	Recommendations in 2026 version	Class [a]	Level [b]
Diagnosis of chronic heart failure—***Section 5***					
CMR is recommended for the assessment of myocardial structure and function in those with poor echocardiographic acoustic windows.	I	C	Contrast-enhanced CMR is recommended in patients with suspected cardiomyopathy, or where the underlying aetiology of HF is uncertain if further characterization is likely to add value to patient care.	I	C
CMR is recommended for the characterization of myocardial tissue in suspected infiltrative disease, Fabry disease, inflammatory disease (myocarditis), LV non-compaction, amyloid, sarcoidosis, iron overload/haemochromatosis.	I	C			
CMR with LGE should be considered in DCM to distinguish between ischaemic and non-ischaemic myocardial damage.	IIa	C			

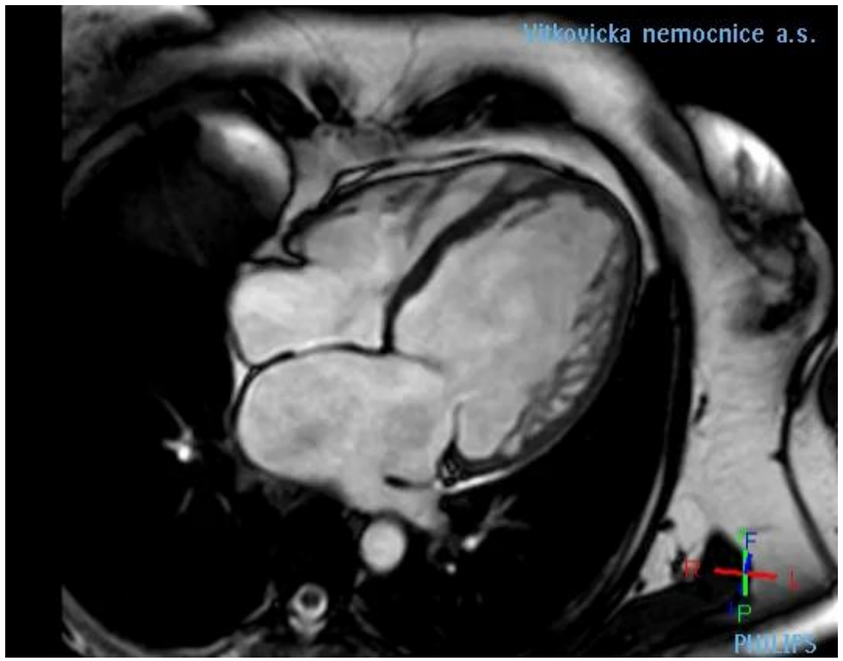


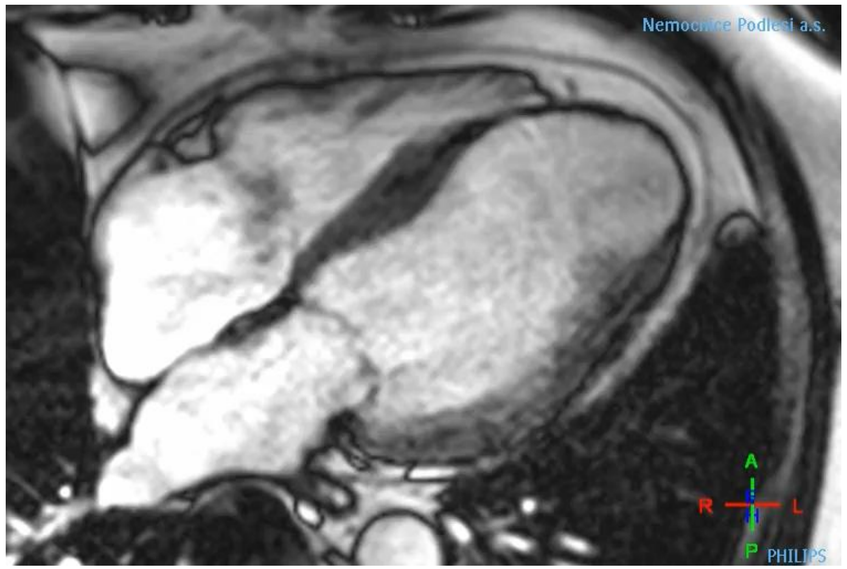




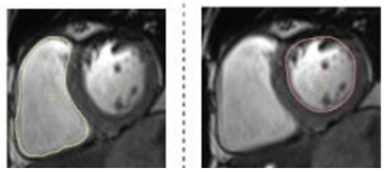
Hlavní výhody MR vyšetření

- nejlepší kombinace časově-prostorového rozlišení
- nejlepší tkáňové rozlišení
- absence “akustického okna”, možnost volit libovolnou rovinu zobrazení
- absence ionizujícího záření, výborně tolerovaná kontrastní látka
- zobrazení parakardiálních struktur

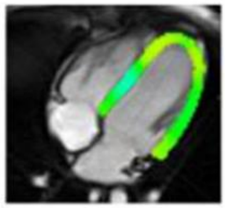




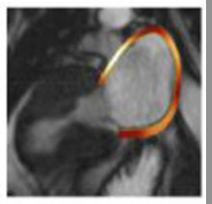
Funkční a morfologické hodnocení



Objemy komor,
Hmotnost myokardu



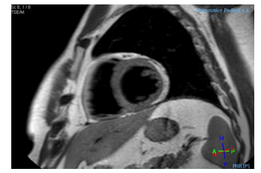
Hodnocení globální a regionální funkce komor, LV strain

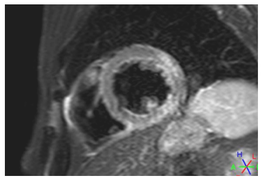


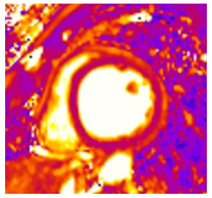
Objem síní, funkce LS, strain

Tkáňová charakteristika

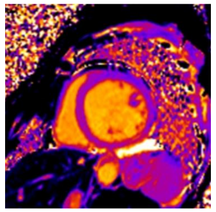
T1w, T2w obrazy







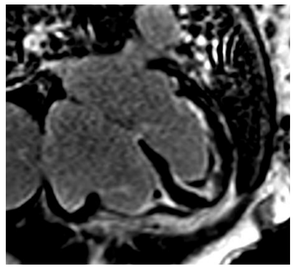
Parametrické mapování:
T1, T2, T2*, ECV



Jedno vyšetření poskytuje multiparametrické komplexní zhodnocení

Zátěžové MRI
Viabilita

LGE, přítomnost trombu



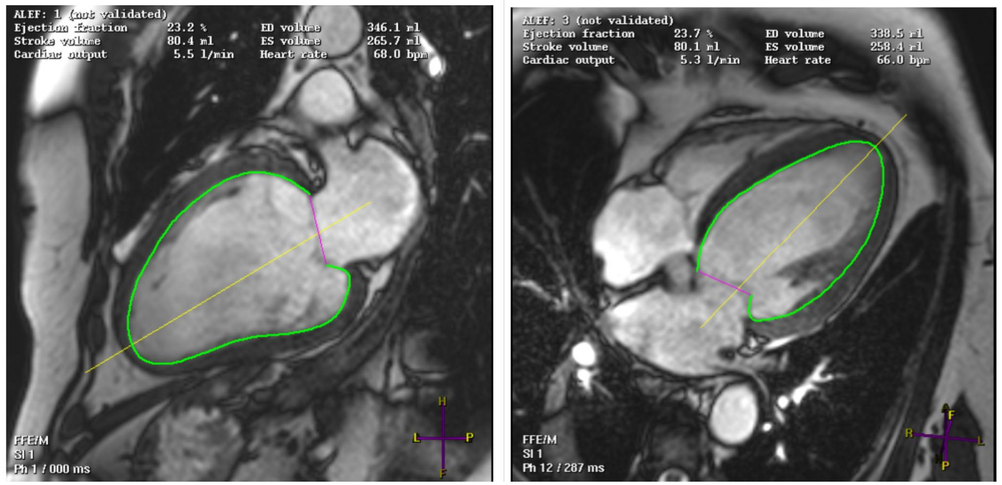
angiografie

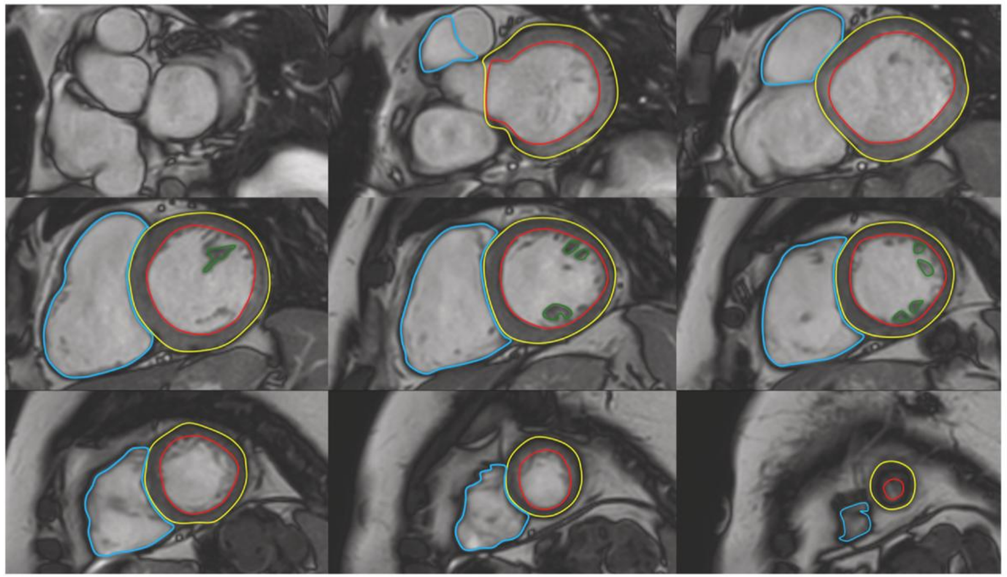
PC-
MRI, kvantifikace průtoků, RF, Qp:Qs

4D flow

Hodnocení objemu a funkce komor

Simpson’s rule





- MR “zlatý standard” hodnocení globální a regionální systolické funkce a objemů obou komor i síní
- EF LK, PK, EDV/EDVi, ESV/ESVi, SV, LV mass
- nejlepší kombinace časově-prostorového rozlišení, vynikající kontrast mezi krví a myokardem
- není limitace akustickým oknem
- stanovení objemu a funkce komor nevyžaduje podání k.l.

Contents lists available at ScienceDirect

Journal of Cardiovascular Magnetic Resonance

journal homepage: www.sciencedirect.com/journal/jocmr

Review Article

Society for Cardiovascular Magnetic Resonance reference values ("normal values") in cardiovascular magnetic resonance: 2025 update

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		Men			Women		
Parameter	References	n	Mean ± SD	LL-UL	n	Mean ± SD	LL-UL
LVEDV (mL)	[8,10,12,21]	4867	143 ± 31	81-204	5213	113 ± 23	68-158
LVEDV/BSA (mL/m^2)	[8,10,12,21]	4868	75 ± 14	49-102	5209	68 ± 11	46-90
LVESV (mL)	[8,10,12,21]	4857	52 ± 18	17-88	5203	39 ± 13	14-63
LVESV/BSA (mL/m^2)	[8,10,12,21]	4847	28 ± 8	11-44	5200	23 ± 6	11-36
LVSV (mL)	[8,10,12,21]	4867	91 ± 19	53-128	5212	74 ± 15	45-103
LVSV/BSA (mL/m^2)	[8,10,21]	4805	47 ± 9	30-64	5159	44 ± 8	29-60
LVEF (%)	[8,10,12,21]	4854	64 ± 7	51-77	5209	66 ± 6	54-79
LVM (g)	[8,10,12,21]	4859	105 ± 23	60-150	5203	74 ± 14	47-101
LVM/BSA (g/m^2)	[8,10,12,21]	4850	55 ± 8	39-72	5205	45 ± 6	33-56
LVCO (L/min)	[8,10,12,21]	4856	6.1 ± 1.3	3.6-8.6	5199	4.9 ± 1.1	2.9-7.0
LVCI (L/min/m^2)	[8,10]	404	3.2 ± 0.6	1.9-4.4	572	3.0 ± 0.6	1.8-4.2
LVM/LVEDV (g/mL)	[10]	340	0.9 ± 0.2	0.5-1.3	512	0.8 ± 0.1	0.6-1.0

		Men			Women		
Parameter	References	n	Mean ± SD	LL-UL	n	Mean ± SD	LL-UL
RVEDV (mL)	[8,9,11,12,19,21]	5097	152 ± 40	74-231	5219	115 ± 29	59-172
RVEDV/BSA (mL/m^2)	[8,9,11,12,19,21]	5095	82 ± 18	47-116	5221	71 ± 14	44-99
RVESV (mL)	[8,9,11,12,19,21]	5103	65 ± 20	26-104	5216	46 ± 15	17-75
RVESV/BSA (mL/m^2)	[8,9,11,12,19,21]	5102	34 ± 9	16-52	5214	28 ± 8	13-43
RVSV (mL)	[8,11,12,19,21]	5041	89 ± 29	33-146	5166	71 ± 20	32-109
RVSV/BSA (mL/m^2)	[8,11,19,21]	4984	48 ± 14	21-76	5114	45 ± 10	25-64
RVEF (%)	[8,9,11,12,19,21]	5095	58 ± 7	44-72	5219	61 ± 7	47-75
RVM (g)	[9,21]	4366	36 ± 9	18-54	4550	29 ± 7	15-43
RVM/BSA (g/m^2)	[9,21]	4372	18 ± 4	11-26	4550	16 ± 4	9-24
RVCO (L/min)	[8,19,21]	4779	5.5 ± 1.6	2.4-8.6	4852	4.6 ± 1.2	2.2-7.1
RVCI (L/min/m^2)	[8]	64	2.9 ± 0.9	1.1-4.7	60	2.7 ± 0.7	1.3-4.1

nelze srovnávat objemy z MR a echo

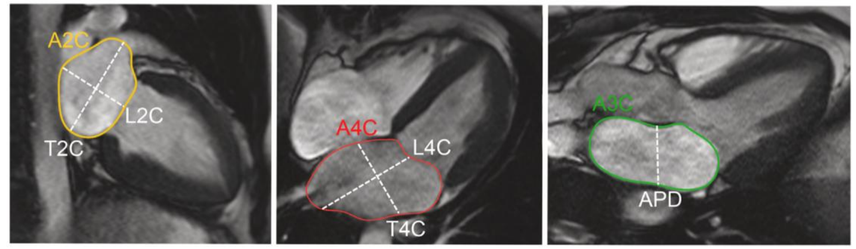


Fig. 3. Measurements of left atrial area (A2C, A4C, A3C), longitudinal (L2C, L4C), and anteroposterior (APD) diameters on the two-, four-, and three-chamber view according to reference [38]

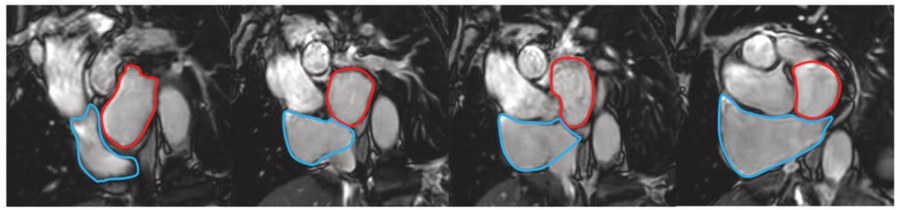
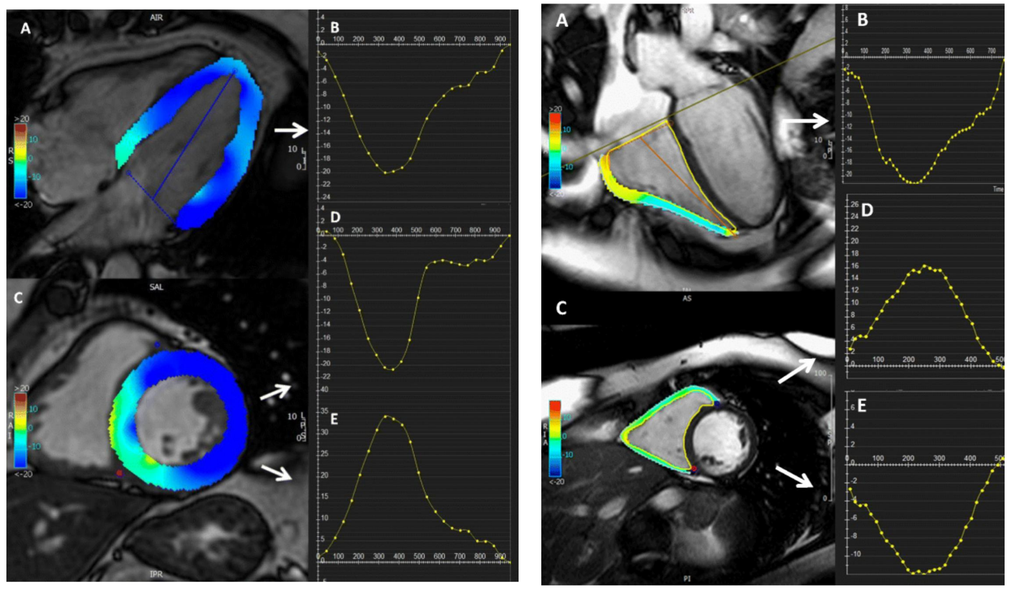


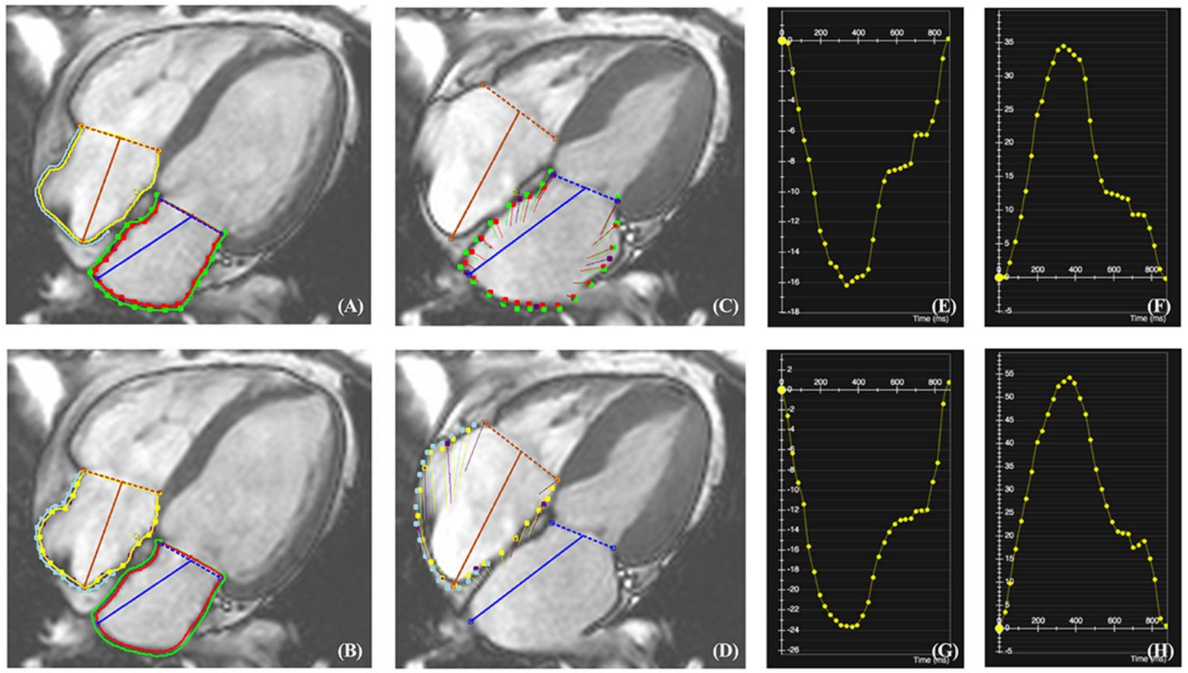
Fig. 4. Measurements of maximal left and right atrial volume using the Simpson's method, obtained on a short-axis cine stack of balanced steady-state free precession images covering the atria, by contouring left (red) and right (blue) atrial borders at ventricular systole according to reference [11]

			Men			Women		
Method	Parameter	References	n	Mean ± SD	LL-UL	n	Mean ± SD	LL-UL
Bi-plane area-length	Max. LA volume (mL)	[16,20,21,39–42]	13,969	68 ± 22	26-110	15,563	60 ± 17	26-94
method; LA	Max. LA volume/BSA (mL/m^2)	[16,20,21,39–42]	13,972	36 ± 10	16-56	15,557	36 ± 9	18-54
appendage	Min. LA volume (mL)	[16,20,21,39,41,42]	13,800	28 ± 14	2-55	15,359	24 ± 11	3-45
excluded	Min. LA volume/BSA (mL/m^2)	[16,20,21,39,41,42]	13,803	15 ± 7	2-28	15,335	14 ± 6	3-26
	LASV (mL)	[20,41]	1219	40 ± 14	13-68	2144	38 ± 15	10-67
	LASV/BSA (mL/m^2)	[20]	1114	18 ± 6	6-29	2067	18 ± 6	7-30
	LA ejection fraction (%)	[20,21,39,41,42]	13,703	59 ± 13	35-84	15,175	61 ± 11	39-83
Simpson's method;	Max. LA volume (mL)	[11,38,39]	322	75 ± 18	40-111	367	65 ± 14	38-93
LA appendage	Max. LA volume/BSA (mL/m^2)	[11,38,39]	322	40 ± 8	25-56	367	41 ± 8	25-56
included	Min. LA volume (mL)	[11,39]	262	32 ± 9	15-50	307	26 ± 8	11-41
	Min. LA volume/BSA (mL/m^2)	[11,39]	262	18 ± 4	9-26	307	17 ± 5	7-27
	LASV (mL)	[11]	196	47 ± 13	21-73	238	39 ± 10	19-59
	LASV/BSA (mL/m^2)	[11]	196	24 ± 6	12-36	238	24 ± 5	14-34
	LA ejection fraction (%)	[11,39]	262	57 ± 9	40-74	307	59 ± 7	45-73

CMR Strain - Feature-tracking

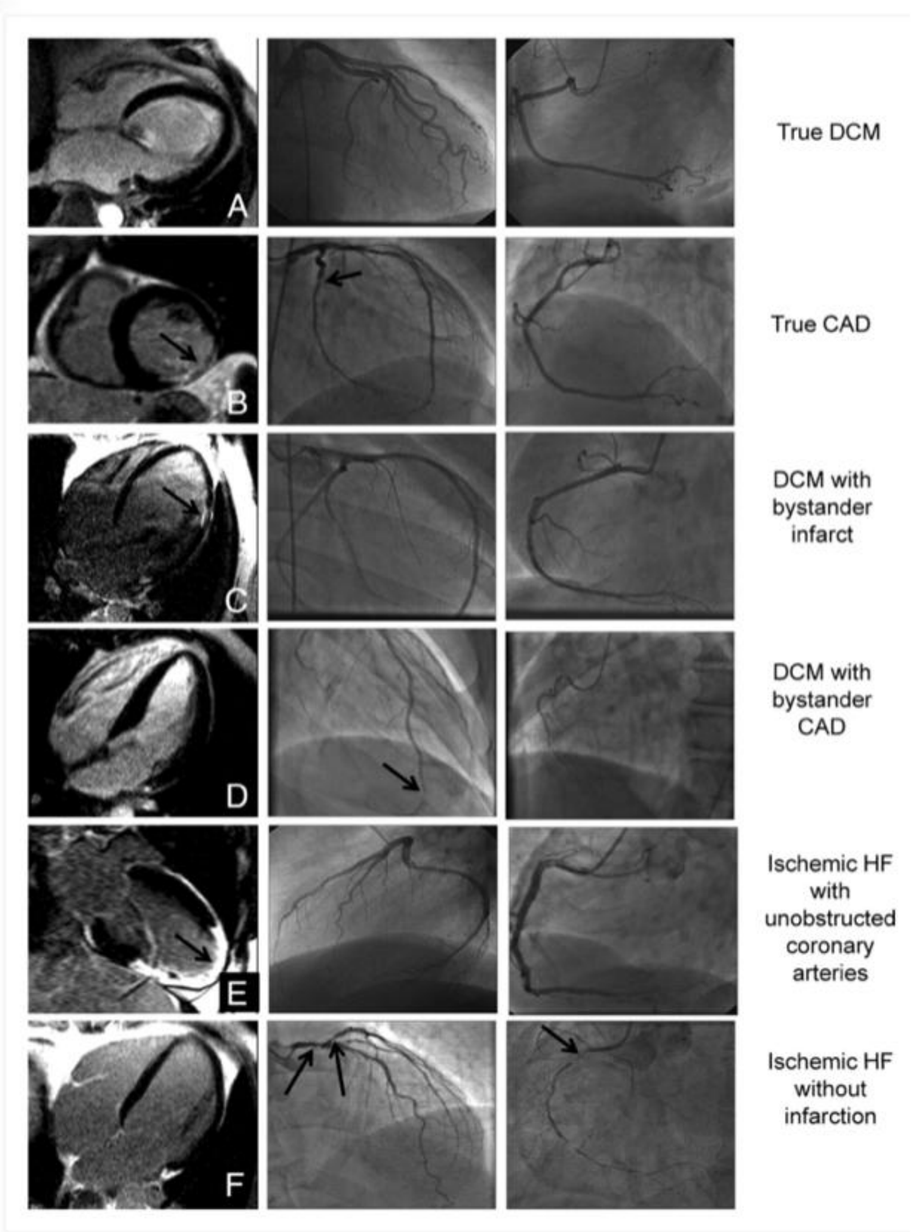
- kvantitativní hodnocení ventrikulární celkové a regionální mechaniky na principu sledování deformace svalových vláken
- postprocessingové zpracování rutinně používaných sekvencí, neprodlužuje se čas vyšetření
- rychlá semi-automatická analýza dat
- dobrá shoda mezi STE a CMR-FT





MR - LGE

- klíčové pro detekci lokalizované fibrózy
- poskytuje informace k etiologii srdečního selhání, rozlišení ischemické a neischemické etiologie
- neischemické fibróza nezávislá na etiologii (genetické příčiny i získané)
- limitace: LGE selhává v detekci intersticiální (difusní fibrózy)



Shah et al. In: Edelman RR, et al., eds. Clinical Magnetic Resonance Imaging. 3rd ed. New York: Elsevier Press; 2005.

Stratifikace rizika NSS - Ischemická vs neischemická KMP

u NICM samotná LVEF postrádá senzitivitu a specificitu jako rizikový marker pro SCD

ESC European Society of Cardiology European Heart Journal (2022) 43, 3997–4126 https://doi.org/10.1093/eurheartj/ehac262 ESC GUIDELINES

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Developed by the task force for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death of the European Society of Cardiology (ESC)

Endorsed by the Association for European Paediatric and Congenital Cardiology (AEPC)

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ESC European Society of Cardiology European Heart Journal (2026) 00, 1–112 https://doi.org/10.1093/eurheartj/ehag100 ESC GUIDELINES

2026 ESC Guidelines for the management of heart failure

Developed by the task force for the management of heart failure of the European Society of Cardiology (ESC)

With the special contribution of the Heart Failure Association (HFA) of the ESC

Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS)

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ESC European Society of Cardiology European Heart Journal (2023

2023 ESC Guidelin… of cardiomyopathies

Developed by the task force on the management of cardiomyopathies of the European Society of Cardiology (ESC)

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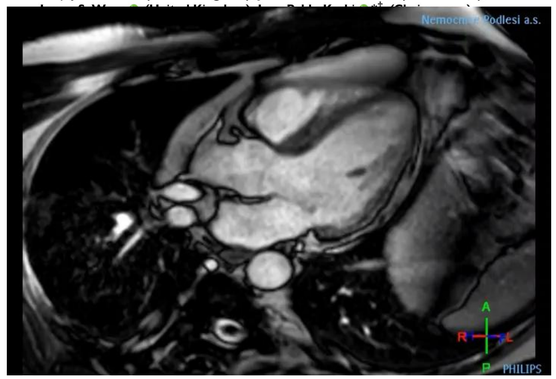
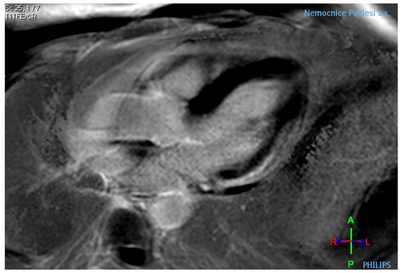
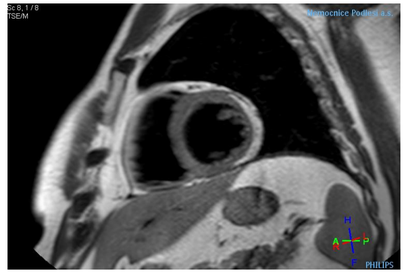






Diagnosis of chronic heart failure—*Section 5*

Genetic testing is recommended in patients fulfilling diagnostic criteria for cardiomyopathy in cases where it enables diagnosis, prognostication, therapeutic stratification, or reproductive management of the patient, or where it enables cascade genetic evaluation of their relatives who would otherwise be enrolled into long-term surveillance.	I	C

Recommendation Table 24 — Recommendations for risk stratification, sudden cardiac death prevention, and treatment of ventricular arrhythmias in chronic coronary artery disease

Recommendations	Class[a]	Level[b]
Risk stratification and primary prevention of SCD		
In patients with syncope and previous STEMI, PES is indicated when syncope remains unexplained after non-invasive evaluation.[146,584]	I	C
ICD therapy is recommended in patients with CAD, symptomatic heart failure (NYHA class II–III), and LVEF ≤35% despite ≥3 months of OMT.[354,356]	I	A
ICD therapy should be considered in patients with CAD, NYHA class I, and LVEF ≤30% despite ≥3 months of OMT.[354]	IIa	B
ICD implantation should be considered in patients with CAD, LVEF ≤40% despite ≥3 months of OMT, and NSVT, if they are inducible for SMVT by PES.[355]	IIa	B

Table 5 Changes in recommendations since 2015

DCM/HNDCM

ICD implantation should be considered in patients

Gene	Annual SCD rate	Predictors of SCD
LMNA[185,186,438,541,865,878,879]	5–10%	Estimated 5-year risk of life-threatening arrhythmia using *LMNA* risk score (https://lmna-risk-vta.fr)
FLNC-truncating variants[866,867,880]	5–10%	LGE on CMR LVEF < 45%
TMEM43[868,881]	5–10%	Male Female and any of the following: LVEF <45%, NSVT, LGE on CMR, >200 VE on 24h Holter ECG
PLN[542,882,883]	3–5%	Estimated 5-year risk of life-threatening arrhythmia using *PLN* risk score (https://plnriskcalculator.shinyapps.io/final_shiny) LVEF < 45% LGE on CMR NSVT
DSP[185,186]	3–5%	LGE on CMR LVEF < 45%
RBM20[869]	3–5%	LGE on CMR LVEF < 45%

remains unexplained after non-invasive evaluation.[661,668]

ESC European Society of Cardiology
Europace (2025) **27**, euaf214
https://doi.org/10.1093/europace/euaf214

META-ANALYSIS

Prediction of ventricular arrhythmias and sudden cardiac death by quantification and location of late gadolinium enhancement on cardiac magnetic resonance: a systematic review and meta-analysis

Thomas Nia Jensen [1†], **Sharif Omara** [2†], **Jens Cosedis Nielsen** [1,3,4], **Michelle Samuel** [5,6], **Rob J. van der Geest** [7], **Won Yong Kim** [1], **and Katja Zeppenfeld** [1,2,3,4*]

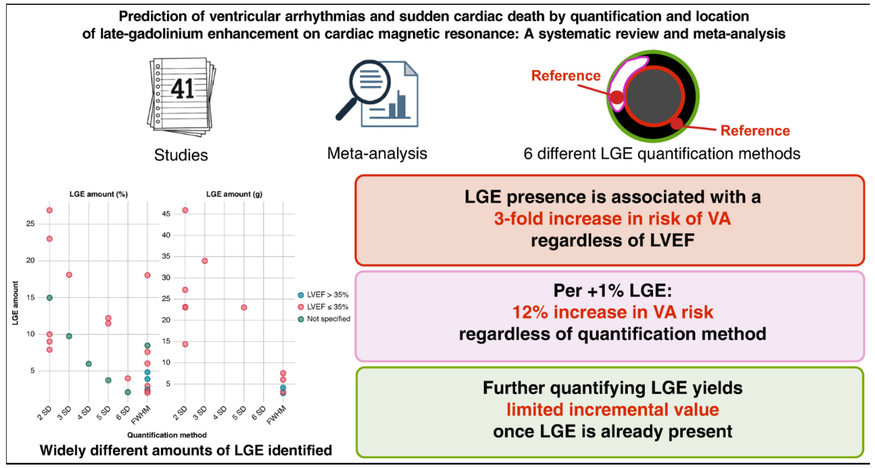
N=14658 pc s NICM, FU 3y

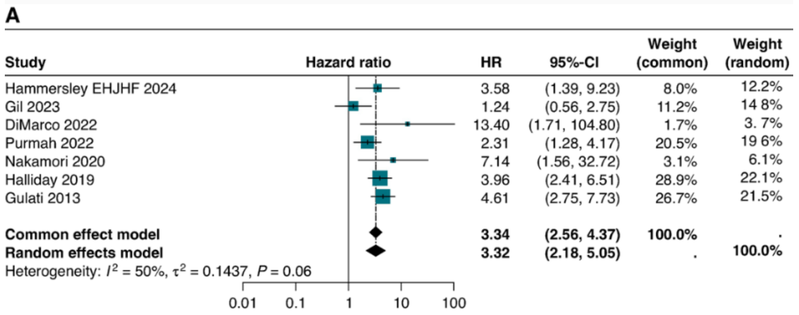
Aims In non-ischaemic cardiomyopathy (NICM), late gadolinium enhancement (LGE) detected by cardiovascular magnetic resonance is related to ventricular arrhythmia (VA) and sudden cardiac death (SCD) risk. The incremental prognostic value of quantifying LGE volume or mass beyond its mere presence, however, remains unresolved. The aim was to evaluate whether LGE quantification improves the prediction of SCD.

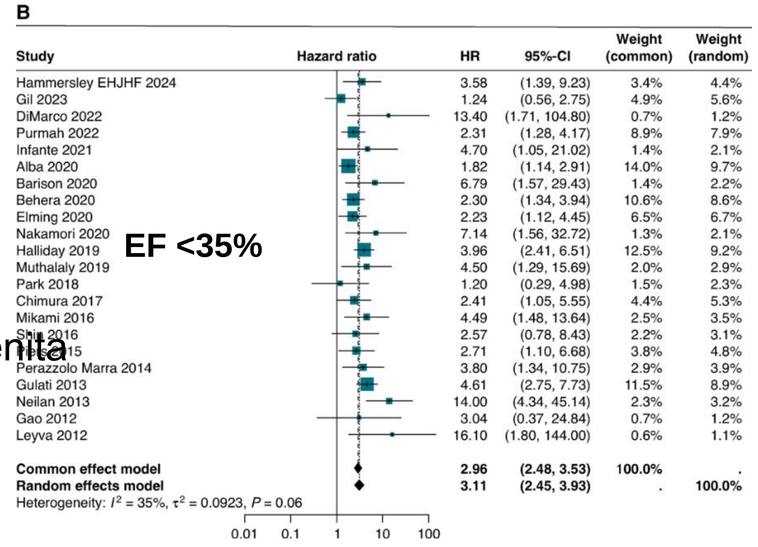
Methods and results PubMed, Embase, and Web of Science were searched on 20 November 2024 for observational studies that related quantified LGE burden to ventricular arrhythmia (VA)/SCD in NICM. Forty-one studies met prespecified criteria. Hazard ratios (HRs) were pooled with random-effects models, and quantification information was depicted in figures. Presence of any LGE was associated with a three-fold increase in VA/SCD risk (pooled HR 3.31, 95% confidence interval: 2.58–4.24). Beyond this binary marker, every additional 1% (or 1 g) of LGE was associated with a 12% relative risk increase (range 10–20%), independent of left ventricular ejection fraction and consistent across eight semi-automated thresholding techniques. This included 2–6 standard deviations above the reference myocardium and the full-width half-maximum method. Additionally, results were prone to substantial methodological heterogeneity ($\tau^2 = 1.49$) and small-study bias. Once the presence of LGE was accounted for, scar quantification and location conferred minimal additional prognostic value.

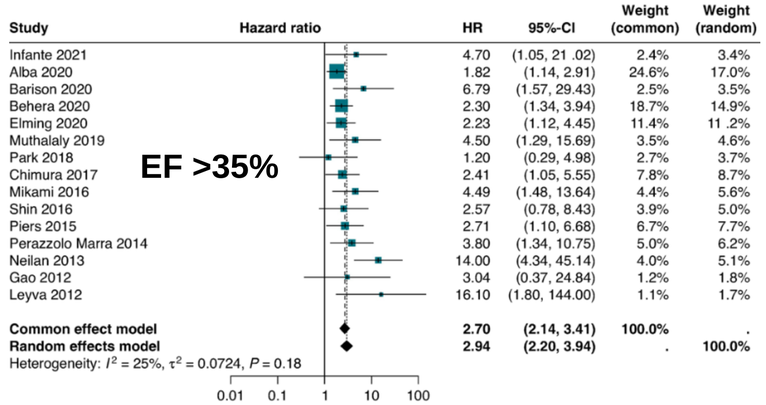
Conclusion Quantitative LGE assessment provides little incremental prognostic utility over dichotomous LGE detection. Consensus imaging standards and prospective validation are requisite before LGE burden can guide primary implantable cardioverter defibrillator allocation in NICM.

- Přítomnost LGE je asociována s rizikem VA
- Mezi metodami kvantifikace LGE je značná heterogenita
- Kvantifikace LGE nepřidává významnou prognostickou hodnotu



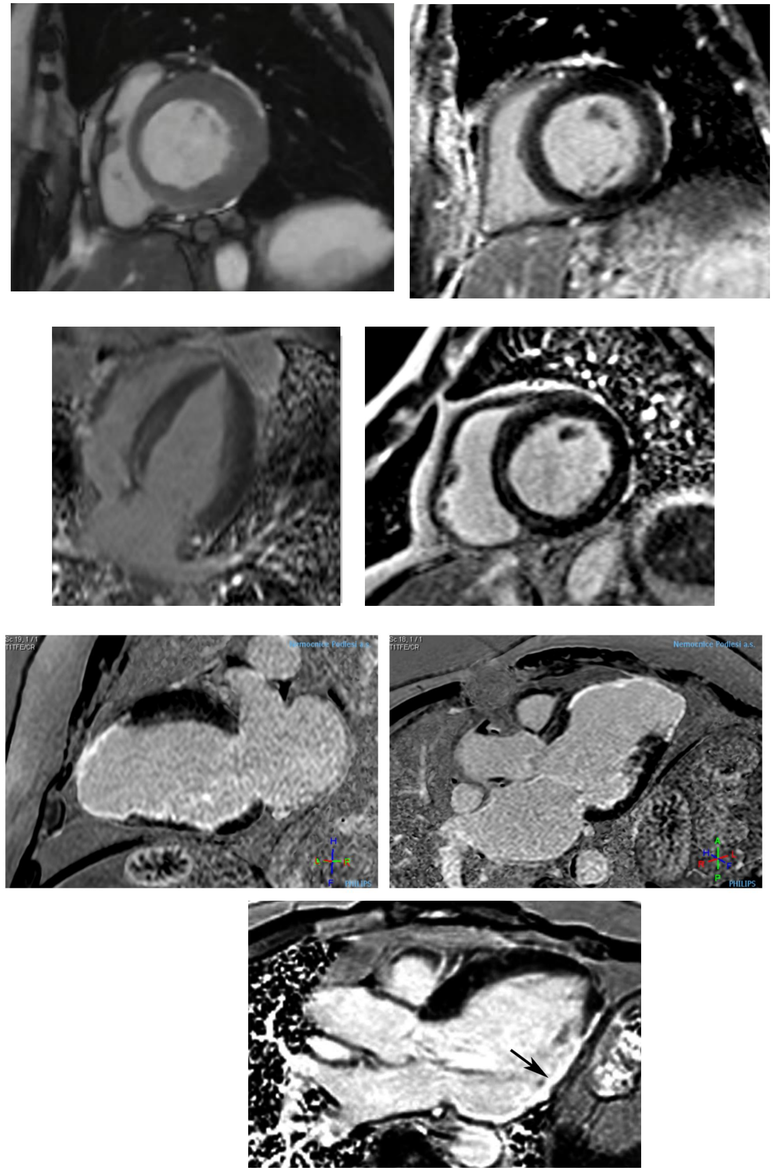






Další využití informací z MR - strategie arytmologické léčby

Zkušenosti (praxe) našeho pracoviště



A. Resynchronizační léčba

Indikace k CSP (resp. LBBP)

- primárně LBBB bez pozdního sycení. Jsou nejlepšími respondery a při LBBP dokonce superrespondery

- ev. LBBB, kteří mají nerozsáhlé pozdní sycení v bazálním septu (pravděpodobně i příčina LBBB)

Indikace k BiV resynchronizaci

- ischemici nebo neischemici s větším rozsahem jizev (dyssynchronie zde pravděpodobně způsobena pozdním vedením jizvami na boční stěnu a ne LBBB)
- ischemik s velkou jizvou na lat. stěně- BiV nemusí fungovat dobře, stimulace do jizvy navíc může být proarytmogenní pro KT

B. Diferenciální dg. arytmií indukované KMP

C. Pátrání po arytmogenním substrátu před ablací

MR parametrické mapování

- Mapovací techniky citlivější na difusní změny, umožňují přímou kvantifikaci relax.časů
- T2 mapování specifičtější pro detekci edému
- nativní T1 citlivý na přítomnost edému, fibrózy akumulaci amyloidních proteinů - samotný T1 nemusí být schopen rozlišit akutní onemocnění od chronického
- T1 mapování nativně a postkontrastně umožňuje kvantifikaci ECV (nutná znalost aktuálního Htk)
- Normální hodnota ECV je 0,25±0,04 (1,5 Tesla)

Contents lists available at ScienceDirect

Journal of Cardiovascular Magnetic Resonance

journal homepage: www.sciencedirect.com/journal/jocmr

Review Article

Society for Cardiovascular Magnetic Resonance reference values (“normal values”) in cardiovascular magnetic resonance: 2025 update

Nadine Kawel-Boehm[a], Scott J. Hetzel[b], Bharath Ambale-Venkatesh[c], Gabriella Captur[d,e], Calvin W.L. Chin[f,g], Christopher J. François[h], Michael Jerosch-Herold[i], Judy M. Luu[j], Zahra Raisi-Estabragh[k], Jitka Starekova[l], Michael Taylor[m], Max van Hout[n], David A. Bluemke[l,*]

Table 89
Normal native myocardial T1-relaxation time (ms) in adults.[a]

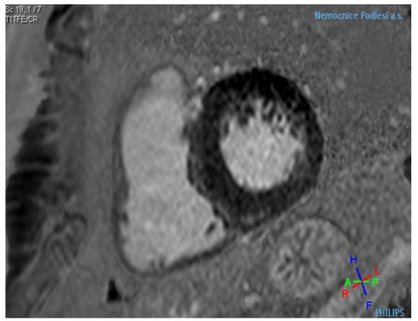
Reference(s)	FS	Vendor	Sequence	n	Mean ± SD	LL-UL
[18]	1.5	GE[b]	MOLLI 3b(3s)3b(3s)5b	100	1027 ± 36[c]	956-1098
[132]	1.5	Philips[d]	MOLLI 3b(2s)5b	51	974 ± 45	884-1064
[125]	1.5	Philips[d]	MOLLI 3b(3s)3b(3s)5b	50	967 ± 28	911-1023
[116]	1.5	Siemens[e]	MOLLI 5b(4b)2b	40	996 ± 32[c]	933-1059
[128]	1.5	Siemens[e]	MOLLI 5s(3s)3s	94	1024 ± 39	946-1102
[142]	1.5	Siemens[e]	MOLLI 5b(3b)5b(3b)5b(3b)	50	928 ± 25[c]	879-977
[118,122]	1.5	Siemens[e]	MOLLI 3b(3s)3b(3s)5b	127	952 ± 35	883-1020
[128,135]	1.5	Siemens[e]	ShMOLLI 5b(1b)1b(1b)1b	4242	954 ± 41	874-1034
[128]	1.5	Siemens[e]	SASHA	94	1144 ± 45	1054-1234
[121]	3	Philips[d]	MOLLI 3b(3s)3b(3s)5b	46	1057 ± 23	1011-1103
[144,146]	3	Siemens[e]	MOLLI 5s(3s)3s	120	1214 ± 39	1138-1289
[120]	3	Siemens[e]	MOLLI 5b(3s)3b	41	1180 ± 27	1126-1234
[139]	3	Siemens[e]	MOLLI 5b(3b)3b	129	1182 (1162-1200)[f]	
[123]	3	Siemens[e]	ShMOLLI 5b(1b)1b(1b)1b	57	1125 ± 45	1035-1215
[123]	3	Siemens[e]	SASHA	57	1494 ± 43	1408-1580

Extracellular volume fraction, calculated by

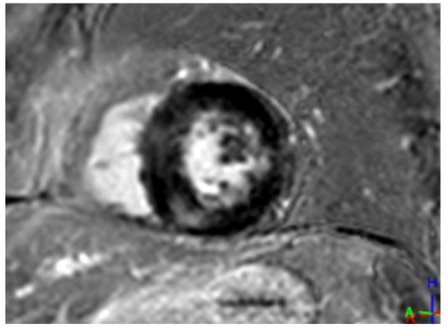
$$ECV = \frac{\left(\frac{1}{T1myo_{postGd}} - \frac{1}{T1myo_{native}}\right)}{\left(\frac{1}{T1blood_{postGd}} - \frac{1}{T1blood_{native}}\right)} \times (100 - hematocrit)$$

where myo = myocardium; blood = intracavitary blood pool; hematocrit = cellular volume fraction of blood [%]

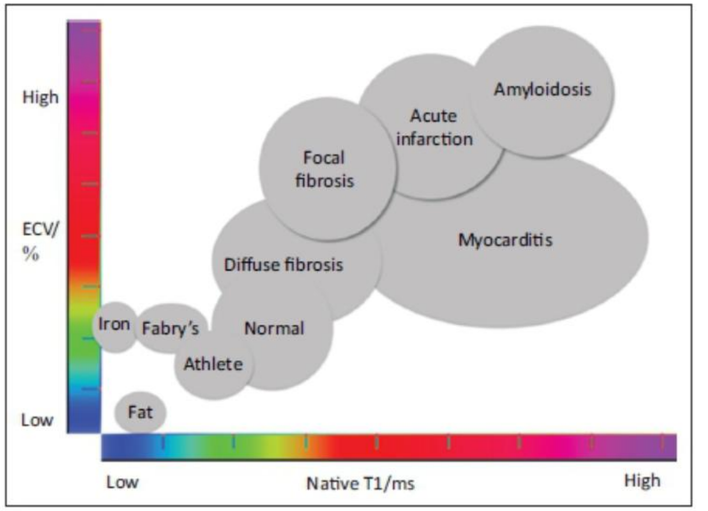
Pacient se srdečním selháním- fenotyp HCM

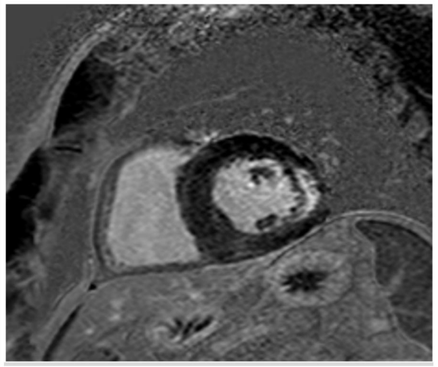


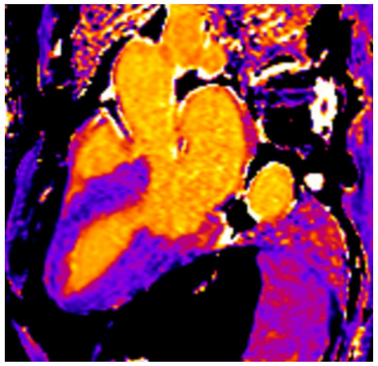
Hypertenzní srdce



Sarkomerická HCM



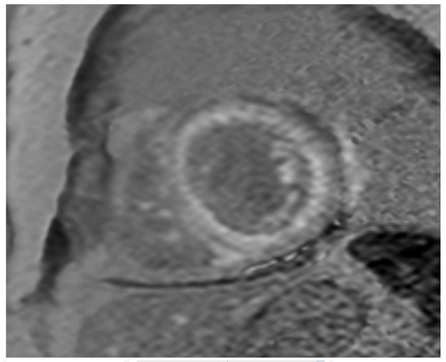


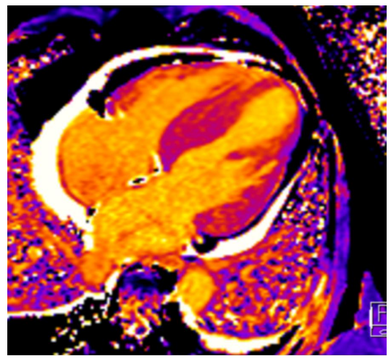


Fabryho choroba

nativní T1 939ms

septum 873ms



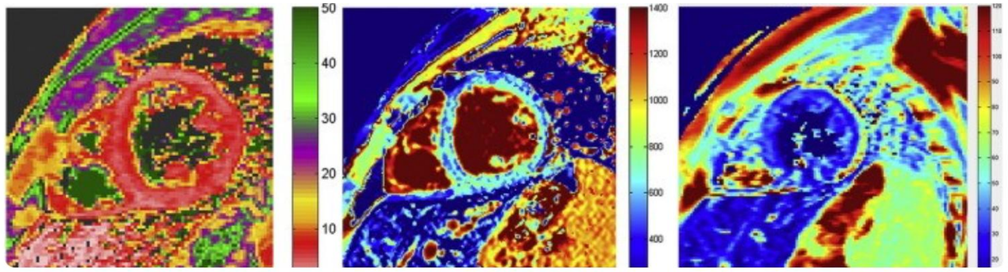


Amyloidóza

nativní T1 1145ms

ECV 58%

Iron overload - T2* mapování



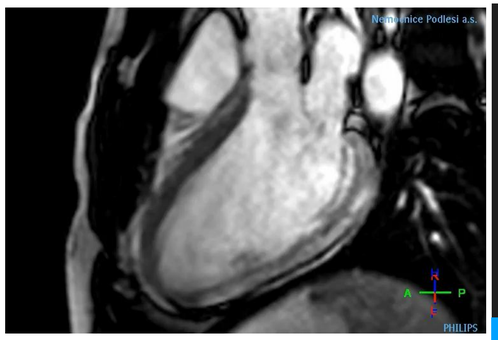
zdroj: Krittayaphong R et al., International Journal of Cardiology 2017

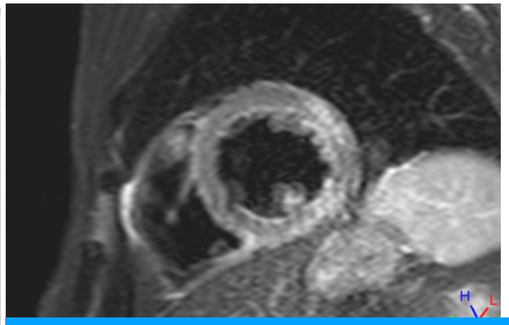
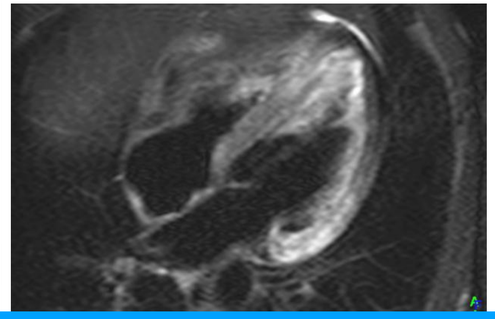
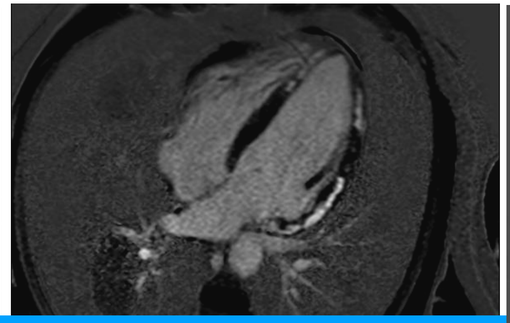
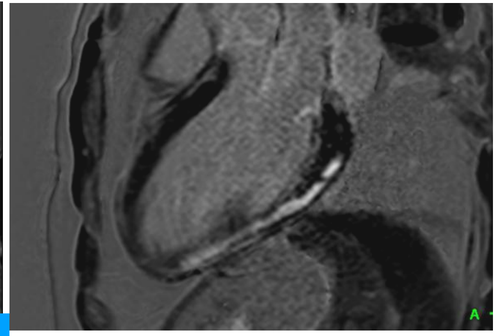
Iron loading stratification	Cardiac MRI 1.5T		Cardiac MRI 3T	
	T2* (msec)	R2* (Hz)	T2* (msec)	R2* (Hz)
Normal	>20	<50	>12	<83
Moderate	10–20	50–100	5.5–12	83–181
Severe	<10	>100	<5.5	>181

MR srdce a zánět - pacient se srdečním selháním fenotyp DCM

diferenciální diagnostika zánětlivé/ pozánětlivé KMP

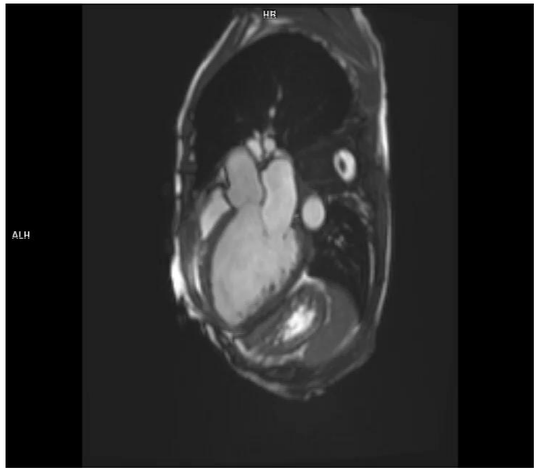
klinický scénář A

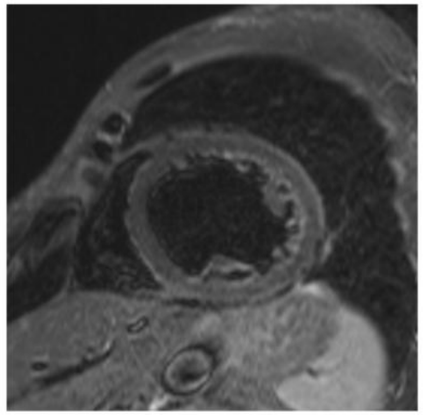
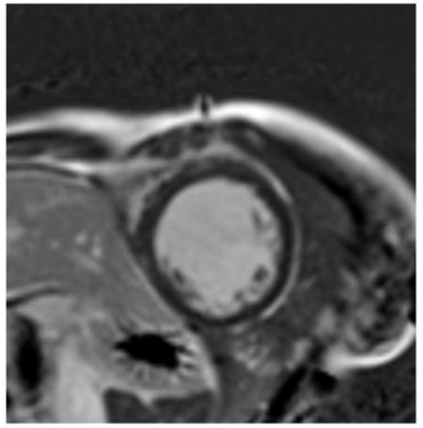


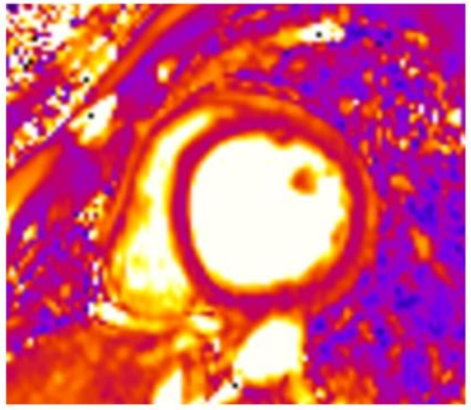
MR “zlatý” neinvazivní standard pro diagnostiku akutní myokarditidy

klinický scénář B

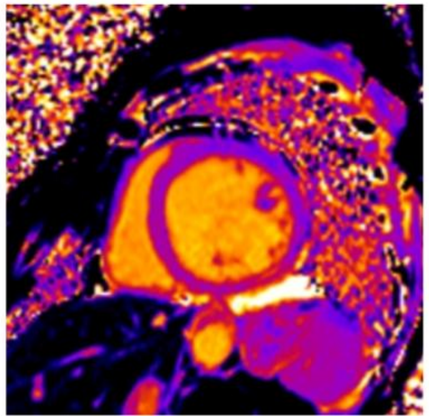


T2 rel.č.≤50ms



T1 1028ms, ECV 32%



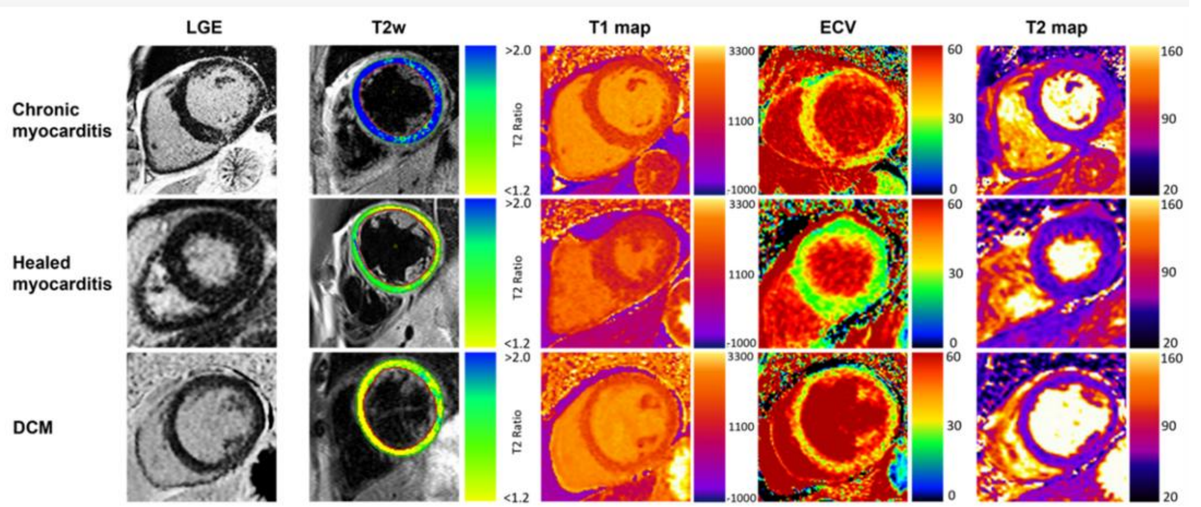
Journal of *Clinical Medicine*

MDPI

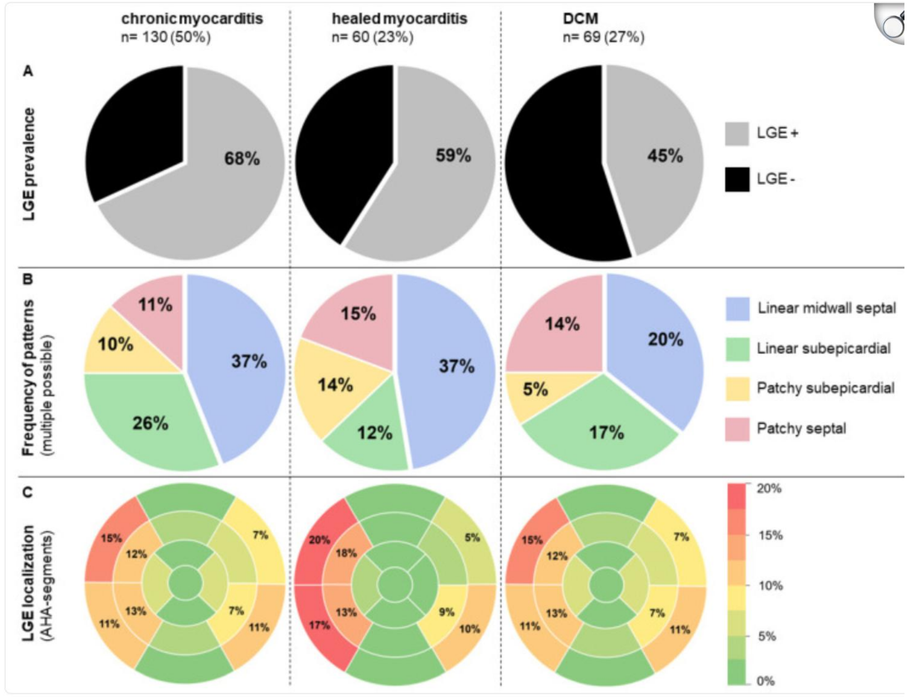
Article

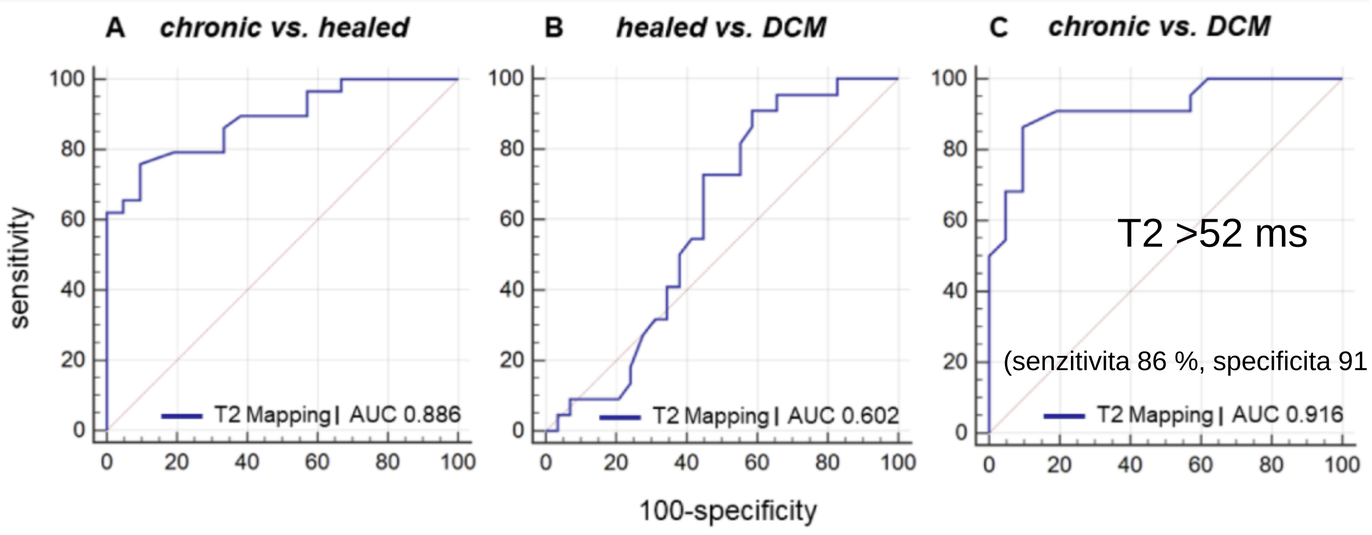
Using Multiparametric Cardiac Magnetic Resonance to Phenotype and Differentiate Biopsy-Proven Chronic from Healed Myocarditis and Dilated Cardiomyopathy

Patrick Krumm [1], Jan M. Brendel [1,*], Karin Klingel [2], Karin A. L. Müller [3], Jens Kübler [1], Christoph Gräni [4], Meinrad Gawaz [3], Konstantin Nikolaou [1] and Simon Greulich [3]



N 259 pts, provedená EMB a CMR



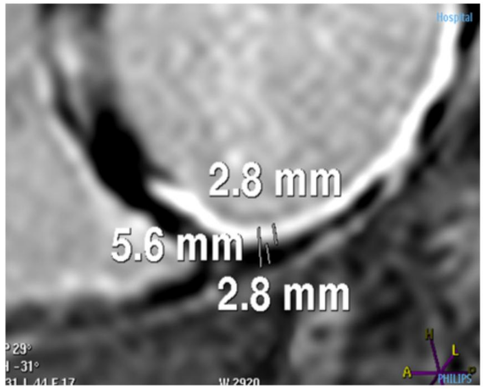


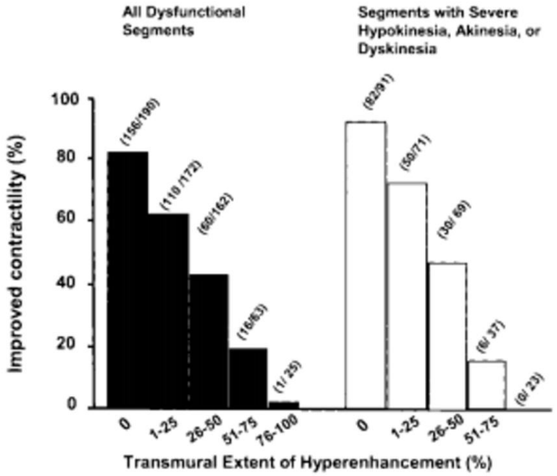
Kombinované protokoly zvyšují pravděpodobnost detekce zánětlivých změn v různých stádiích onemocnění a zlepšují diagnostickou přesnost

Pacient se srdečním selháním - ischemická KMP

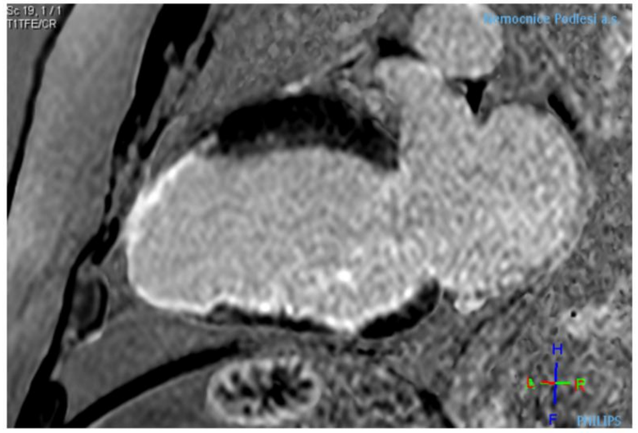
Viabilita LGE - index transmurality (IT)

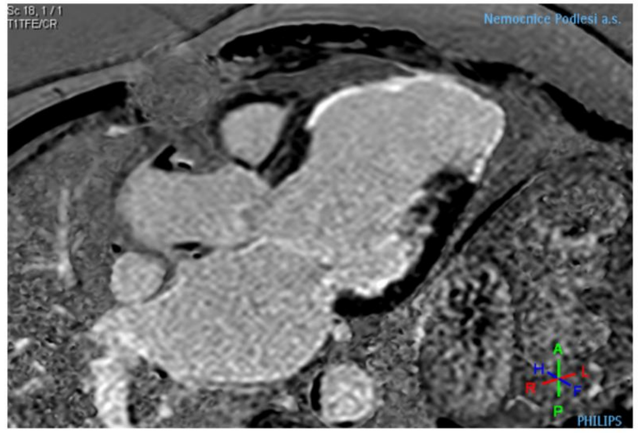
- Cutt-off hodnota IT 50%





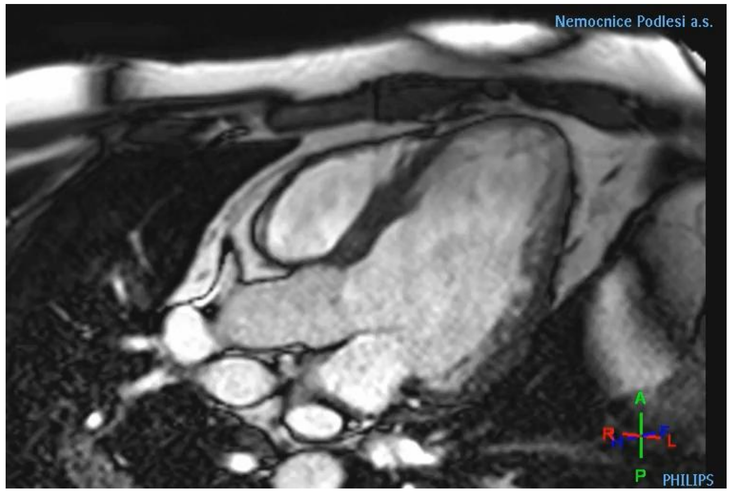
Zdroj: Selvanayagam JB et al. Circulation. 2004;110:1535-1541.

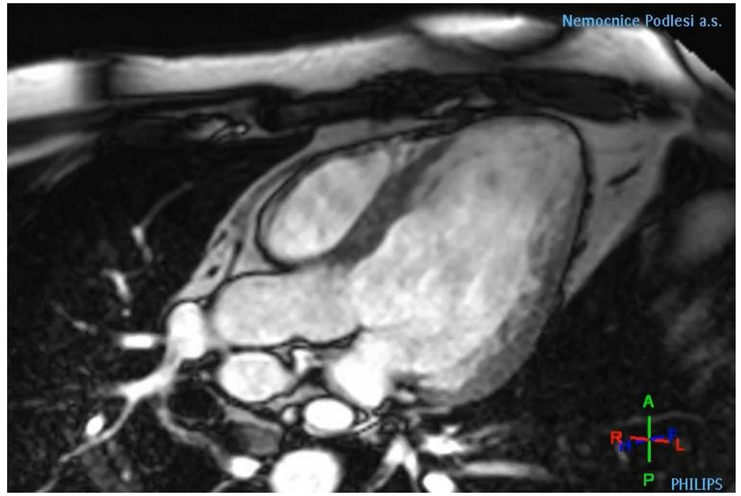




Viabilita- kontraktilní rezerva

DSMRI (low dose)





Pacient se srdečním selháním - chlopenní vady

- kvantifikace RF přímé/ nepřímé metody
- kvantifikace objemů LV/RV
- přítomnost fibrózy LGE/ECV

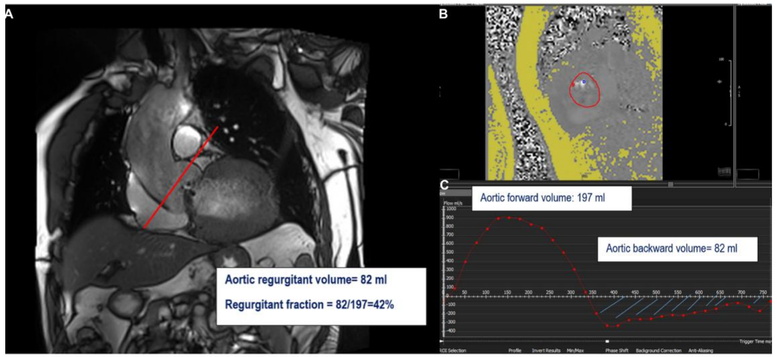
REVIEW article

Front. Cardiovasc. Med., 07 July 2022

Sec. Cardiovascular Imaging

Volume 9 - 2022 | https://doi.org/10.3389/fcvm.2022.881141

Role of Cardiovascular Magnetic Resonance in Native Valvular Regurgitation: A Comprehensive Review of Protocols, Grading of Severity, and Prediction of Valve Surgery



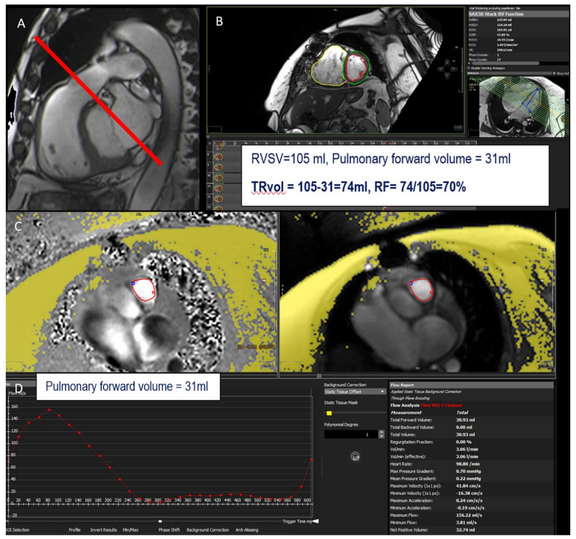


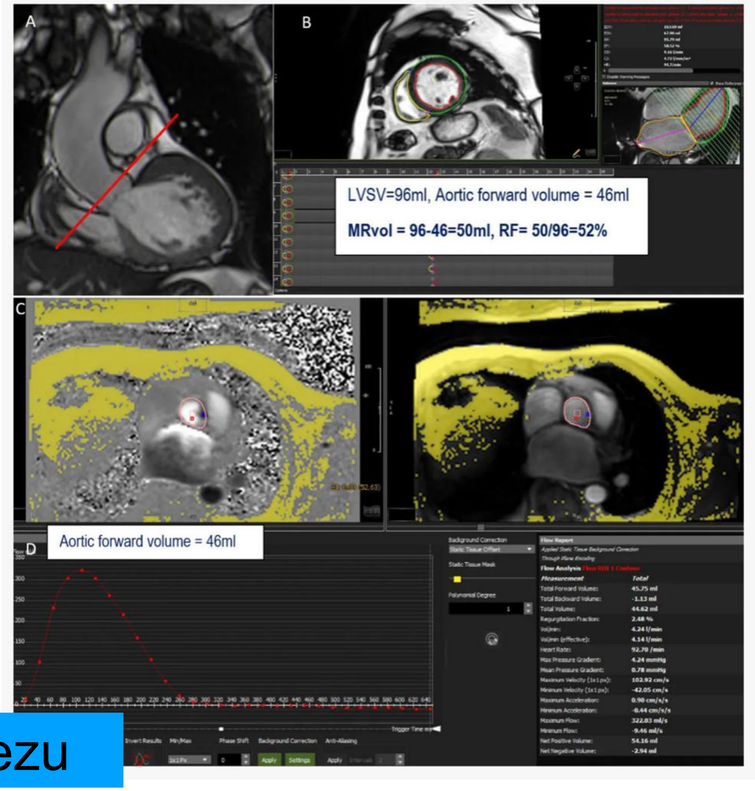
TABLE 4 | Indications, preferred methods and evidence level of CMR to determine severity of mitral, aortic, tricuspid and pulmonary regurgitation according to current American and European guidelines (3, 4, 35, 36).

	Severe MR	Severe AR	Severe TR	Severe PR
When CMR is indicated	Discrepancy between MR severity on echo and clinical findings Inconclusive echo on MR severity or indeterminate MR (3, 4, 35, 36)	Discrepancy between AR severity on echo and clinical findings Inconclusive echo on AR severity or indeterminate AR (3, 4, 35, 36) Patients with bicuspid aortic valve with unsatisfactory assessment of aorta morphology (36)	Discrepancy between TR severity on echo and clinical findings Inconclusive echo on TR severity or indeterminate TR (3, 4, 35, 36) RV assessment (35)	Discrepancy between PR severity on echo and clinical findings Inconclusive echo on PR severity or indeterminate PR (3, 35, 36) RV assessment (35)
Preferred CMR methods	Indirect methods (35, 36)	Direct method (35, 36)	Indirect methods (35, 36)	Direct method (35, 36)
Class of recommendation/ Level of evidence	I/B-NR (3)	I/B-NR (3)	I/B-NR (3)	–

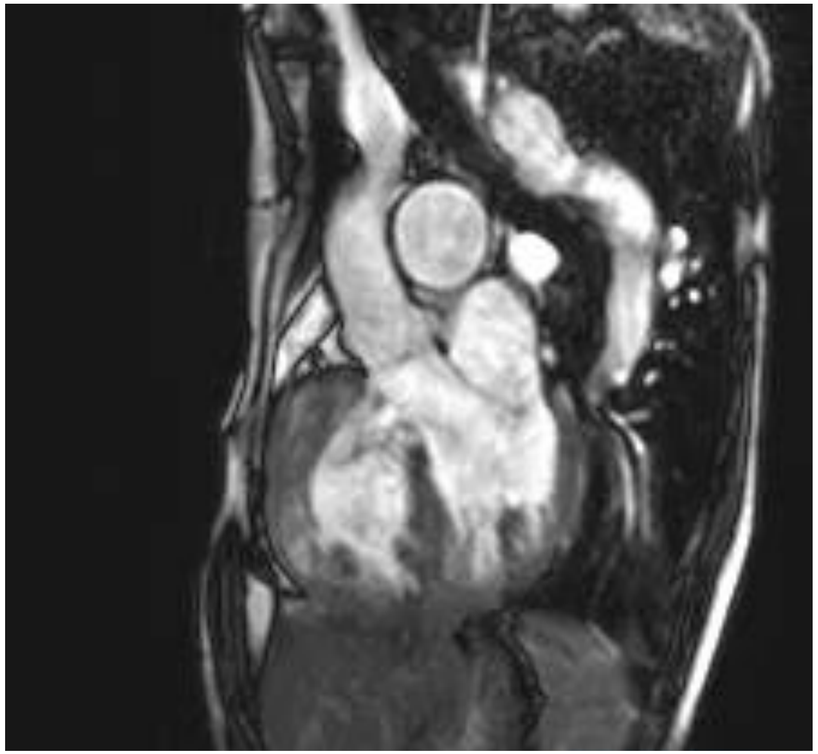
CM

MR metoda druhé volby v případě nekonkluzivního echo nálezu

RO = SV (SV LK/PK)- průtok v asc. aortě/plicnici



Pacient se srdečním selháním - vrozená srdeční vada



- dlouhodobé sledování pacientů po operačních korekcích v dětství a reziduálních nálezů
- hodnocení komplexní anatomie
- volumetrie a funkce RV, LV
- kvantifikace průtoků, RF, zkratů
- absence ionizujícího záření a často i nutnosti podání k.l.
- MR klíčová pro časování a indikaci k reoperacím
- budoucí perspektiva: 4D flow

Role MR- závěry

- MR komplexní metoda pro diagnostiku, fenotypizaci a stratifikaci rizika u celé škály kardiovaskulárních onemocnění
- Poskytuje data o morfologii, funkci, perfuzi, viabilitě a charakterizaci tkáně
- Je referenčním standardem pro měření objemu, hmotnosti a funkce komor
- LGE je silným nezávislým prediktorem nežádoucích událostí
- Diagnostika specifických příčin srdečního selhání je důležitá ve vztahu k cílené farmakoterapii některých onemocnění
- Kombinované protokoly s využitím parametrického mapování zvyšují diagnostickou přesnost a zlepšují rizikovou stratifikaci

Clinical Cardiology

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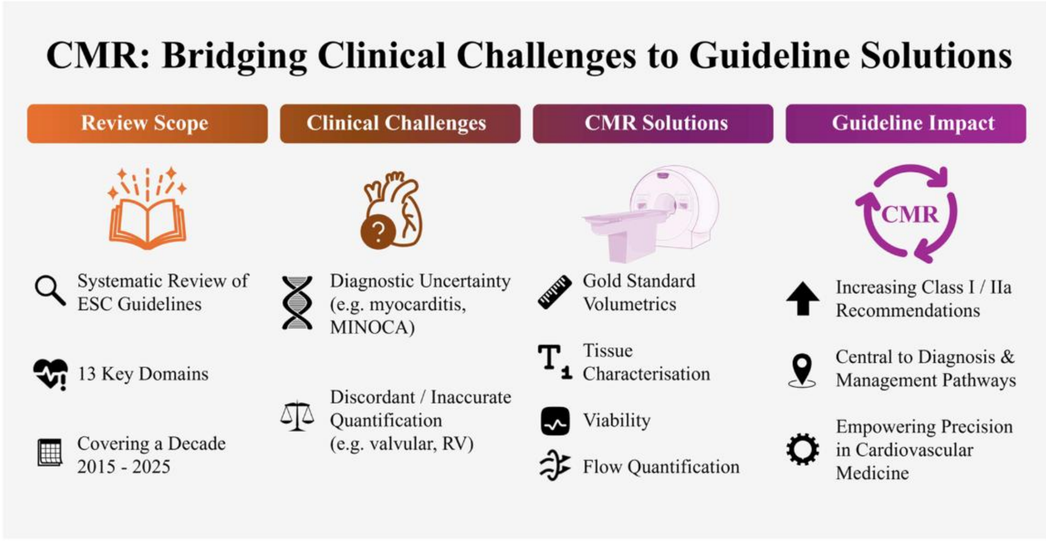
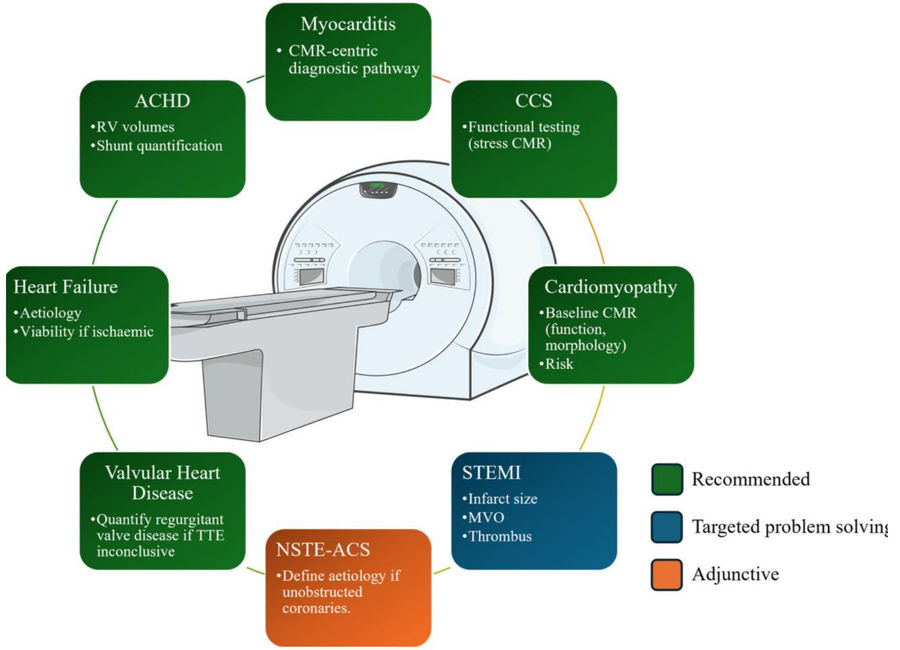
CLINICAL CARDIOLOGY

REVIEW OPEN ACCESS

Cardiac MRI Across ESC Guidance in the Last Decade

		diagnostic echocardiography	or insufficient
Pulmonary hypertension 2022 [21]	RV function/prognosis in expert centers	May be considered for RV volumes/EF, prognostication	IIb C
Infective endocarditis 2023 [22]	Adjunct in selected scenarios	Limited adjunctive use vs echo/CT/PET	—
Myocarditis and pericarditis 2025 [23]	Suspected myocarditis/pericarditis	CMR-centric diagnostic pathway (Lake Louise Criteria 2018 with mapping); structured follow-up	I C (context-specific)





Děkuji za pozornost

Difusní fibróza, T1 mapování a ECV

IJC Heart & Vasculature 51 (2024) 101339

Contents lists available at ScienceDirect

IJC Heart & Vasculature

journal homepage: www.sciencedirect.com/journal/ijc-heart-and-vasculature

Utility of native T1 mapping and myocardial extracellular volume fraction in patients with nonischemic dilated cardiomyopathy: A systematic review and meta-analysis

Michael Tao, Simrat Dhaliwal, Dhairyasheel Ghosalkar, Siyuan Sheng, Neda Dianati-Maleki, Edlira Tam, Tahmid Rahman, Noelle Mann, Smadar Kort *

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- zvýšené hodnoty nativního T1 a ECV asociovány s MACE
- nonrespondéři k léčbě, kteří nezaznamenali reverzní remodelaci LK měli signifikantně vyšší hodnoty nativního T1 a ECV

nativní T1/ MACE

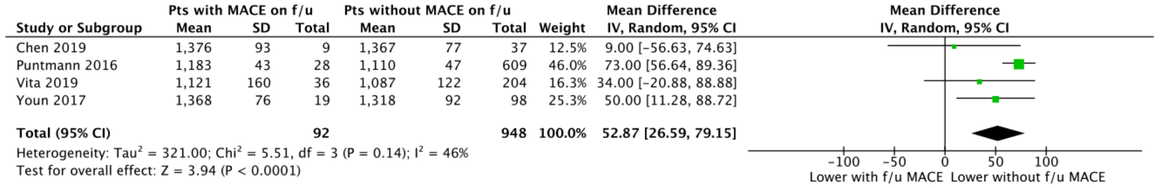

Fig. 4. Association of native T1 time with risk of MACE in NICM patients. Baseline native T1 time was statistically significantly higher in NICM patients who subsequently experienced MACE compared to NICM patients who did not experience MACE with a mean difference of 52.87 (95 % confidence interval 26.59, 79.15; $p < 0.01$).

ECV/ MACE

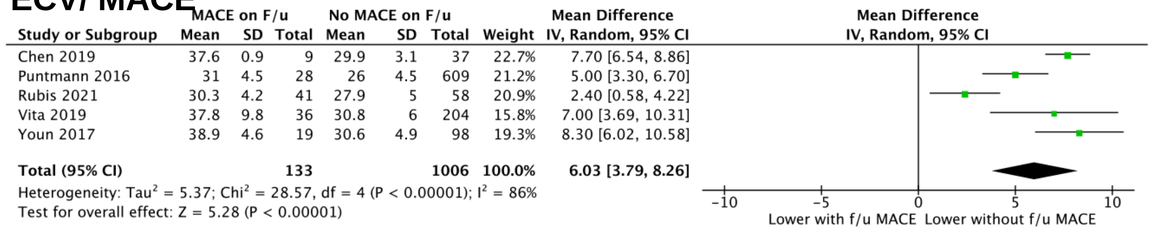

Fig. 5. Association of ECV with risk of MACE in NICM patients. ECV was statistically significantly higher in patients who experienced MACE during follow-up compared to patients who did not experience MACE with a mean difference of 6.03 (95 % confidence interval 3.79, 8.26; $p < 0.01$).

T1/ LVRR

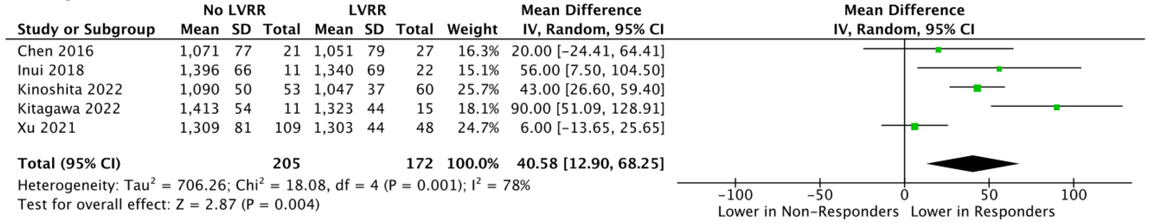

Fig. 7. Association of native T1 time with LVRR Patients who did not have LVRR had significantly higher native T1 time compared to patients who had LVRR on follow-up with a mean difference of 40.58 (95 % confidence interval 12.90, 68.25; $p < 0.01$).

ECV/ LVRR

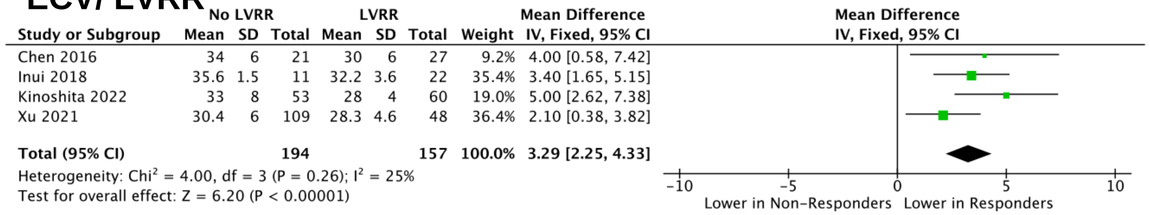

Fig. 8. Association of ECV with LVRR Patients who did not have LVRR had significantly higher ECV compared to patients who had LVRR on follow-up with a mean difference of 3.29 (95 % confidence interval 2.25, 4.33; $p < 0.01$).

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2023) **24**, 512–521
https://doi.org/10.1093/ehjci/jeac142

ORIGINAL PAPER

Extracellular volume fraction improves risk-stratification for ventricular arrhythmias and sudden death in non-ischaemic cardiomyopathy

Andrea Di Marco [1,2,3]*†, Pamela F. Brown[4]†, Joshua Bradley[4], Gaetano Nucifora[4], Ignasi Anguera[1,2], Christopher A. Miller[3,5,6], and Matthias Schmitt[4,5]*

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Received 10 April 2022; revised 20 June 2022; accepted 8 July 2022; online publish-ahead-of-print 25 July 2022

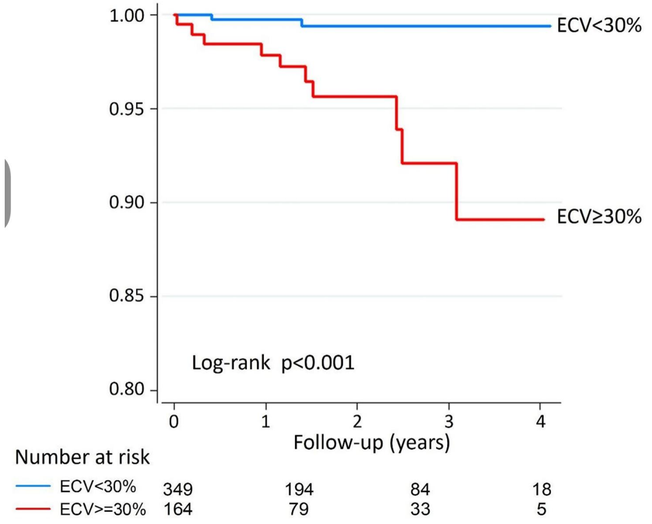
Aims To evaluate whether cardiac magnetic resonance (CMR)-based parametric mapping and strain analysis can improve the risk-stratification for ventricular arrhythmias (VA) and sudden death (SD) in non-ischaemic cardiomyopathy (NICM).

Methods and results Secondary analysis of a prospective single-centre-registry (NCT02326324), including 703 consecutive NICM patients, 618 with extracellular volume (ECV) available. The combined primary endpoint included appropriate implantable cardioverter defibrillator therapies, sustained ventricular tachycardia, resuscitated cardiac arrest and SD. During a median follow-up of 21 months, 14 patients (2%) experienced the primary endpoint. Native T1 was not associated with the primary endpoint. Left ventricular global longitudinal strain lost its significant association after adjustment for left ventricular ejection fraction (LVEF). Among patients with ECV available, 11 (2%) reached the primary endpoint. Mean ECV was significantly associated with the primary endpoint and the best cut-off was 30%. ECV ≥ 30% was the strongest independent predictor of the primary endpoint (hazard ratio 14.1, $P = 0.01$) after adjustment for late gadolinium enhancement (LGE) and LVEF. ECV ≥ 30% discriminated the arrhythmic risk among LGE+ cases and among those with LVEF ≤ 35%. A simple clinical risk-stratification model, based on LGE, LVEF ≤ 35% and ECV ≥ 30%, achieved an excellent predictive ability (Harrell's C 0.82) and reclassified the risk of 32% of the study population as compared to LVEF ≤ 35% alone.

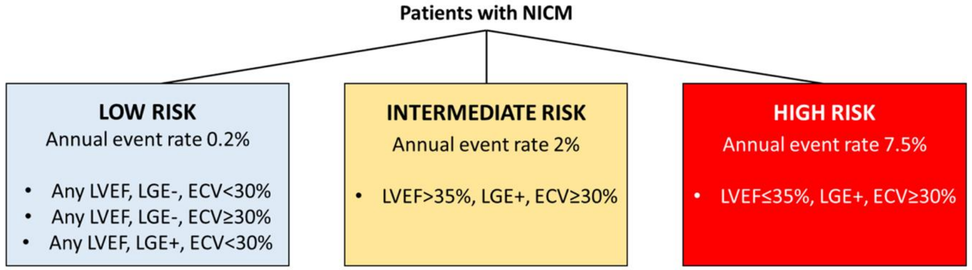
Conclusions Comprehensive CMR evaluation in NICM showed that ECV was the only parameter with an independent and strong predictive value for VA/SD, on top of LGE and LVEF. A risk-stratification model based on LGE, LVEF ≤ 35% and ECV ≥ 30% achieved an excellent predictive ability for VA/SD.

Clinical Trial Registration UHSM CMR study (NCT02326324) https://clinicaltrials.gov/ct2/show/NCT02326324.

SURVIVAL FREE FROM THE COMBINED ARRHYTHMIC ENDPOINT



CLINICAL RISK-STRATIFICATION MODEL FOR VA AND SD



SURVIVAL FREE FROM THE PRIMARY ENDPOINT