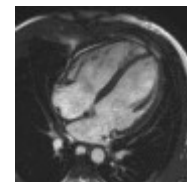


## Sport és Kardiológia

Sportszív morfológiai eltérései –  
különös tekintettel a vízilabdára

# Disclosures



- 3 év vízilabda a KSI-ben (kvázi úszás)
- fél év vízilabda az Újpestben
- 1989-től kajakoztam
  - Újpesti Dózsa
  - 1991-től Multi SE

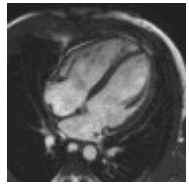


# Cardialis edzettség

- A szív alkalmazkodik a terheléshez
  - Nagyobb perctérfogat leadására lesz képes
- Növekszik az izomzat tömeg
- Tágulnak a kamrák
- Molekuláris változások
  - Génexpresszió

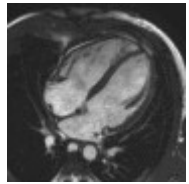


# Cardialis edzettség mérése



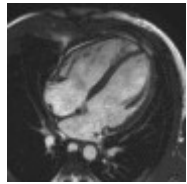
- Kerékpáros / futópados / evezőpados
  - Laktátküszöb, VO<sub>2</sub>, stb...
- EKG, Holter, pulzusmérő órák
- Képkötő vizsgálatok
  - ECHO
  - Szív MR
- Molekuláris markerek
  - Mátrix metalloproteáz szintek

# Cardialis edzettség mérése



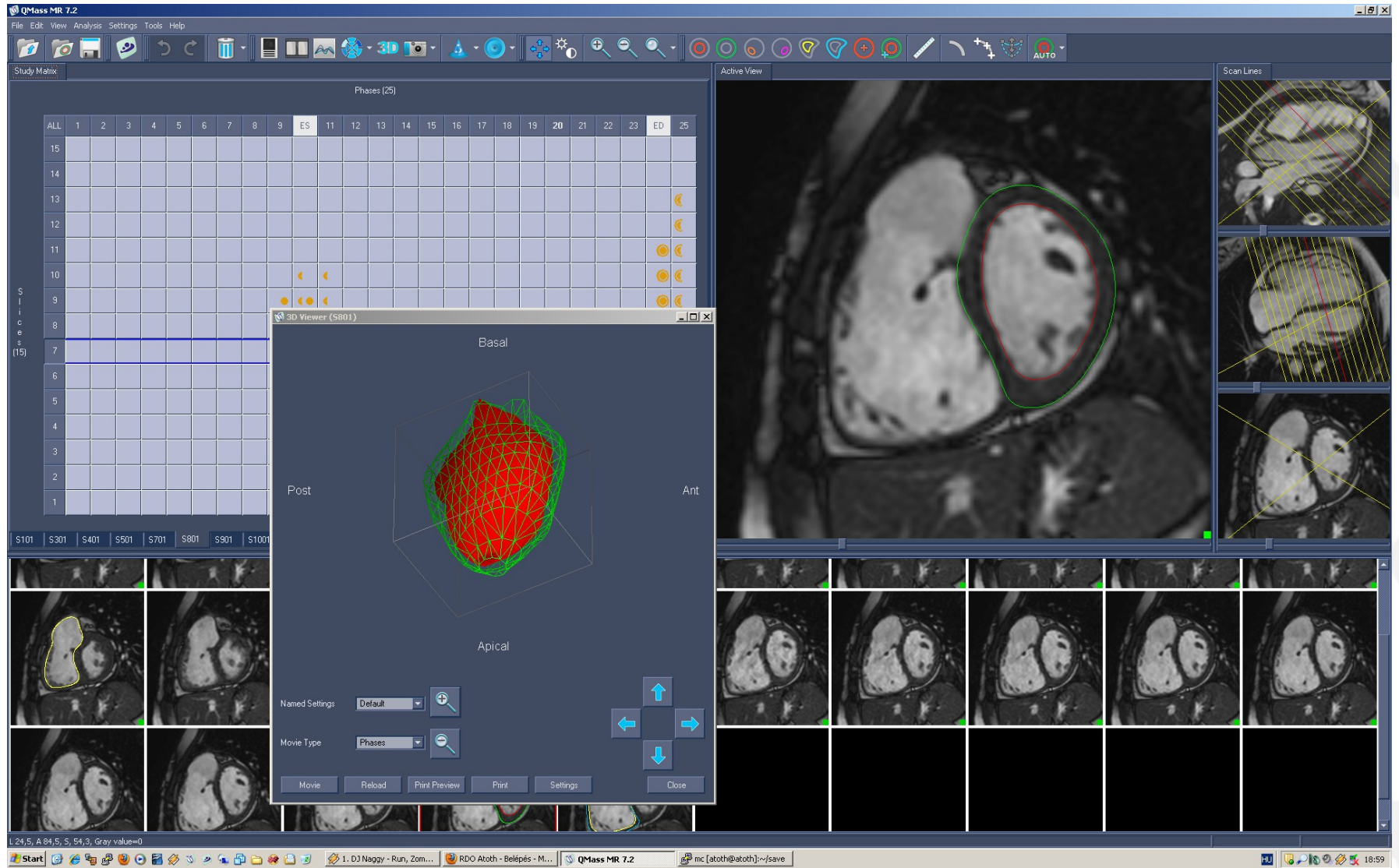
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  - Laktátküszöb, VO<sub>2</sub>, stb...
- EKG, Holter, pulzusmérő órák
- Képképző vizsgálatok
  - ECHO
  - **Szív MR**
- Molekuláris markerek
  - Mátrix metalloproteáz szintek

# Edzettséget jelző paraméterek



- Szívüregek tágassága
  - Bal- és jobb kamra tágasság (L/RVEDVi)
- Szívizomzat tömeg
  - Bal- és jobb kamra izomzat tömeg (L/RVMi)
  - Maximális végdiastoles falvastagság (FVS)
  - FVS – diastoles térfogat index arány (0.14)
- Tagging: Tissue-Doppler / speckle tracking
- Spektroszkópia: metabolizmus

# Bal kamrai kiértékelés



# Jobb kamrai kiértékelés

QMass MR 7.2

File Edit View Analysis Settings Tools Help

Study Matrix

Phases (25)

ALL	1	2	3	4	5	6	7	8	9	ES	11	12	13	14	15	16	17	18	19	20	21	22	23	ED	25
15																									
14																									
13																									
12																									
11																									
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4																									
3																									
2																									
1																									

Slices (15)

3D Viewer (S801)

Basal

Sept

Lat

Apical

Named Settings: Default

Movie Type: Phases

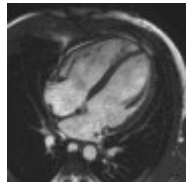
Movie Reload Print Preview Print Settings Close

L 17,2, A 83,3, S, 20,8, Gray value=1

Start 1.D3 Naggy - Run, Zom... RDO Atoth - Belépés - M... QMass MR 7.2 mic [atoth@atoth].../save 18:57



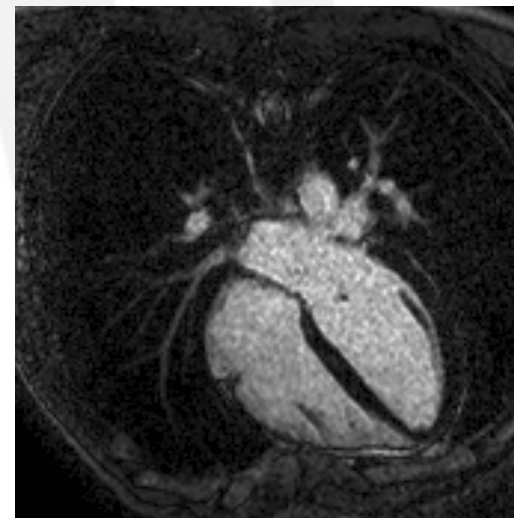
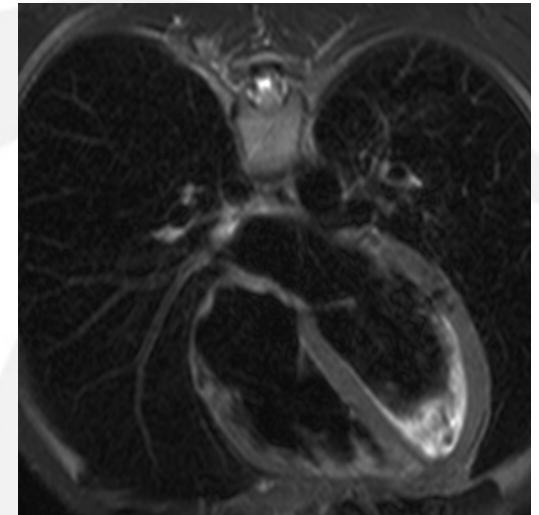
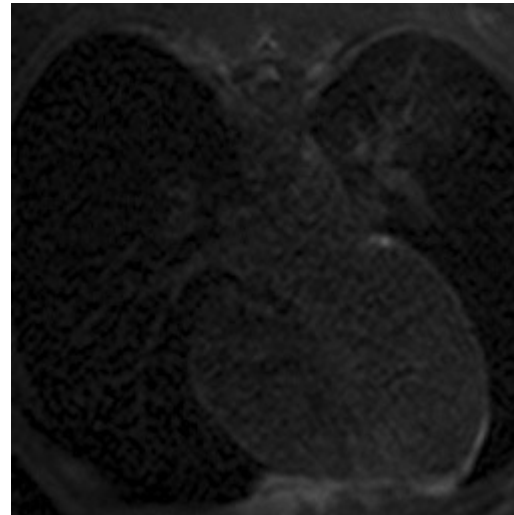
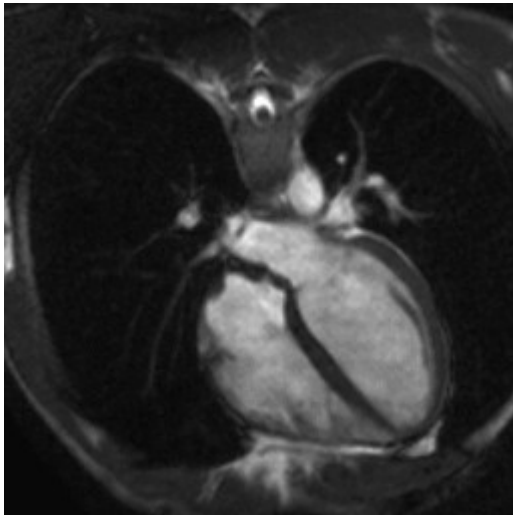
# Saját felmérés: férfiak



- 48 önként jelentkező
- 88 élsportoló
  - 23 vízilabdázó
  - 21 kajakos
  - 15 kenus
  - 9 kerékpáros
  - 5 ultra-marathon futó
  - 15 evezős
- Parolimpikon
  - 6 csörgőlabda játékos

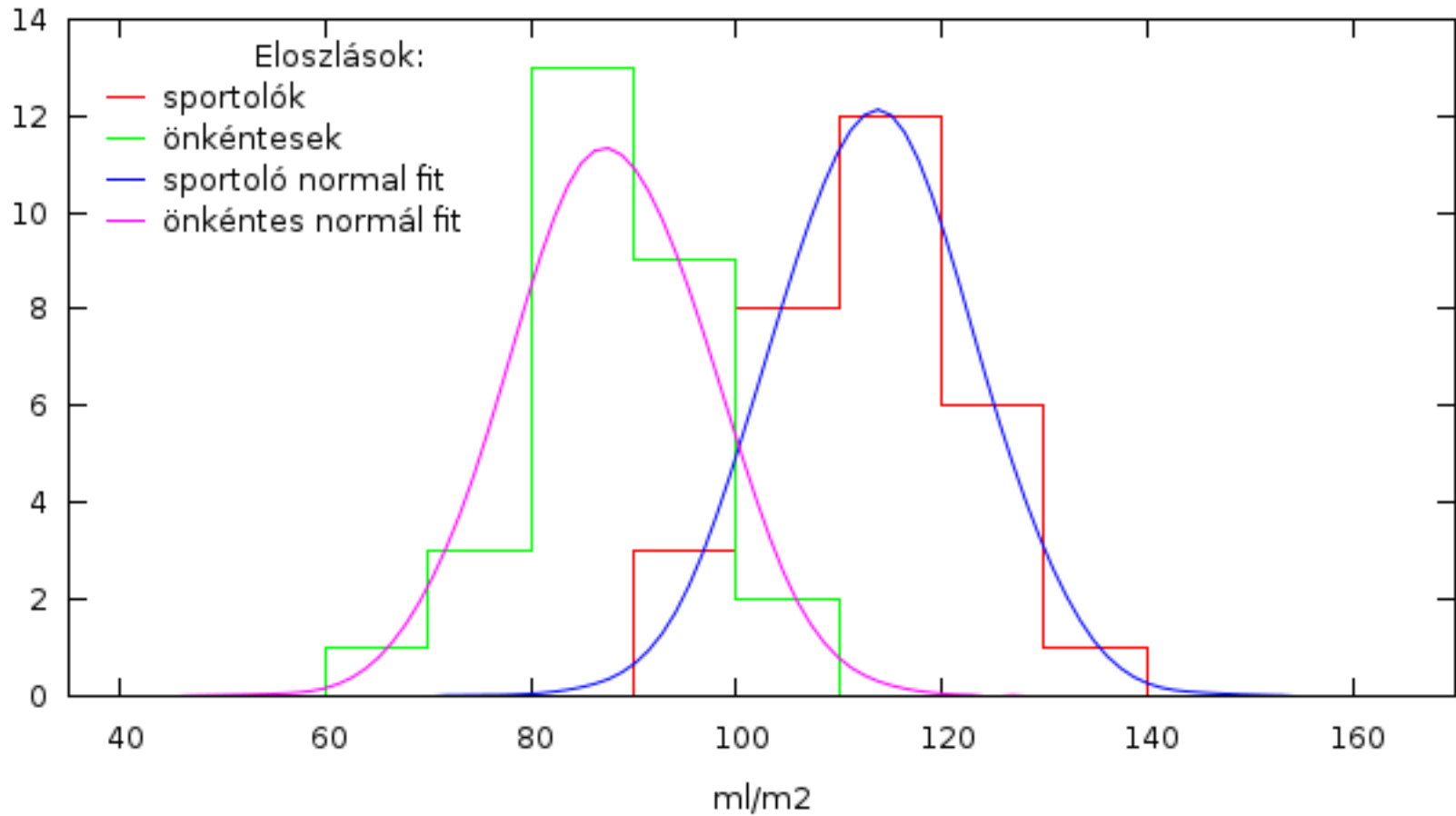


# Spartathlon: 246km (Pheidippides)



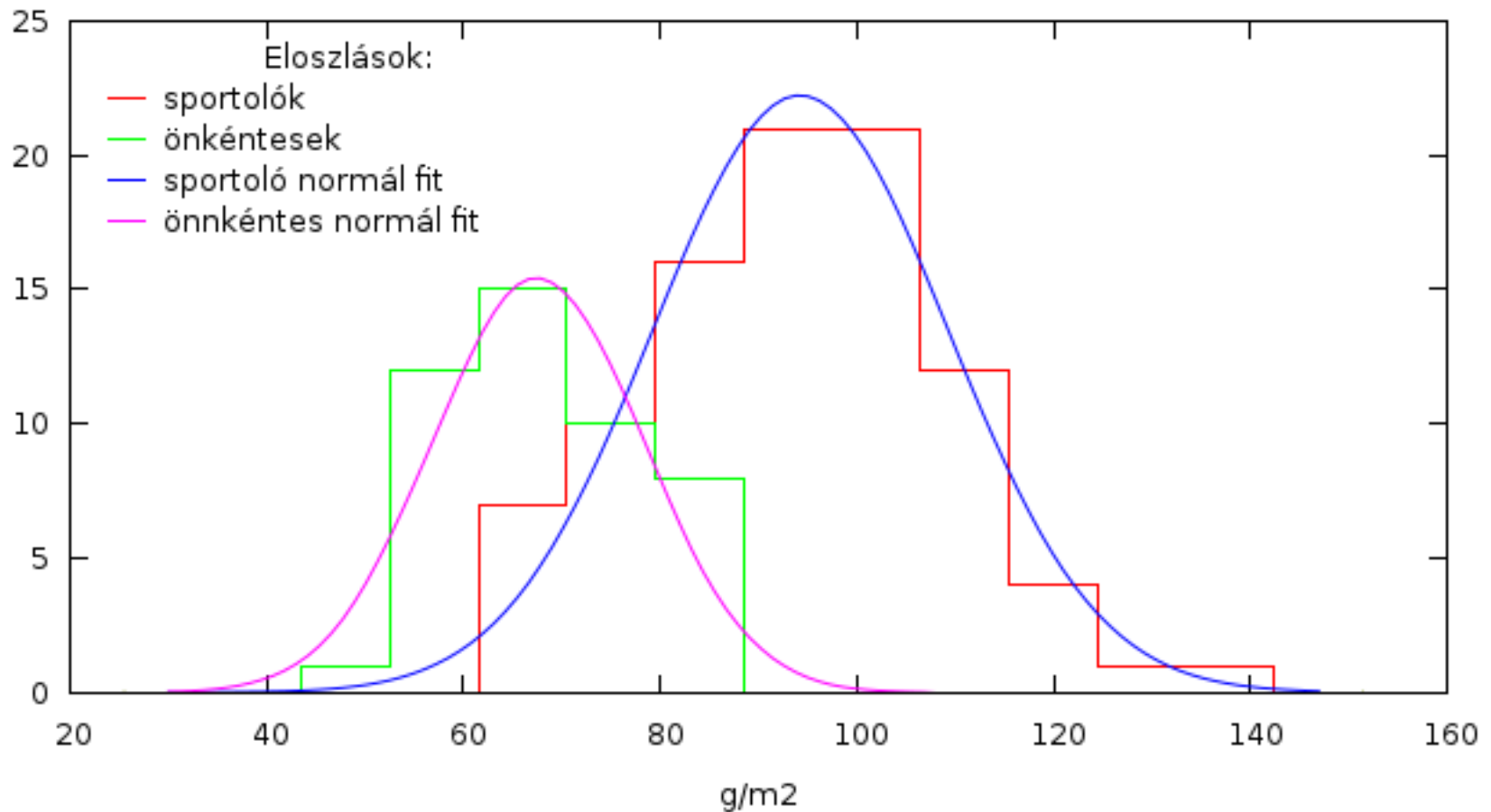
# Bal kamrai végdiastoles térfogat index

LVEDVi - nők

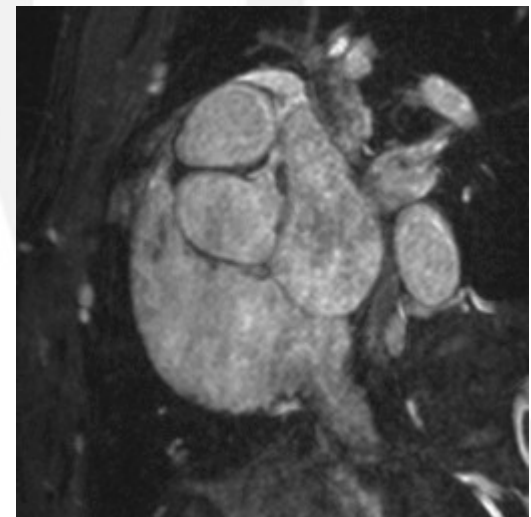
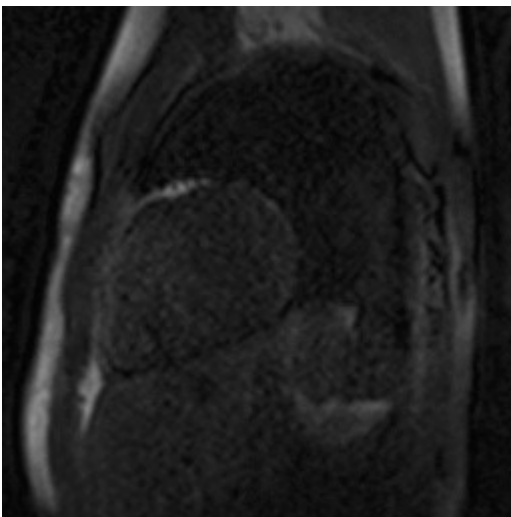
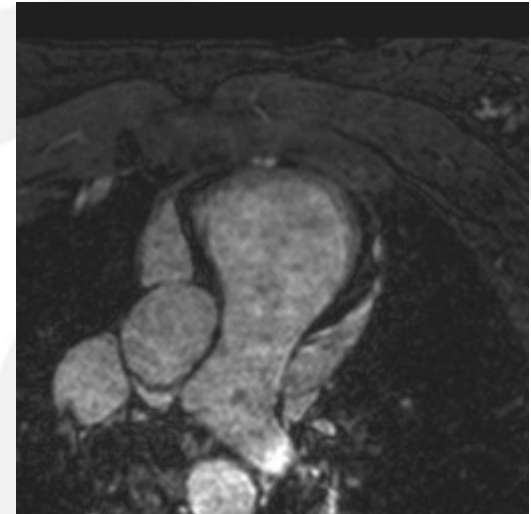
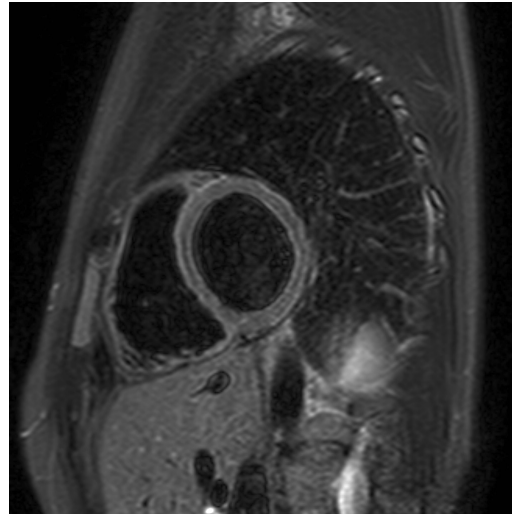
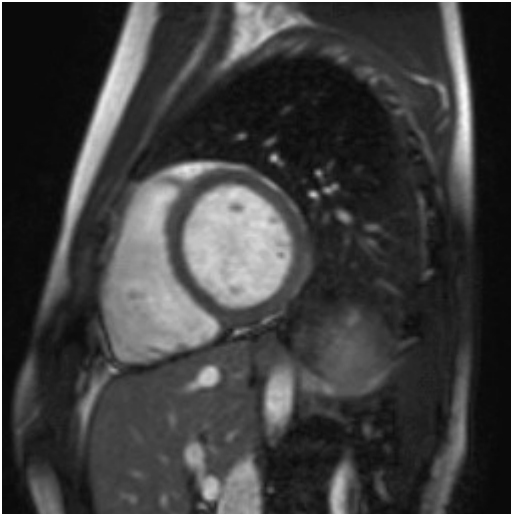


# Bal kamrai izomzat tömeg index

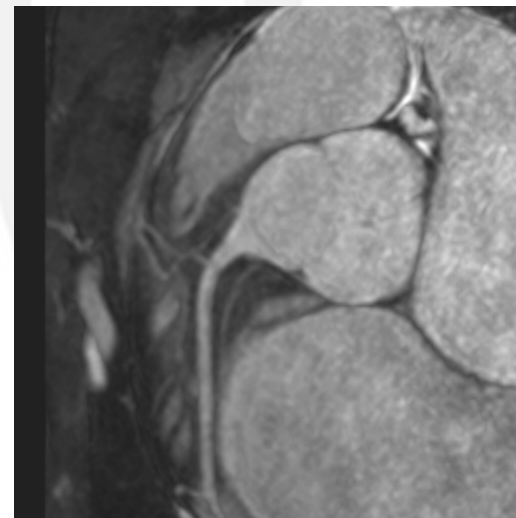
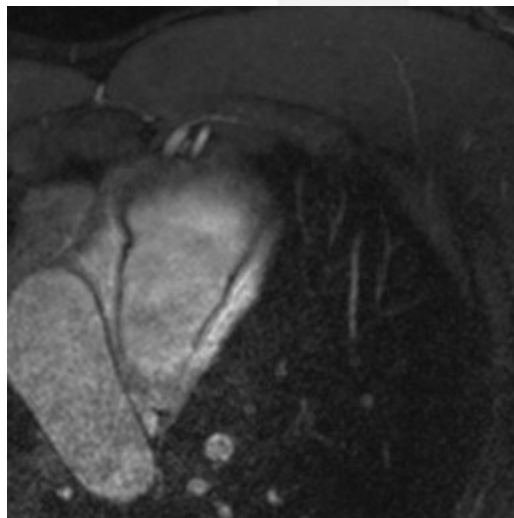
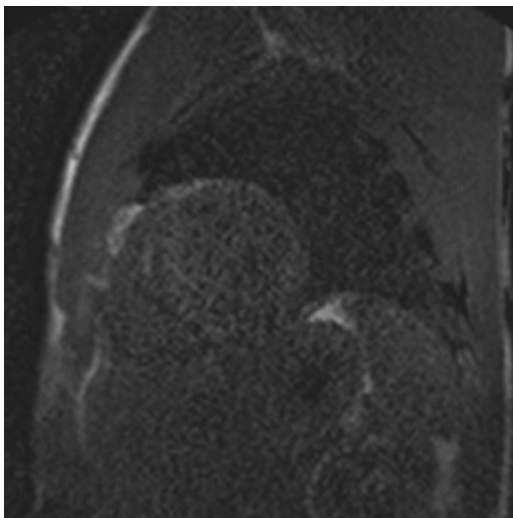
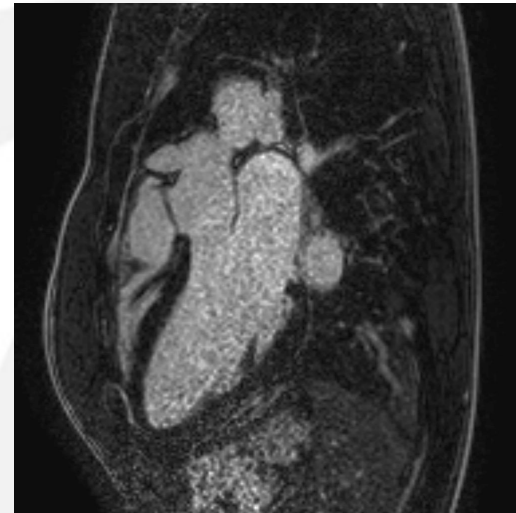
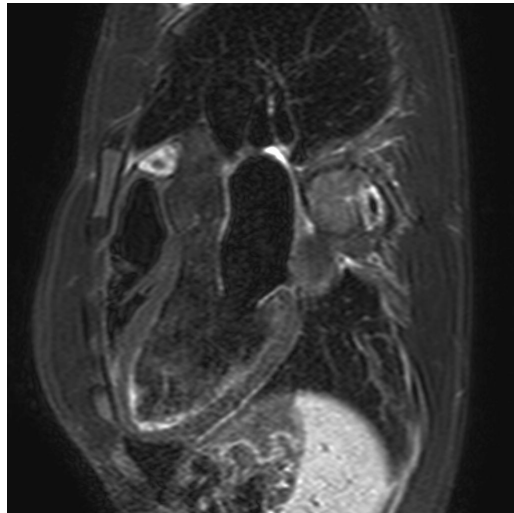
LVMi - férfiak



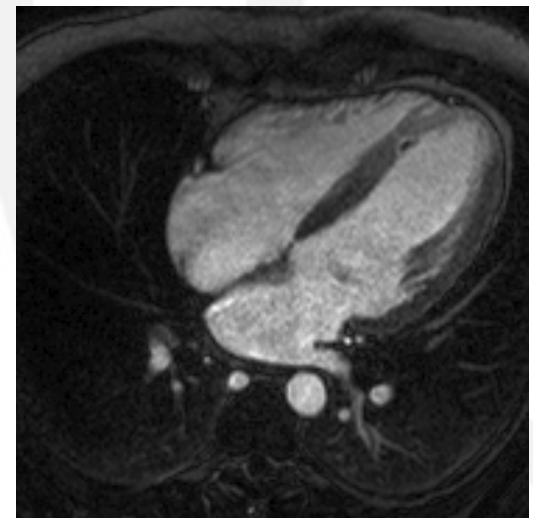
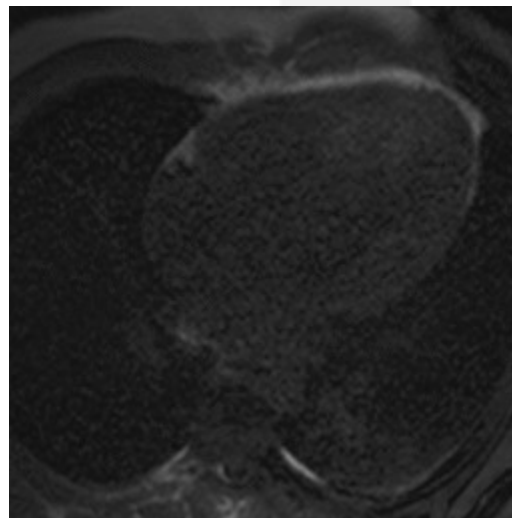
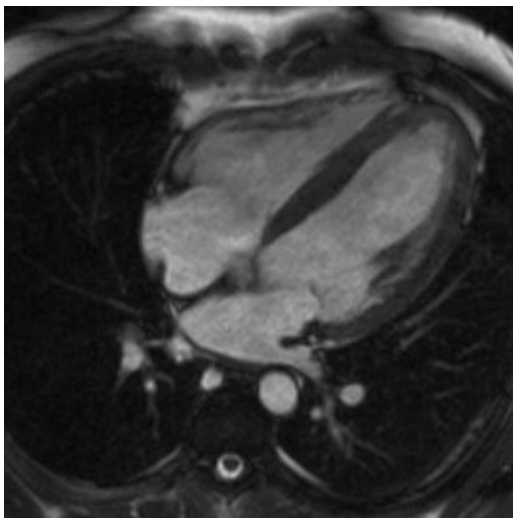
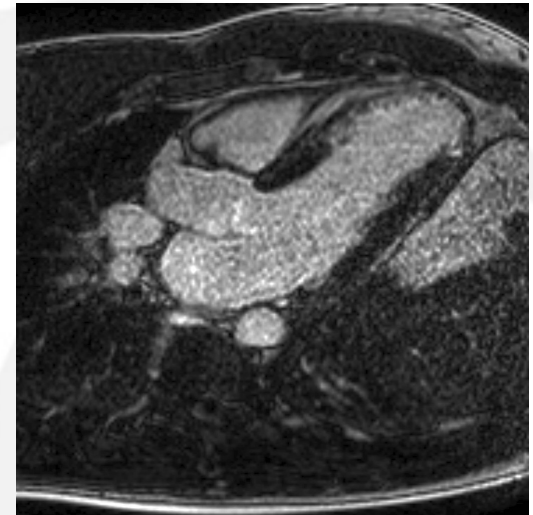
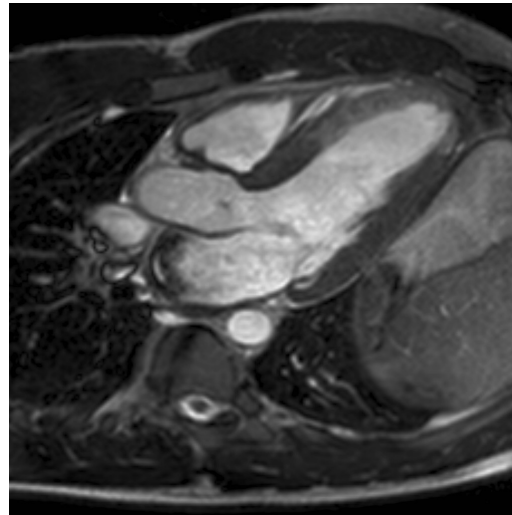
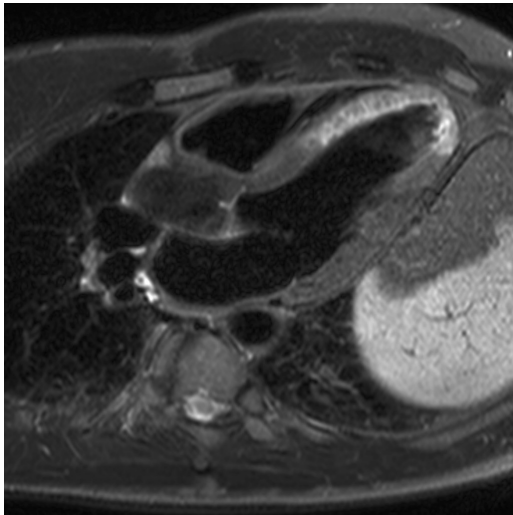
# Női vízilabda játékos: normál vizsgálat



# Férfia kajakos: normál vizsgálat



# Akut infarktus: 21% non-viabilis

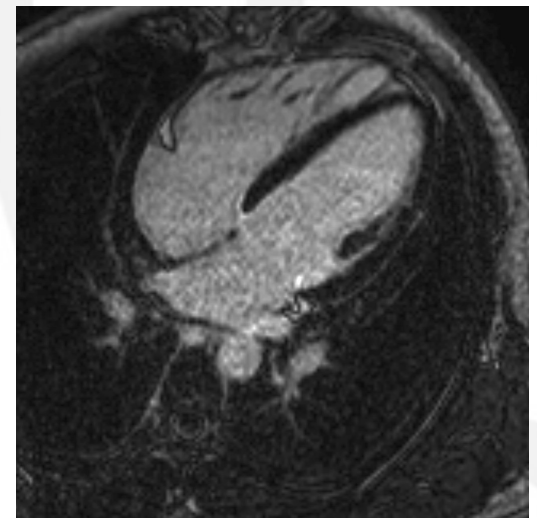
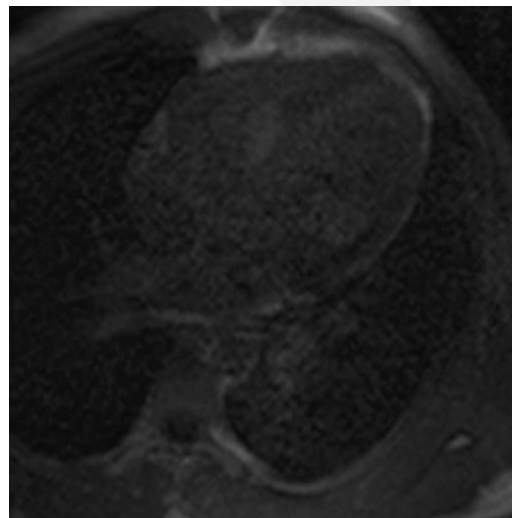
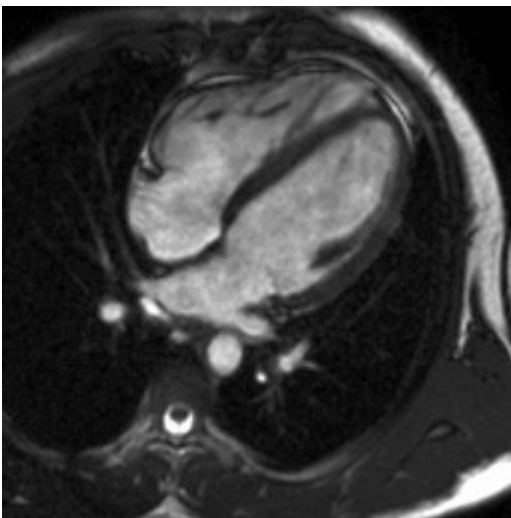
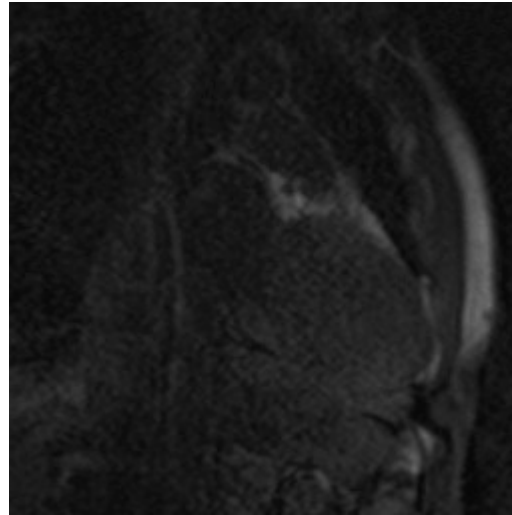
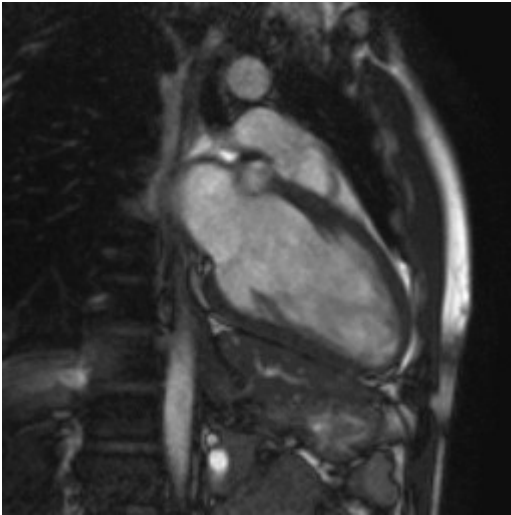


# Férfi normál értékek

Paraméter	Önkéntes (48)	Vízilabdázó (N = 23)	Kajakos (N = 21)	Kenus (N = 15)	Kerékpáros (N = 9)	Ultrafutó (N = 5)	Evezős (N = 15)	Csörgőlabda (N = 6)
BSA (m <sup>2</sup> )	2.04 ± 0.18	<b>2.33 ± 0.09</b>	2.08 ± 0.13	2.00 ± 0.08	<b>1.87 ± 0.10</b>	<b>1.82 ± 0.08</b>	2.00 ± 0.11	2.13 ± 0.19
LVEF	60.2 ± 5.3	57.0 ± 3.4	57.7 ± 4.8	56.9 ± 3.4	56.8 ± 3.5	58.1 ± 3.5	56.2 ± 4.0	58.7 ± 4.4
LVESVi	38.1 ± 8.3	53.0 ± 8.0	52.2 ± 10.5	<b>56.5 ± 8.7</b>	54.3 ± 5.9	46.9 ± 2.8	54.8 ± 9.2	41.6 ± 8.0
LVEDVi	95.2 ± 12.1	123.0 ± 13.3	122.5 ± 14.7	<b>131.0 ± 14.6</b>	125.3 ± 6.4	112.1 ± 5.0	124.5 ± 12.5	99.8 ± 12.2
LVSVi	57.1 ± 7.0	70.0 ± 7.8	70.3 ± 7.6	74.5 ± 8.2	71.1 ± 4.8	65.2 ± 6.3	69.6 ± 5.9	58.3 ± 6.0
LVMi	63.5 ± 10.3	86.4 ± 14.7	<b>95.7 ± 11.1</b>	<b>102.2 ± 13.4</b>	78.1 ± 15.4	79.5 ± 9.7	<b>90.2 ± 9.0</b>	62.6 ± 7.2
RVEF	59.1 ± 4.8	56.2 ± 4.4	55.7 ± 4.3	53.6 ± 3.9	55.1 ± 4.8	57.9 ± 3.0	54.6 ± 3.9	57.1 ± 1.2
RVESVi	40.1 ± 8.3	56.3 ± 11.6	58.1 ± 11.6	64.3 ± 8.9	60.1 ± 10.1	51.4 ± 10.5	59.8 ± 9.4	42.1 ± 5.2
RVEDVi	97.5 ± 13.2	127.7 ± 17.4	130.4 ± 16.7	<b>138.5 ± 14.4</b>	133.3 ± 9.6	122.1 ± 10.5	131.0 ± 12.9	98.3 ± 12.7
RVSVi	57.4 ± 7.7	71.4 ± 8.5	72.3 ± 7.8	74.2 ± 9.0	73.2 ± 5.3	70.7 ± 8.3	71.2 ± 6.2	56.2 ± 7.6
RVMi	24.9 ± 3.6	30.6 ± 3.7	34.2 ± 5.2	34.5 ± 4.9	34.5 ± 4.4	28.2 ± 2.8	33.6 ± 2.7	22.0 ± 2.4
LVED FVS	11.02 ± 1.38	13.17 ± 1.64	13.52 ± 1.91	12.87 ± 1.60	12.00 ± 1.23	12.25 ± 1.26	13.07 ± 1.39	10.50 ± 0.55
Sport index	.118 ± .0246	.107 ± .0149	.112 ± .0231	.099 ± .0181	.096 ± .0122	.109 ± .0119	.106 ± .0150	.106 ± .0115



# Focista: nincs sportszíve



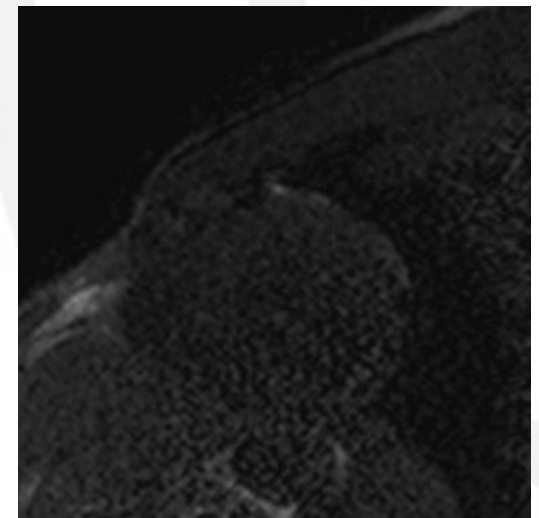
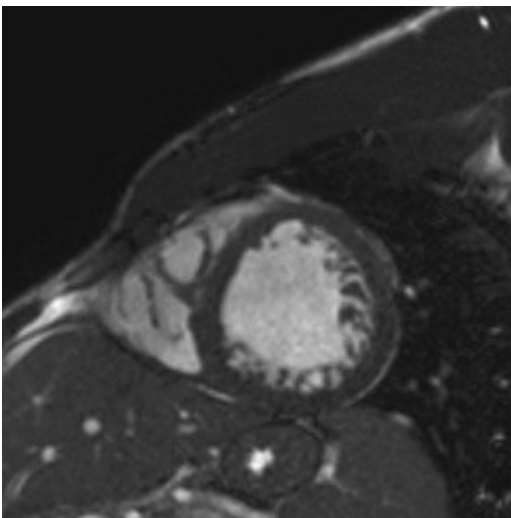
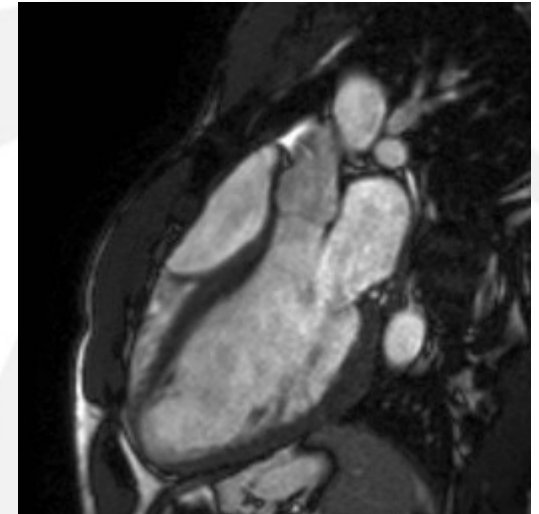
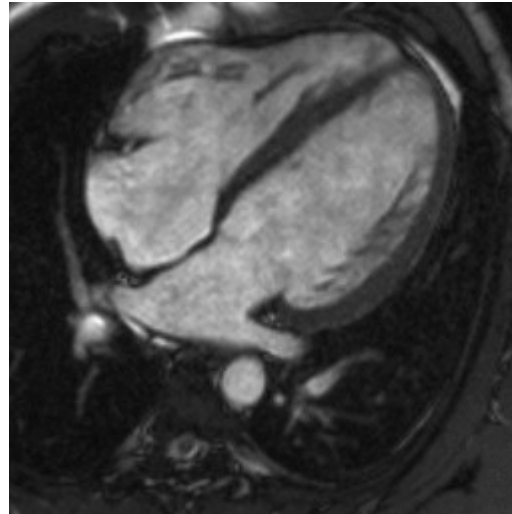
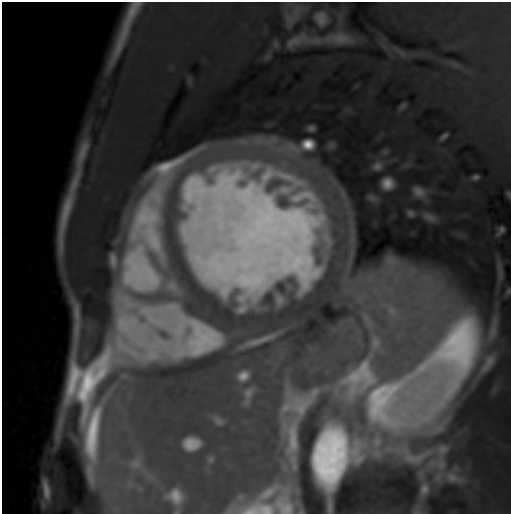
# HCM és DCM példa

Parametér	Önkéntes	Élsportoló	DCM	HCM
HR	66,74 (11,24)	59,52 (10,10)	46	53
BSA	2,056 (0,191)	2,046 (0,184)	2,08	2,04
LVEF	59,53 (5,57)	57,51 (4,26)	40,4	63,78
LVESVi	38,72 (8,69)	53,50 (9,63)	112,45	39,99
LVEDVi	95,09 (12,77)	125,25 (13,87)	188,57	110,41
LVSVi	56,37 (7,53)	71,76 (7,21)	76,13	70,42
LVMi	62,93 (11,21)	88,09 (17,66)	125,98	160,90
RVESVi	41,30 (8,10)	59,19 (11,45)	68,52	36,86
RVEDVi	98,37 (13,61)	132,66 (15,40)	144,45	102,08
RVSVi	57,08 (8,33)	73,46 (7,28)	75,94	65,22
RVMi	25,11 (3,97)	34,16 (5,17)	34,30	36,17
ED WT	11,09 (1,46)	12,78 (1,93)	–	29
Sport index	0,119 (0,026)	0,103 (0,021)	–	0,26

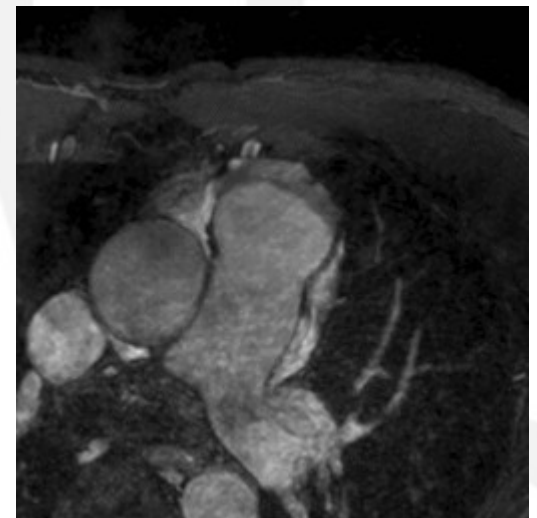
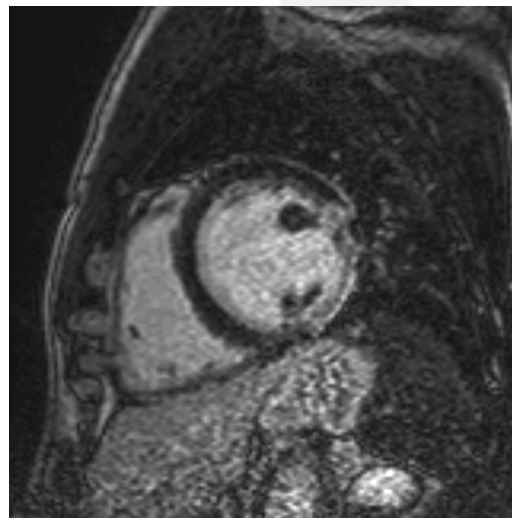
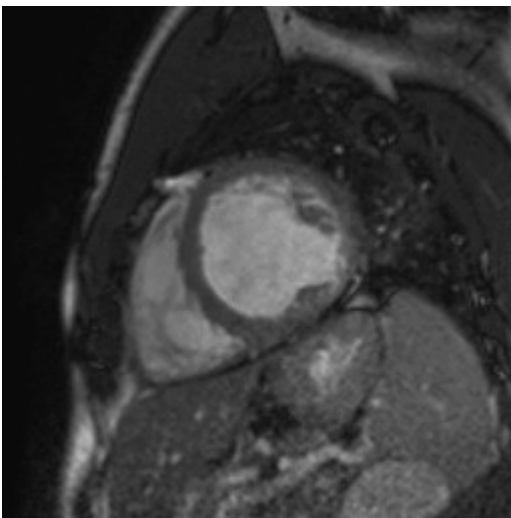
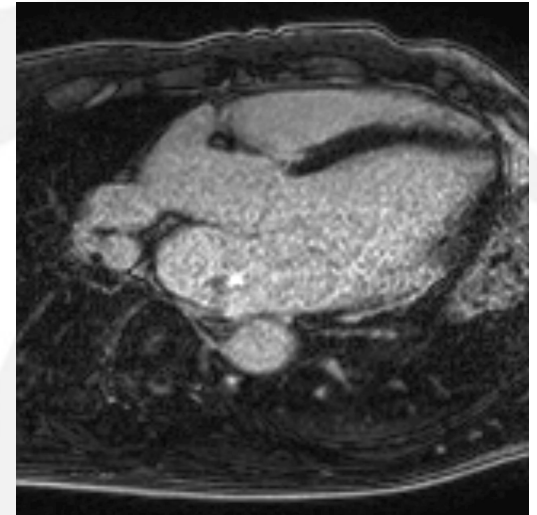
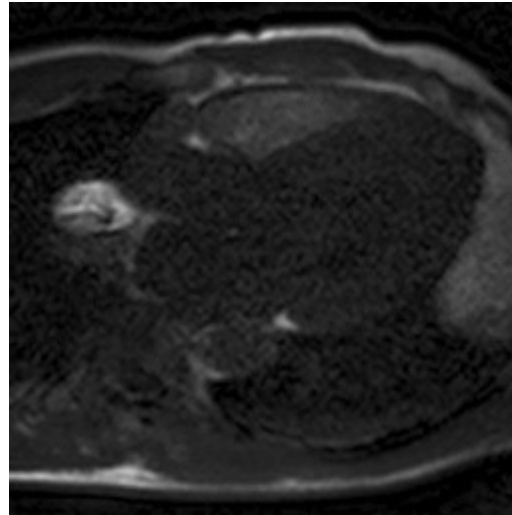
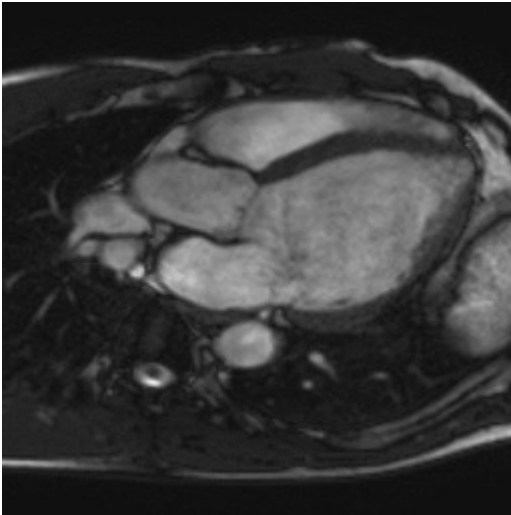
# DCM példa

Parametér	Önkéntes	Élsportoló	DCM	HCM
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# Jégkorong játékos: dilatatív CMP



# Duathlon, ultra-marathon: chrn. ifarktus



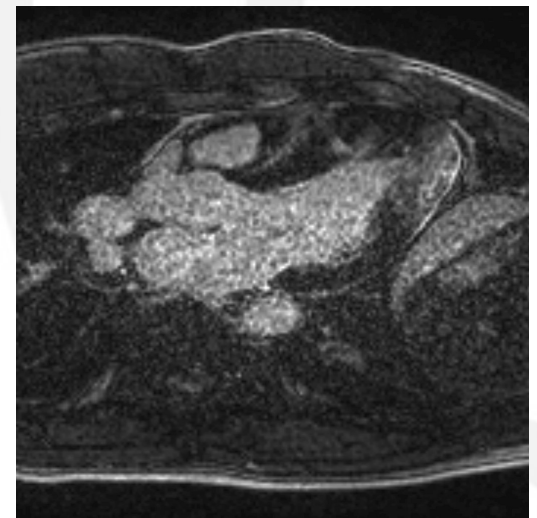
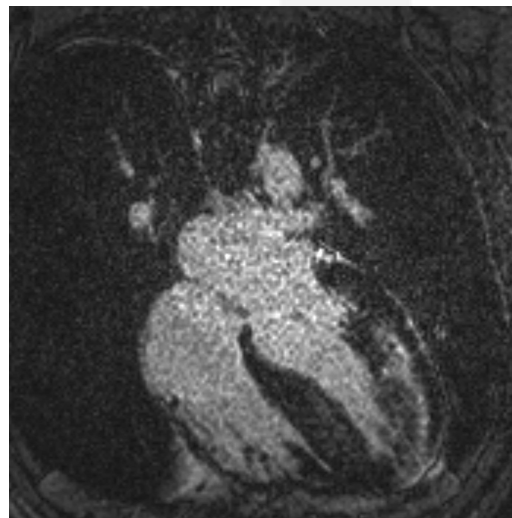
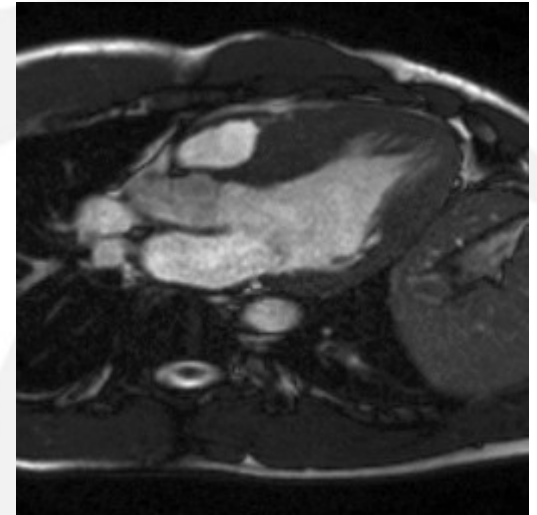
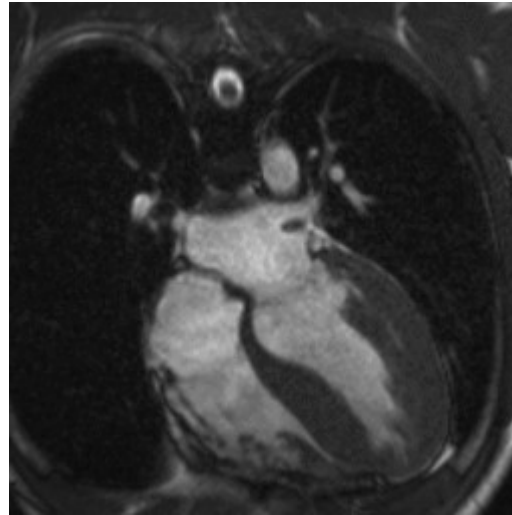
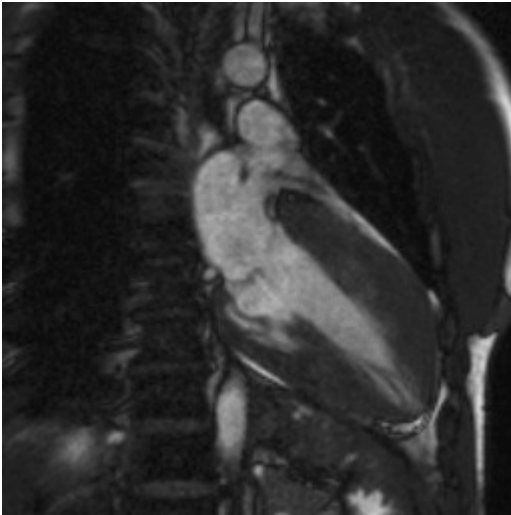
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# Hypertrophias cardiomyopathia





# DE kvantifikáció: 63g heg a 360g-ból

The screenshot displays the QMass MR 7.2 software interface. The main window shows a cardiac MRI scan with a red contour for the myocardium and a green contour for the total mass. The software is in the 'Step 4: Specifying Transmurality Threshold and Placing Reference Point' stage. The 'Transmurality Threshold [%]' is set to 50. The 'Result Dialogs' section shows the following DSI results:

Total myocardial mass:	360.33 g
Scar tissue mass:	63.20 g
Scar tissue volume:	60.19 ml
Scar tissue percentage:	18 %
Nonviable mass:	5.33 g
Nonviable volume:	5.08 ml
Nonviable percentage:	1 %
Transmurality threshold:	50 %

Technical parameters for the scan are listed in the bottom right of the main window:

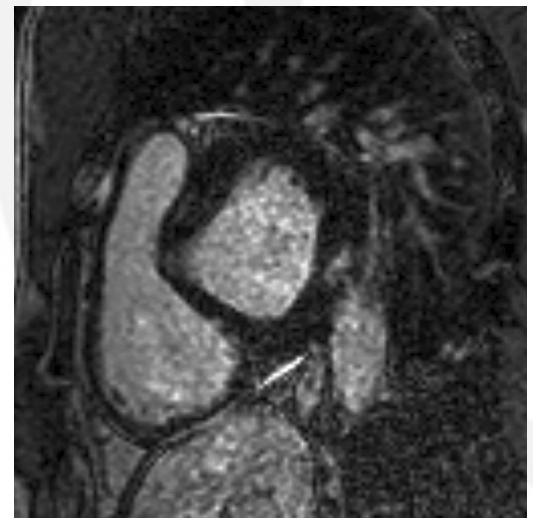
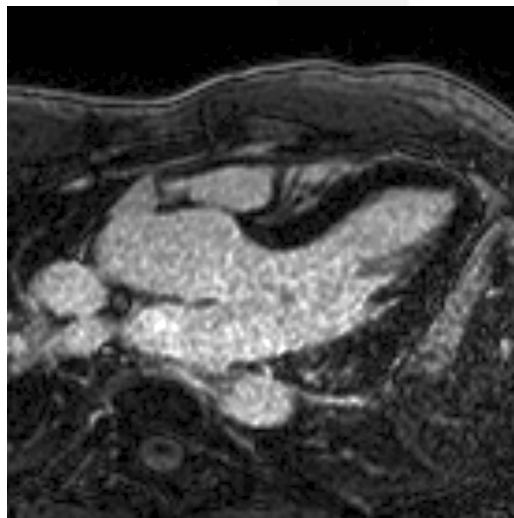
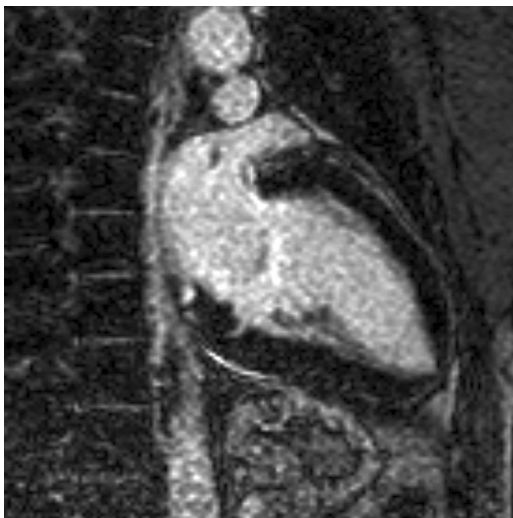
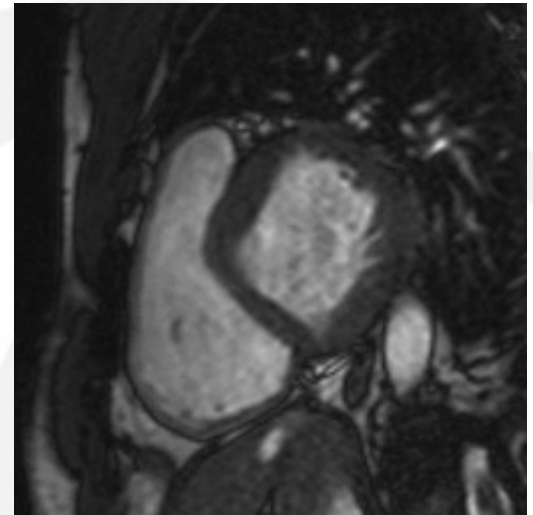
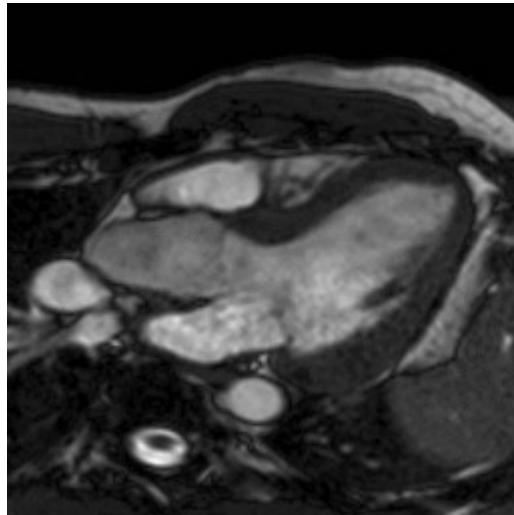
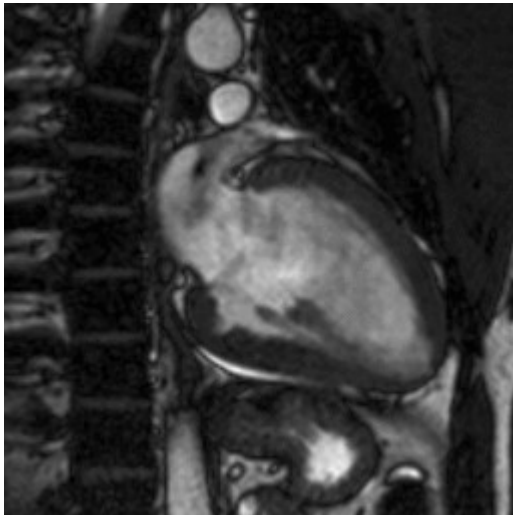
- TR: 5.49ms
- TE: 2.52ms
- Ti: 0.00ms
- TD: 773ms
- SL: 12
- PH: 1
- SP: 88.00mm
- SI th: 8mm

Summary statistics at the bottom right of the main window:

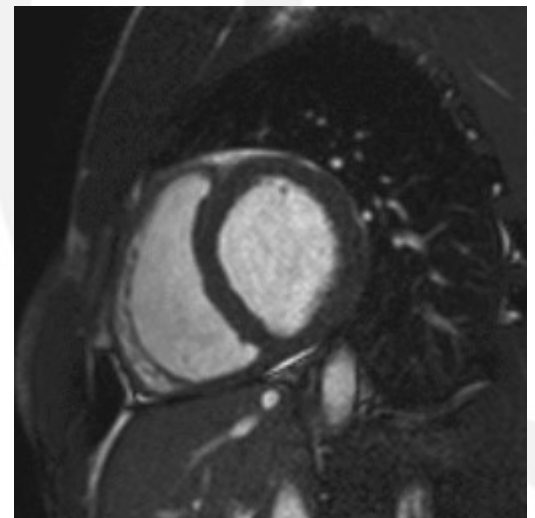
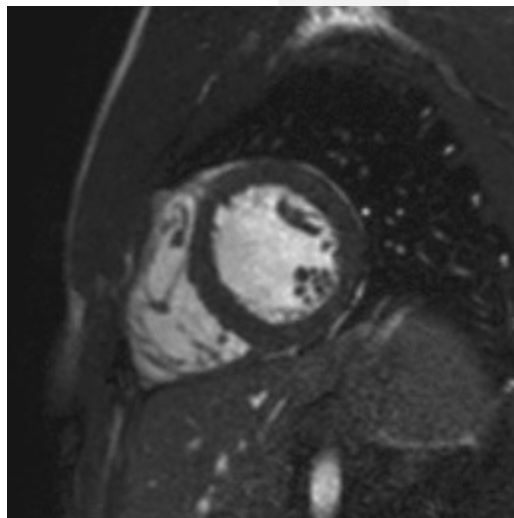
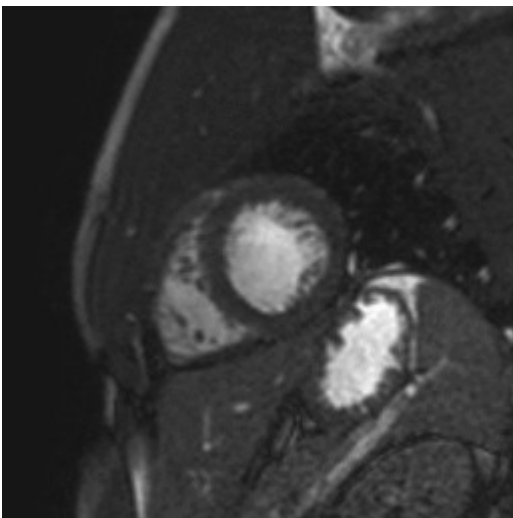
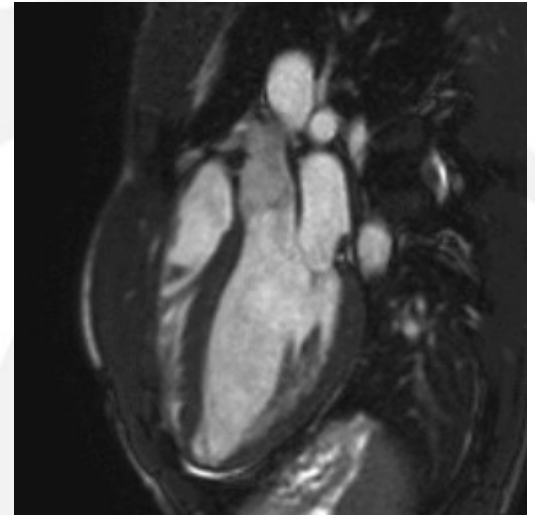
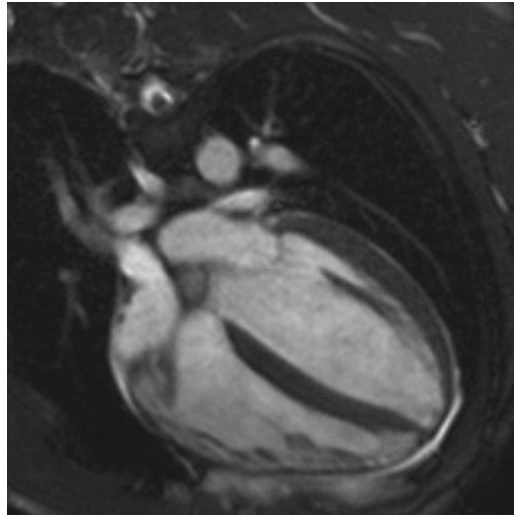
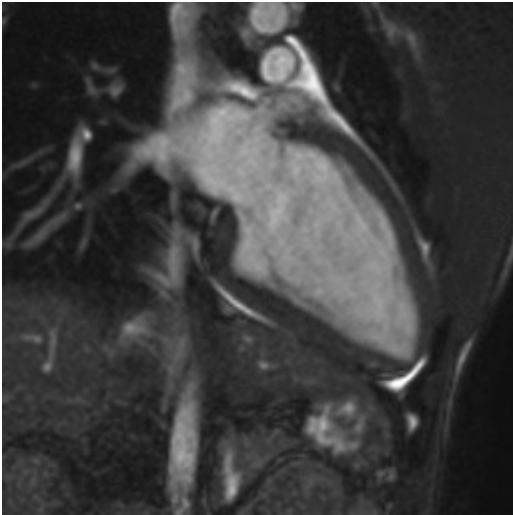
- Total mass: 360.33g
- Scar tissue: 63.20g / 18%
- WW: 138
- WL: 2 090
- Zoom: 175%

The bottom of the interface shows a grid of 20 small image thumbnails, each with a label like 's1p1 773ms' and a green/red contour. The Windows taskbar at the very bottom shows the Start button and several open applications, including 'Atoth SquireMail 1.4.1...', 'e-MedSolution - Mozilla F...', '1. Axion b2b Virtual xtc...', and 'mc [atoh@atoh]:~\jsa...'. The system clock shows 21:21.

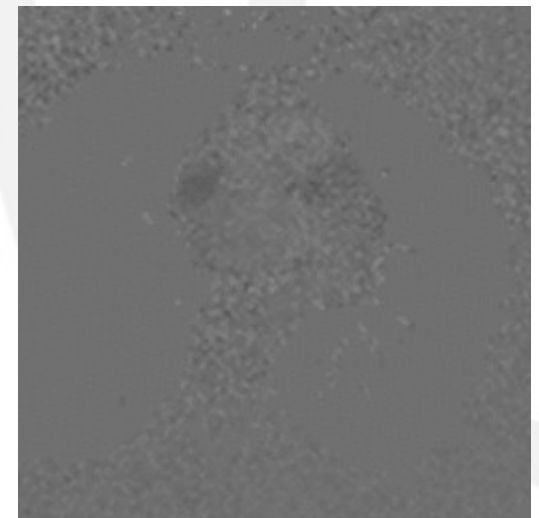
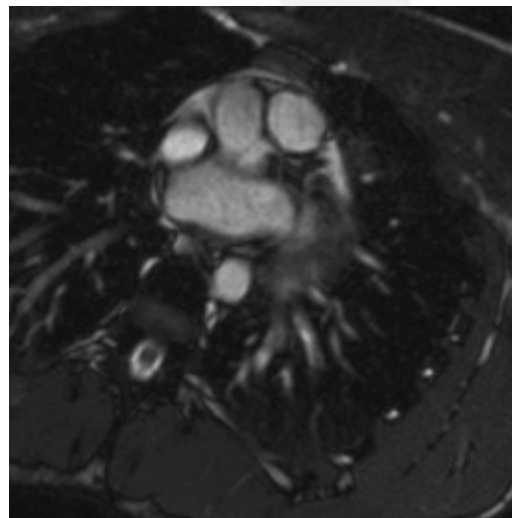
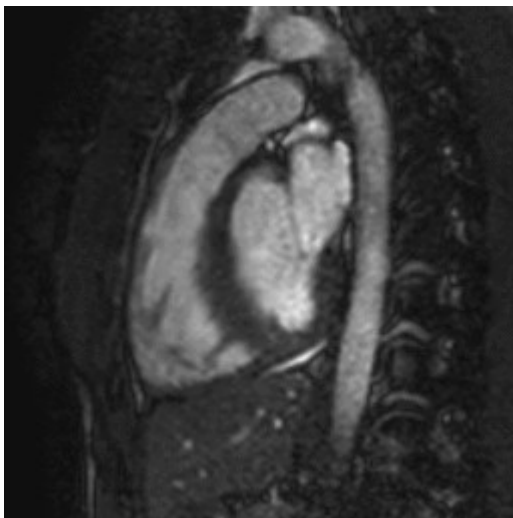
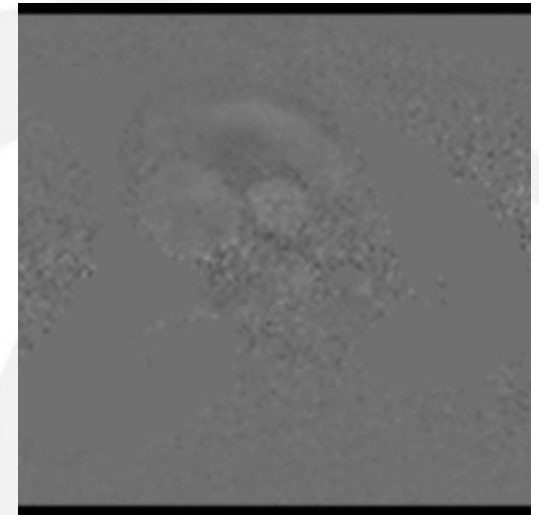
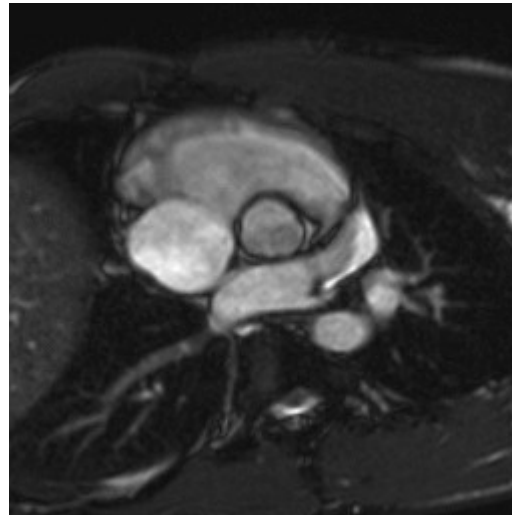
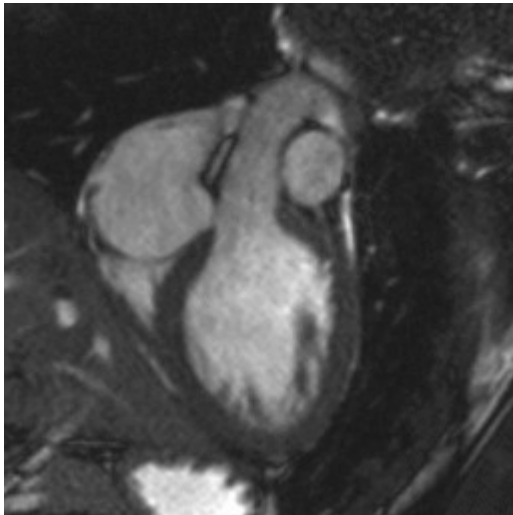
# Muaj thai: Anderson-Fabry (19mm)



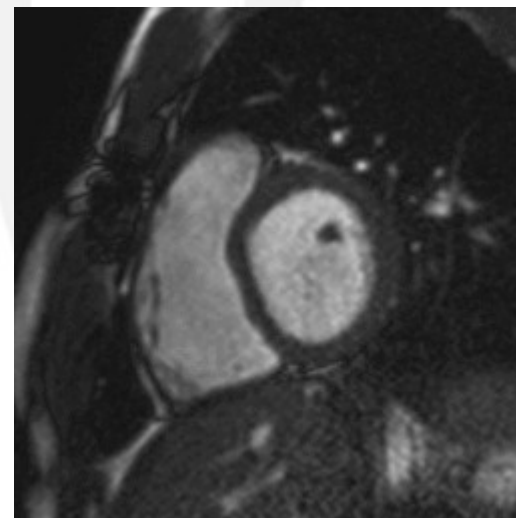
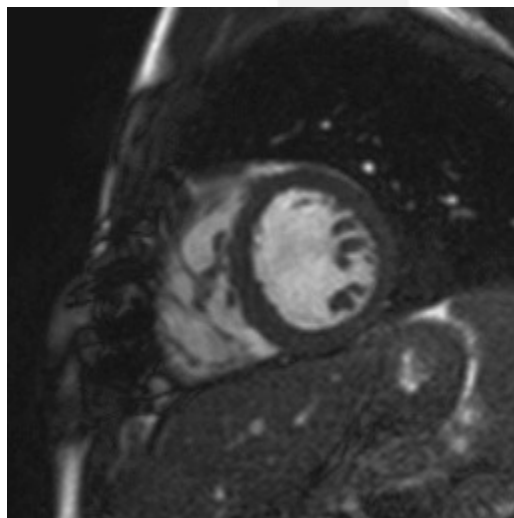
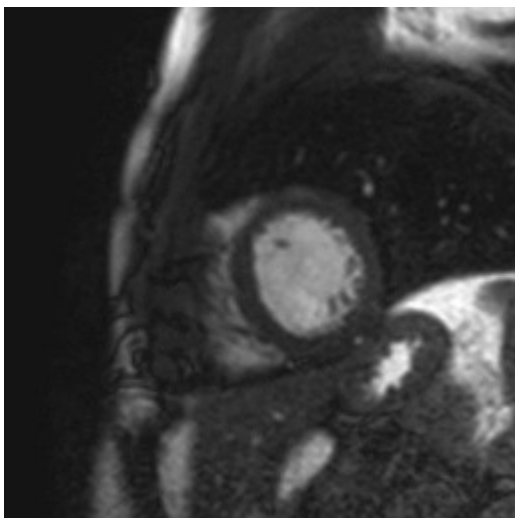
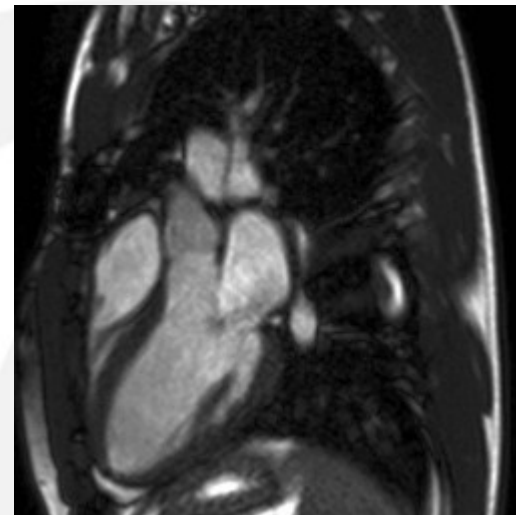
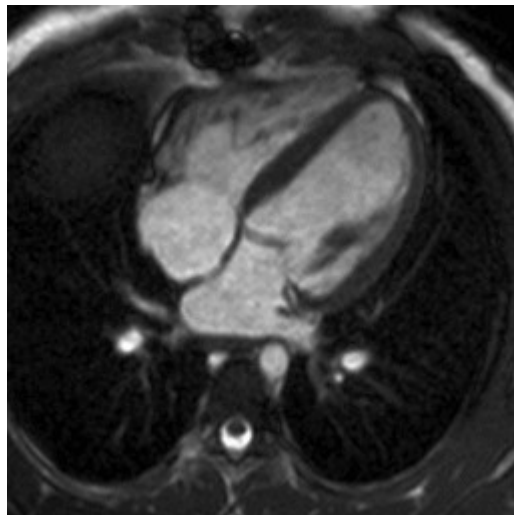
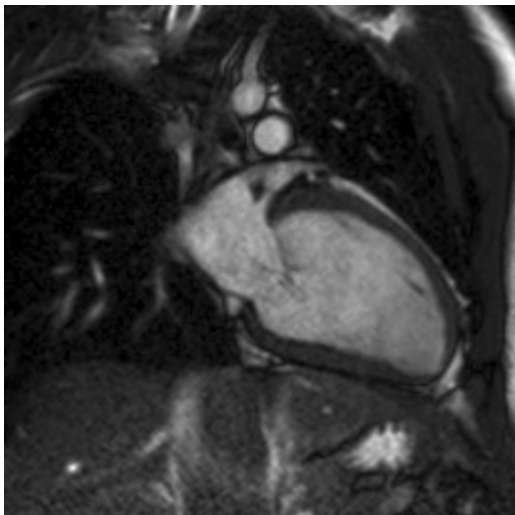
# LA és SA: kajakos, ismert ASD-vel



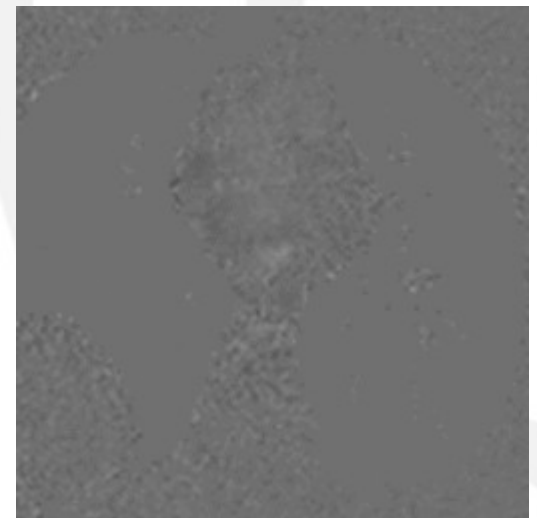
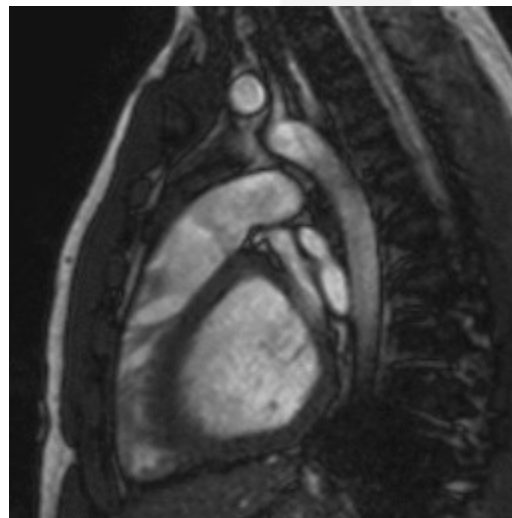
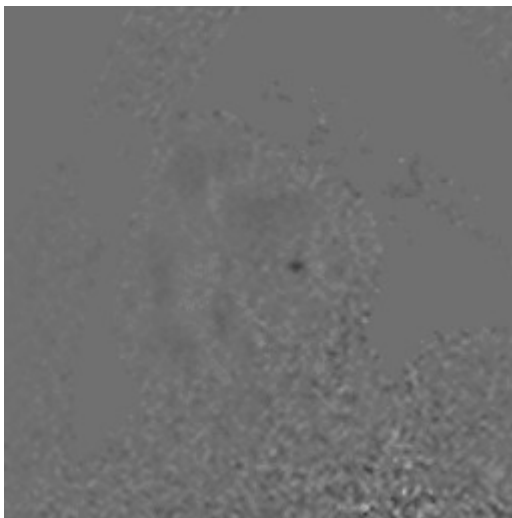
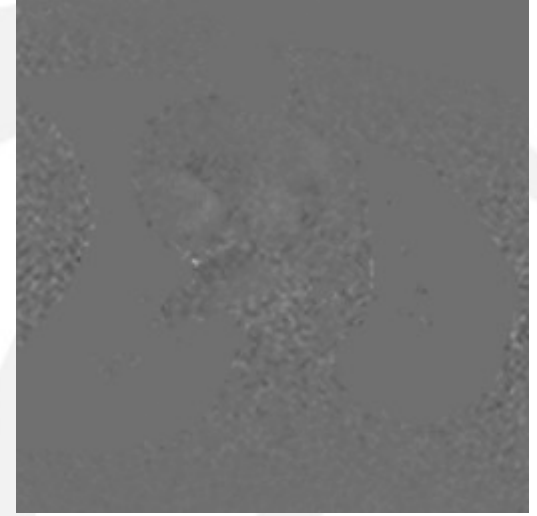
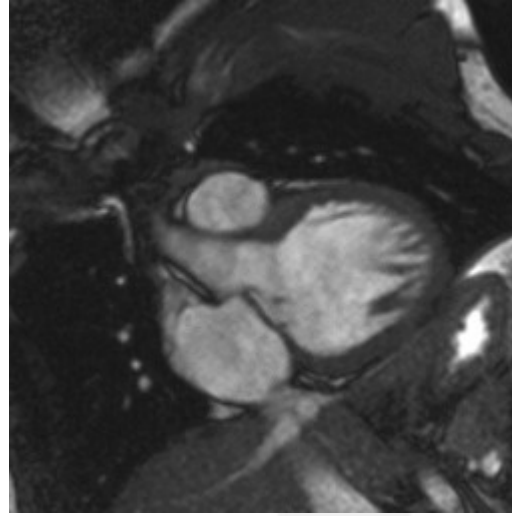
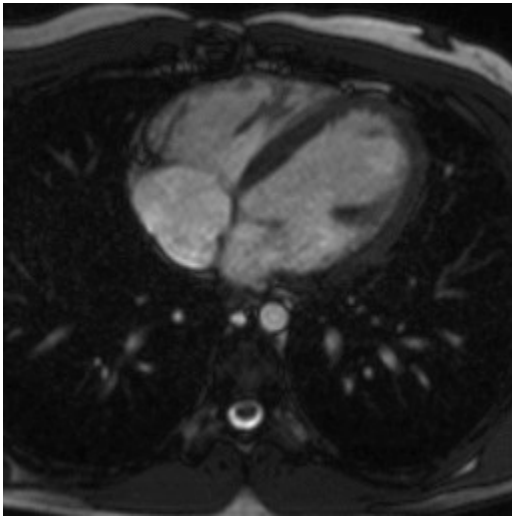
# Áramlás: Qp/Qs 1.15



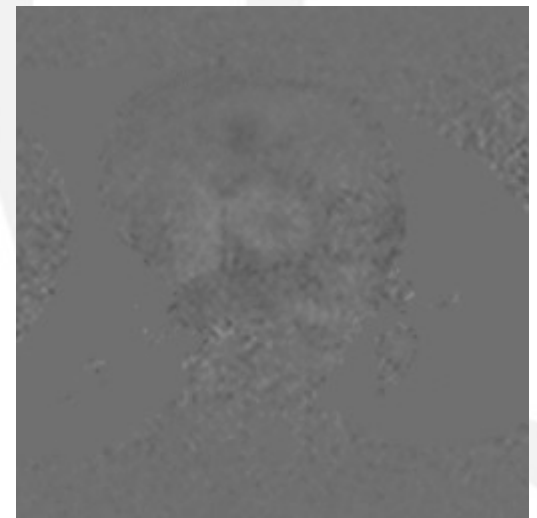
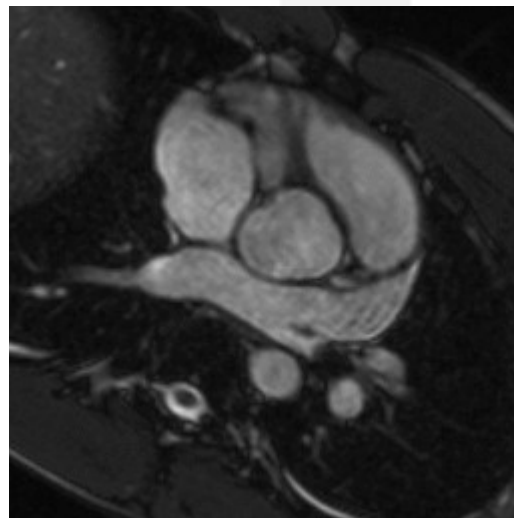
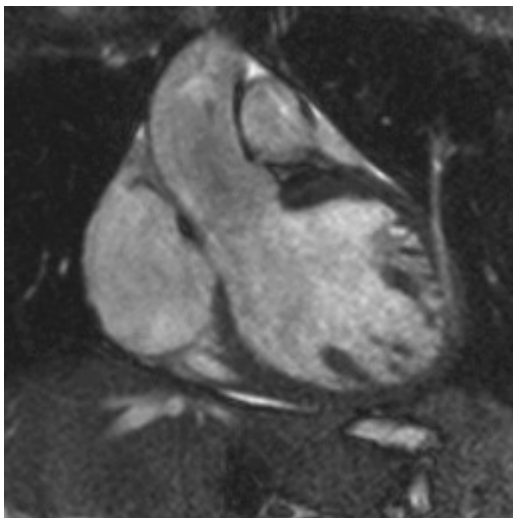
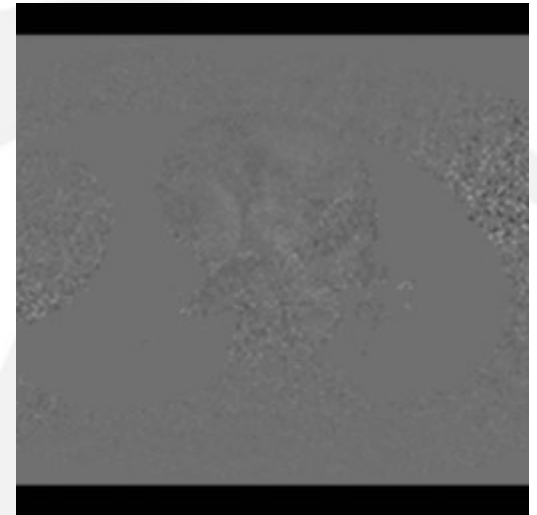
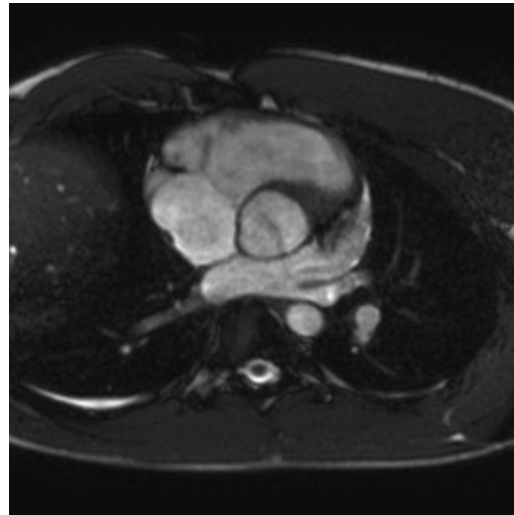
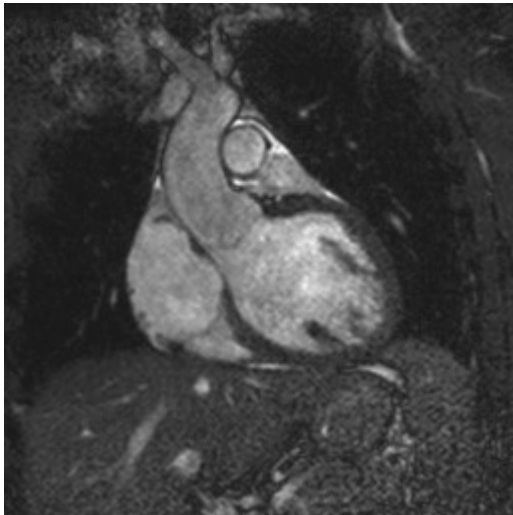
# LA és SA cine: műtét után



# Áramlás II.: Qp/Qs 0.93, MI Rf: 4% (5ml)



# Kajakos – AOI Rf I.: 23%, II.: 19%



# Navigátoros 3D MRA

**PHILIPS**  
Patient System Help 19:11

1968 07 13 M  
SURVEY\_BFFE FOV 450  
2009 11 12,18:12 Slice 16/20

**Planscan**  
Geometry: Navigator A  
Delete Copy  
Volume Stack Slab  
All midplanes 3PPS

System Ready 20

HC Screen HC Case  
Compose Compose

Scan: 1

More... All  
View Window RAL

VCG+Resp 5 s 63 ...

**3D\_BTFE\_BH**  
Remaining scan time: 00:00:59  
56%

Autoview...  
Start Scan Stop Scan

HAJNI VIAB II(2) 00:03:45

Seq	Icon	Name	Plane
9,1	✓	SA_movie	SA(1)
10,1	✓	LL F8 TD150	LA(1)
SA_VIA-3D	✗	SA_VIA-3D	SA(1)
11,1	✓	SA_VIA-3D	SA(1)
12,1	✓	LA_LE_IR	LA(1)
13,1	✓	LA_LE_IR	LA
14,1	✗	SA_LE_IR	SA
15,1	✓	IRTFE_3D_NA...	SA
16,1	✓	BTFE_FB_50	4CH
17,1	✓	3D_BTFE_WH	WH
18,1	✓	BTFE_FB_50	LA
3D_BTFE_BH	✗	3D_BTFE_BH	CORON
3D_BTFE_BH	✗	3D_BTFE_BH	CORON

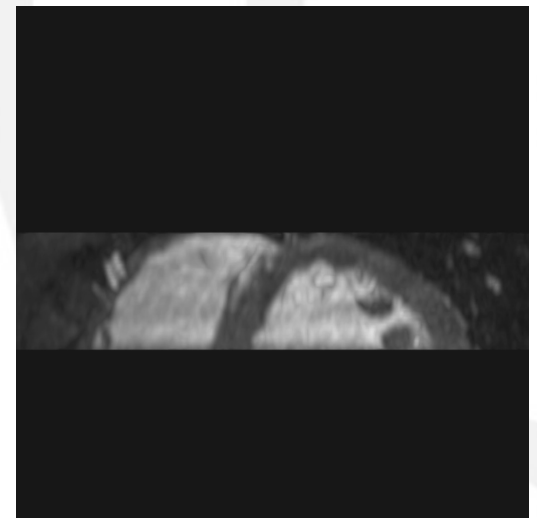
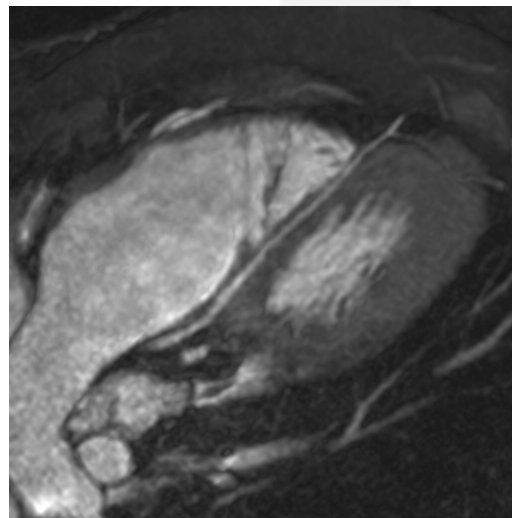
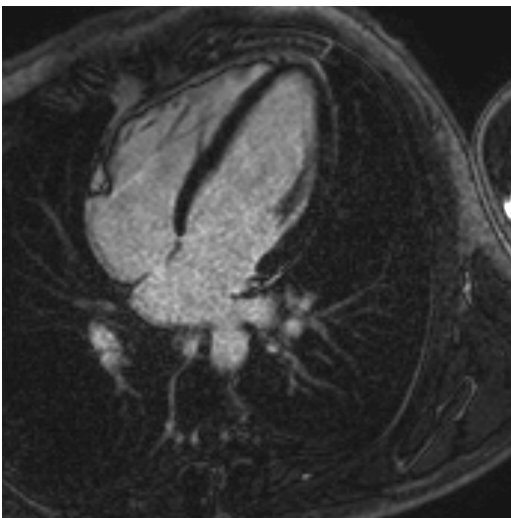
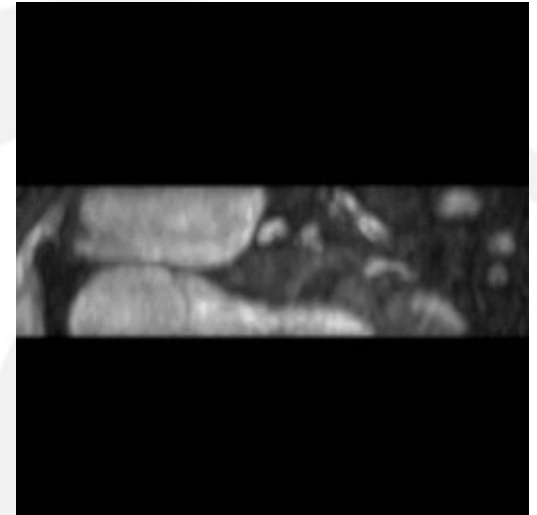
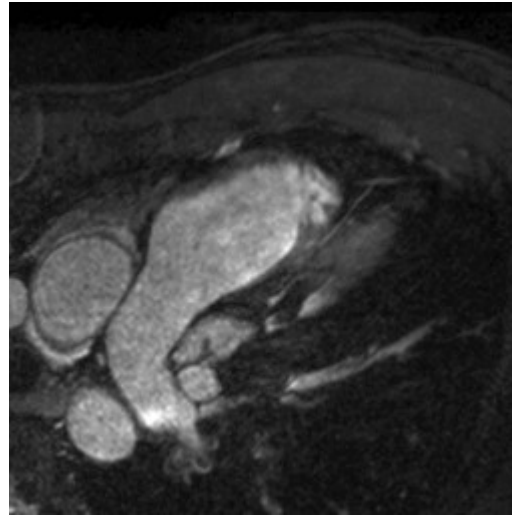
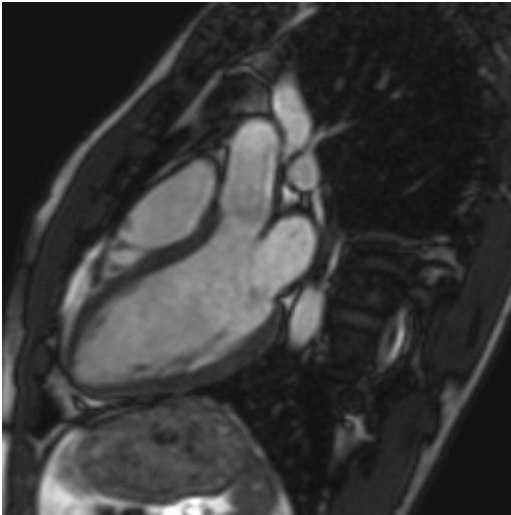
Parameter	Value	Parameter	Value
Coil selection	SENSE-Cardiac	Total scan duration	02:45.7
element selection	12345	Ret. signal level (%)	100
connection	d	Act. TR/TE (ms)	4.9 / 2.4
Dualcoil	no	ACQ matrix M x P	228 x 182
CLEAR	yes	ACQ voxel MPS (mm)	1.10 / 1.11 / 1.10
FOV FH (mm)	250	REC voxel MPS (mm)	0.49 / 0.49 / 1.10
AP (mm)	200	Scan percentage (%)	98.9
RL (mm)	25	TFE shots	172
Voxel size FH (mm)	1.1	TFE dur. shot / acq (ms)	270.9 / 112.5
AP (mm)	1.1	TFE shot interval (beats)	1
RL (mm)	1.1	Entered heartrate	63
Recon voxel size (mm)	0.5	Trigger delay max. / act...	904.8 / 630.0
Fold-over suppression	yes	Max. heart phases	1
Slice oversampling	default	Act. WFS (pix) / BW (Hz)	0.223 / 974.7
Reconstruction matrix	512	Min. WFS (pix) / Max. B...	0.222 / 980.4
SENSE	no	SAR / whole body	< 32% / 1.3 W/kg
k-tBLAST	no	Whole body / level	< 1.3 W/kg / normal
Overcontiguous slices	no	B1rms [uT]	2.6
Stacks	1	PNS / level	59% / normal
slices	23	Sound Pressure Level (...)	14.5
slice orientation	sagittal (coronal)		
fold-over direction	AP (RL)		

19:11 Gating efficiency is 57% over the last 60s.

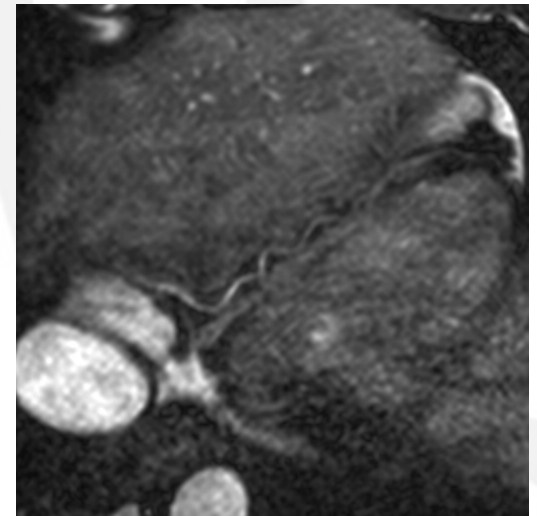
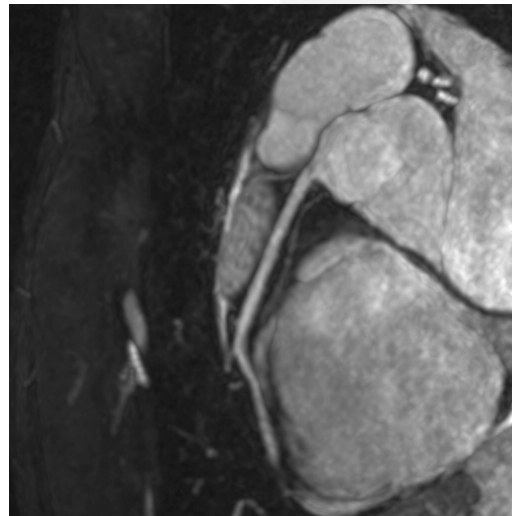
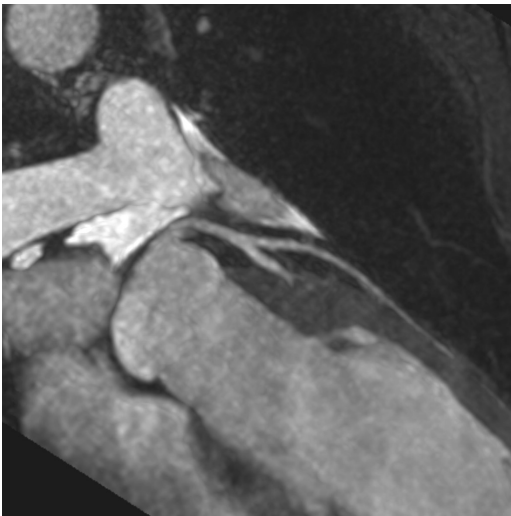
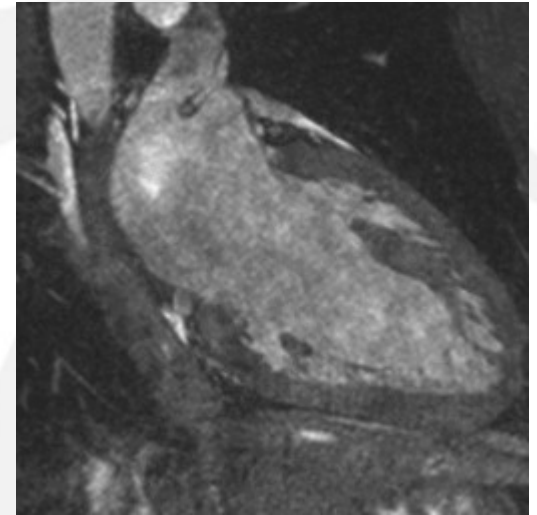
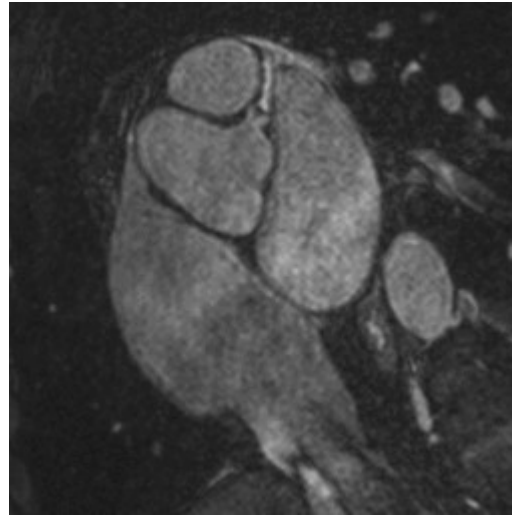
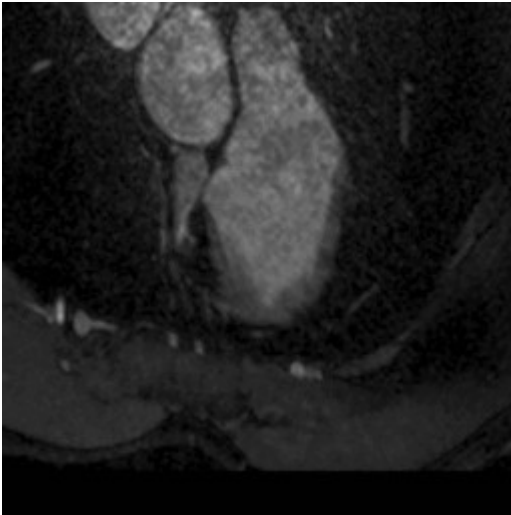
**3D\_BTFE\_BH**  
3D Balanced TFE coronary scan  
Navigator Display  
3D\_BTFE\_BH  
Leading navigator, beam 1  
artery and the  
en the arteries  
asure the precise



# Terheléses panaszok: LAD bridge



# Coronaria eredési variatio



# Köszönöm a figyelmet!



Semmelweis Egyetem

KARDIOLÓGIAI  
KÖZPONT



Sportkardiológia: szív MR – [atoth@atoth.sote.hu](mailto:atoth@atoth.sote.hu)