

Rund 1000

→ Mitarbeitende stehen täglich bei uns im Einsatz.



Kardiale Pathologien im Fokus der CT und MRT Bildgebung

Annette Schumacher, Leitende Ärztin Kardiologie

ZUGER Kantonsspital

Inhalt

- > Herz Anatomie
- > Kleiner EKG Kurs
- > Herz CT
 - > Indikationen
 - > Was muss ich beachten
 - > Patientenbeispiele
- > Herz MRT
 - > Indikationen
 - > Was muss ich beachten
 - > Patientenbeispiele

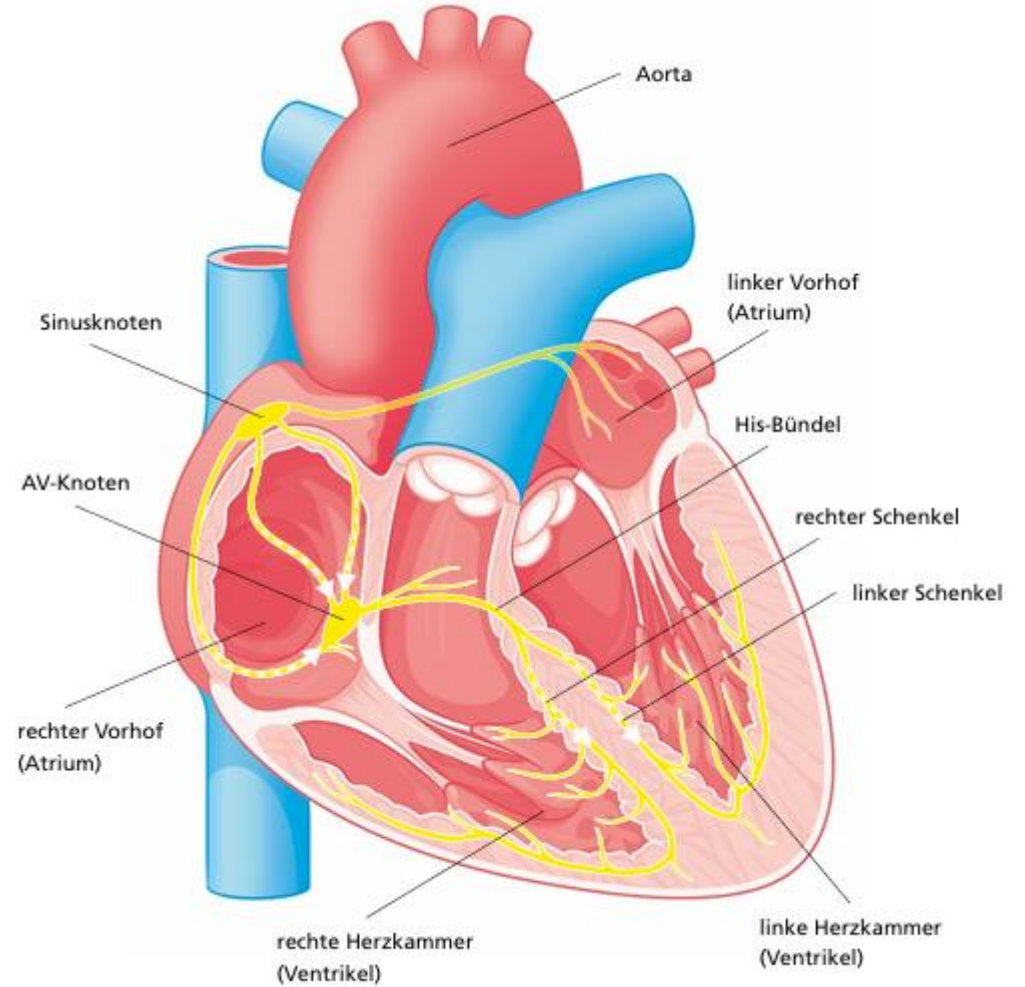
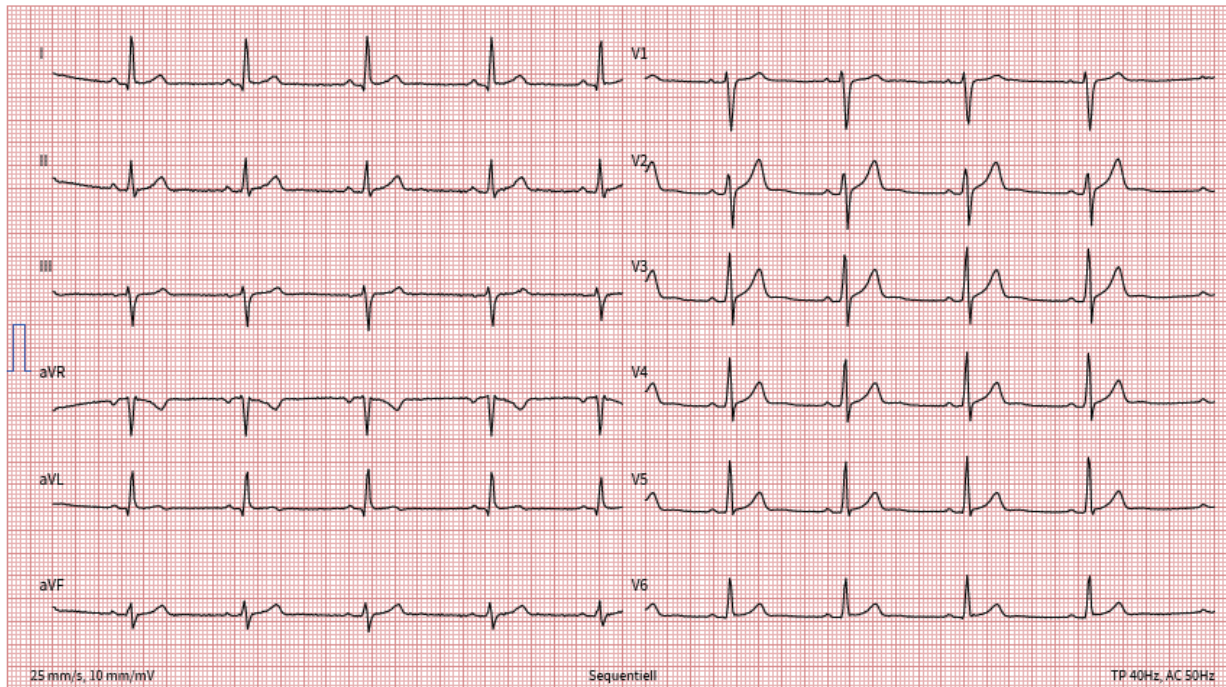
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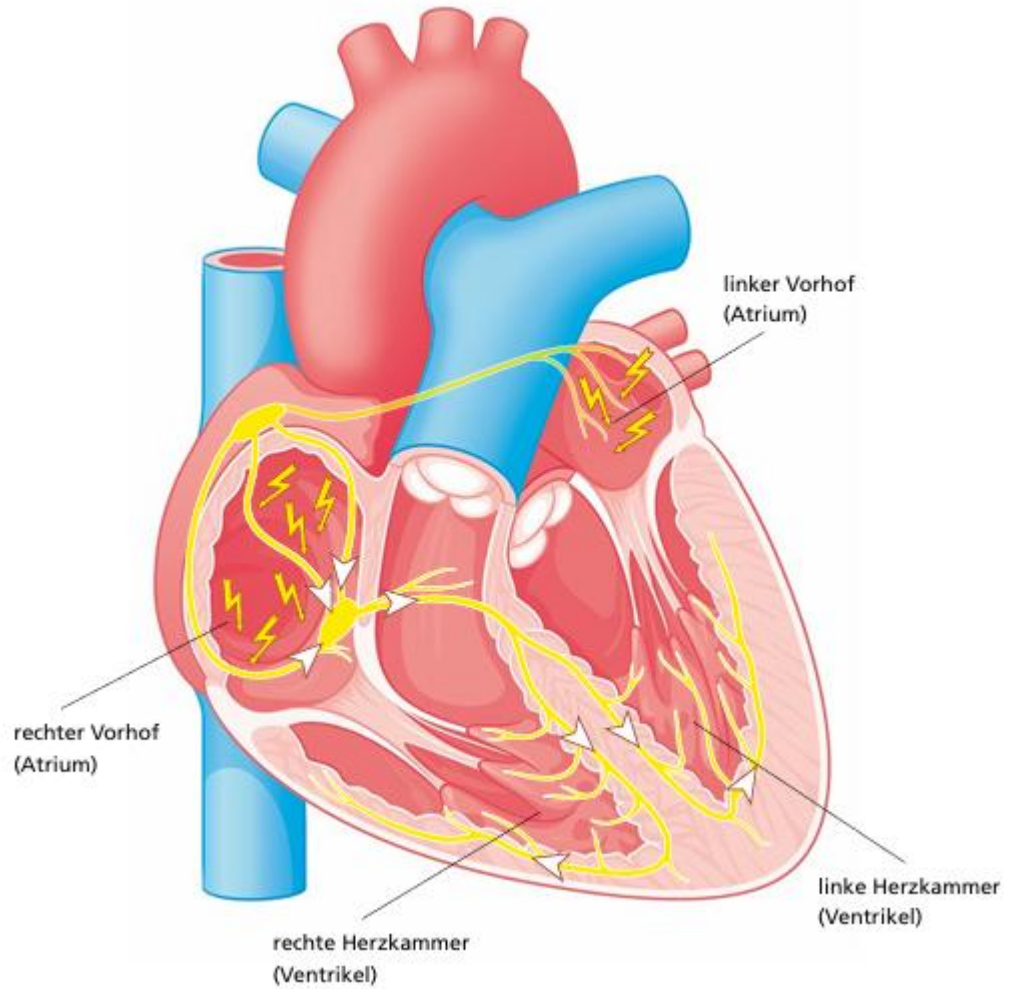
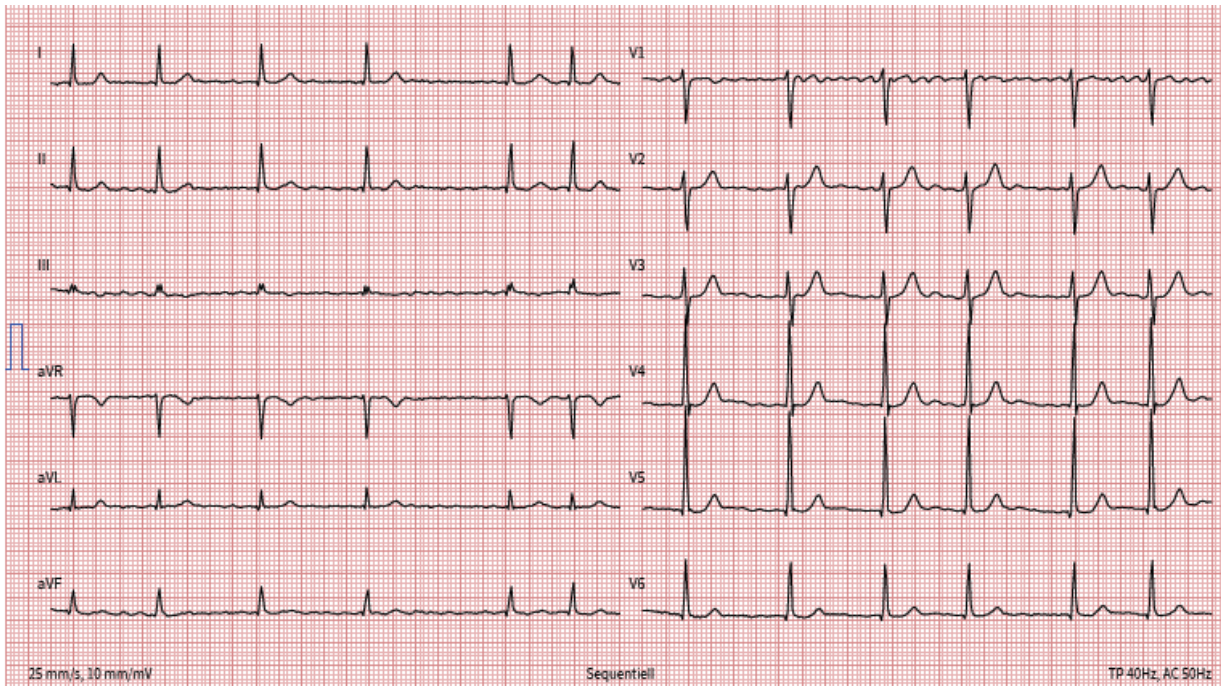
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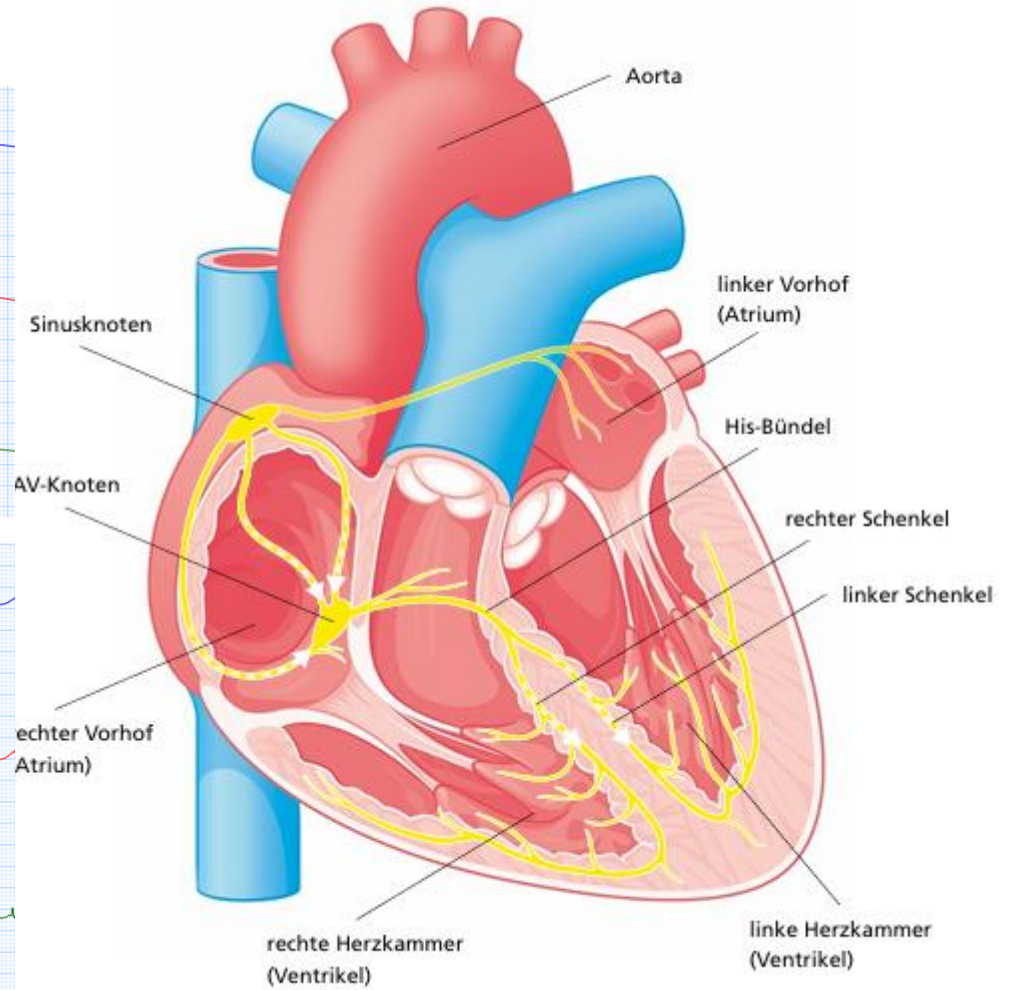
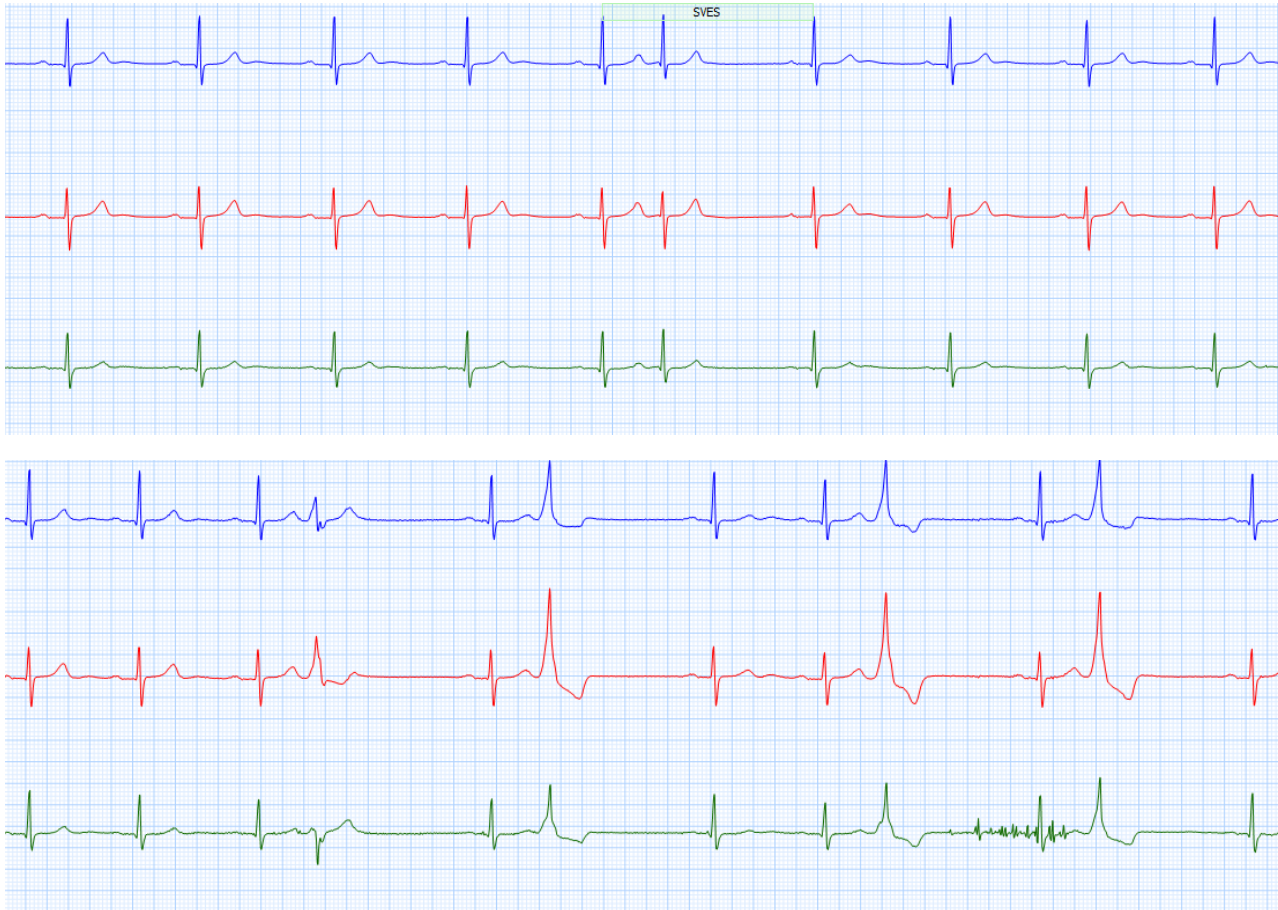
Kleiner EKG Kurs



Kleiner EKG Kurs

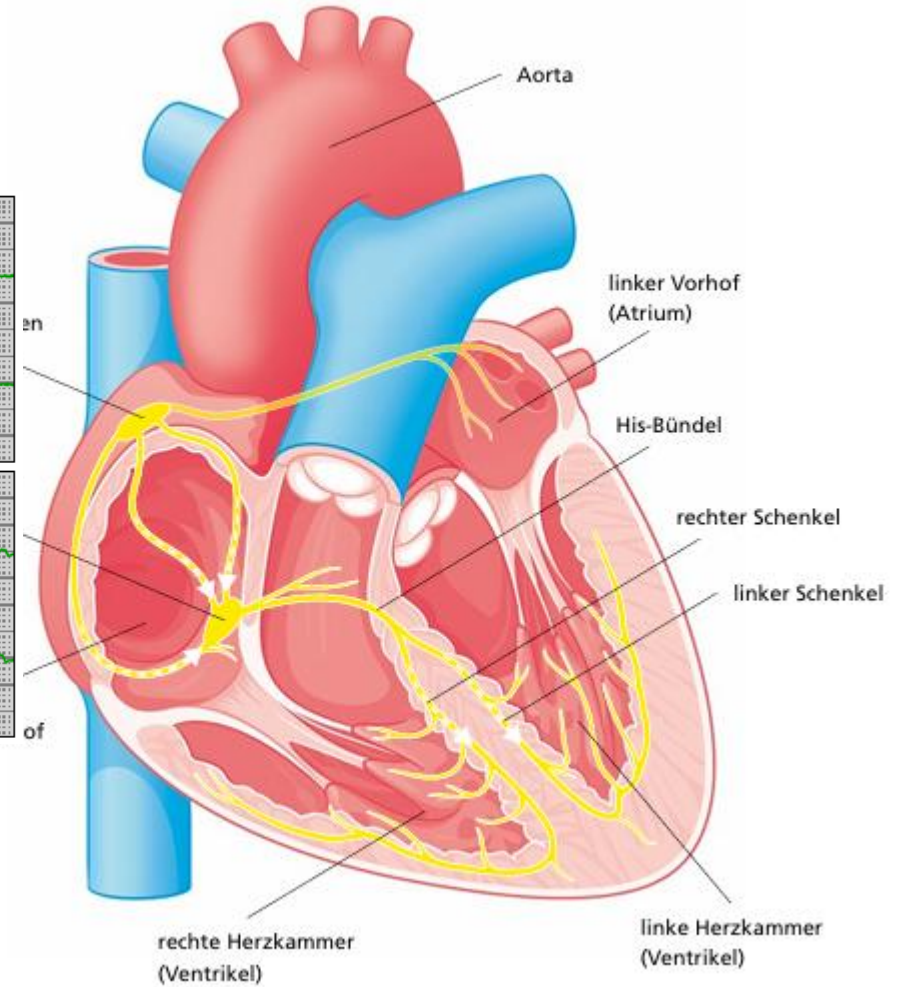
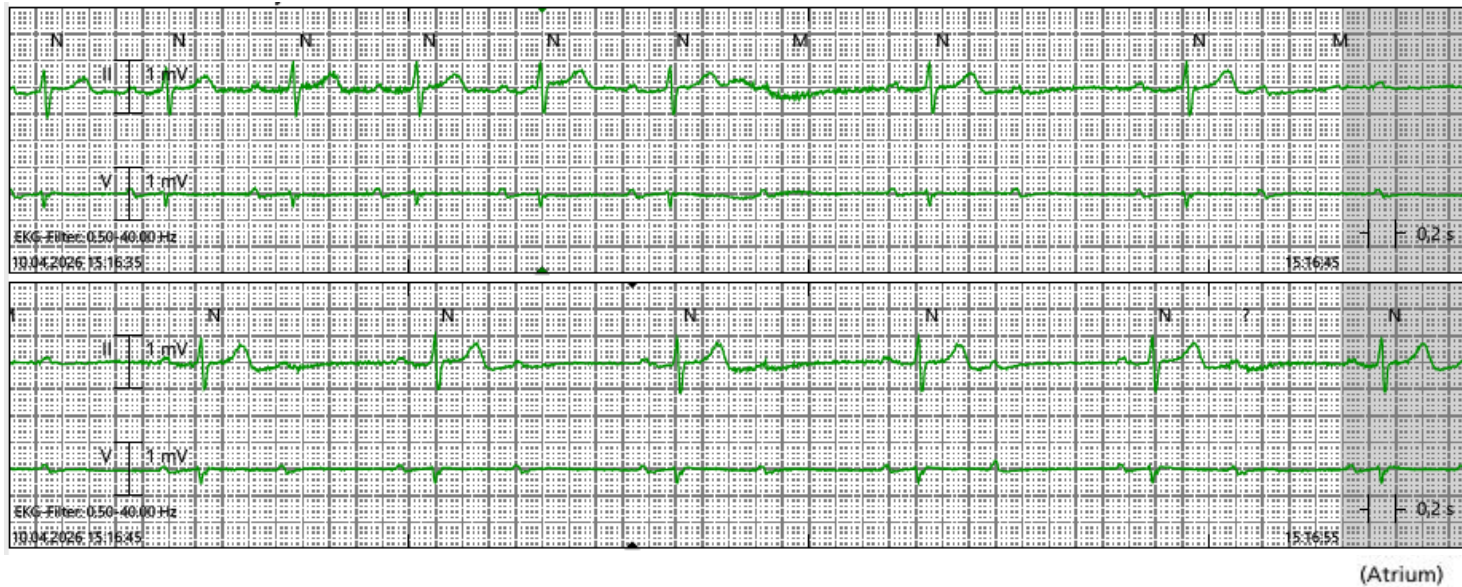


Kleiner EKG Kurs



Schweizerische Herzstiftung

Kleiner EKG Kurs



Inhalt

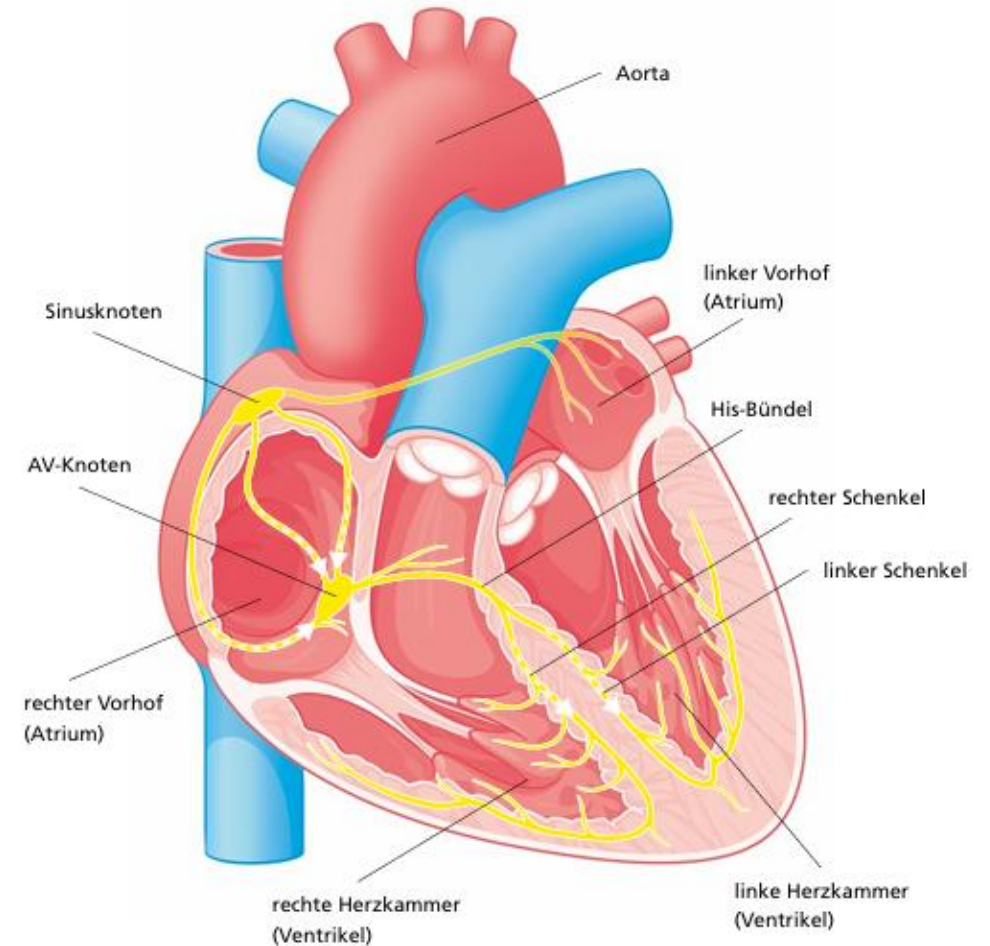
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Herz CT: Indikationen

- > Koronararterien: **Ausschluss KHK**, Koronaranomalien
- > Herzklappen: **TAVI-Planung**, Planung andere Klappenoperation/-intervention, Klappenfunktion nach Ersatz
- > Elektrophysiologie/Planung Interventionen: Vorhofanatomie, Mündung Pulmonalvenen, LAA Verschluss, Vorhofohrthrombus
- > Angeborene Herzfehler

Koronar CT: Was muss ich beachten

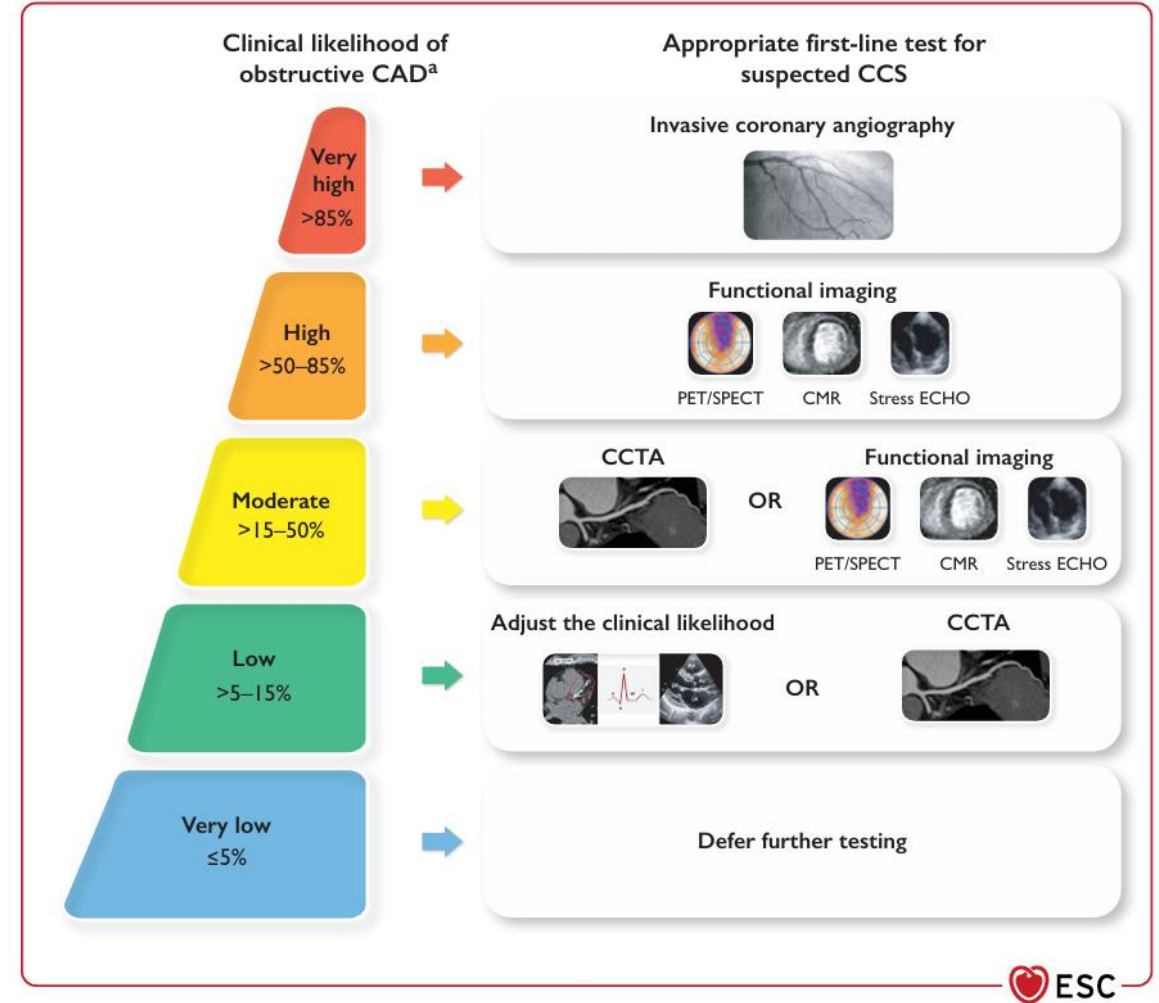
- > Ziel gute Bildqualität
- > Ziel Herzfrequenz je nach Scanner, oft < 65/min
- > Ivabradin, Betablocker po und iv:
 - > Kontraindikationen: höhergradiger AV-Block, Herzschwäche, Hypotonie
- > Nitroglycerin sl:
 - > Kontraindikationen: PDE5-Hemmer, schwere Aortenklappenstenose, HOCM, Herzschwäche, Hypotonie



Patientenbeispiel

56-jährige Patientin

- > Atypische Thoraxschmerzen
- > cvRF: Dyslipidämie
- > EKG und Echokardiographie normal

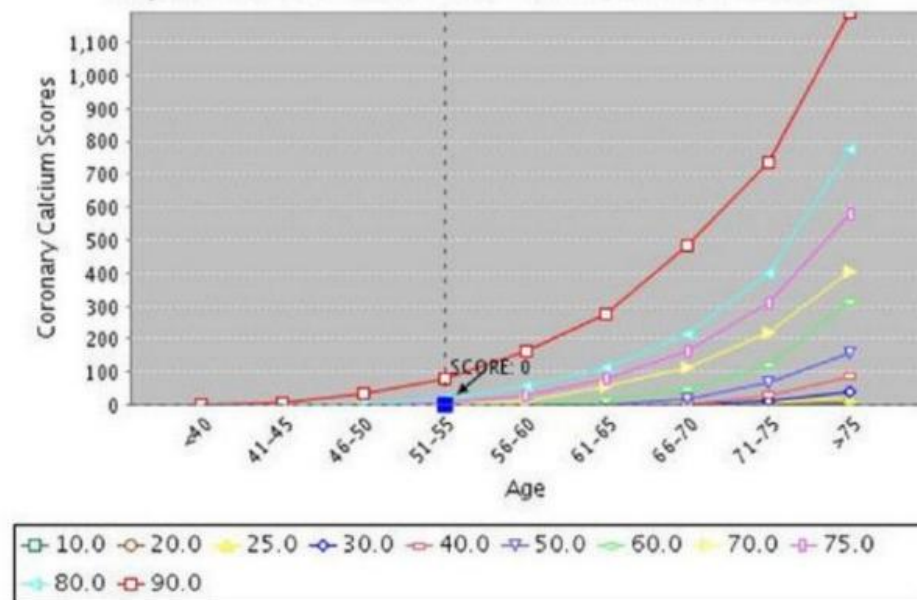


Calciumscore



CORONARY	AJ-130	Mass	Volume-130
(LMA) Left Main Artery	0	0	0
(LAD) Left Anterior Descending	0	0	0
(LCX) Left Circumflex	0	0	0
(RCA) Right Coronary Artery	0	0	0
(PDA) Posterior Descending Artery	0	0	0
A	0	0	0
B	0	0	0
C	0	0	0
Total	0	0	0
Total (without additional vessels)	0	0	0

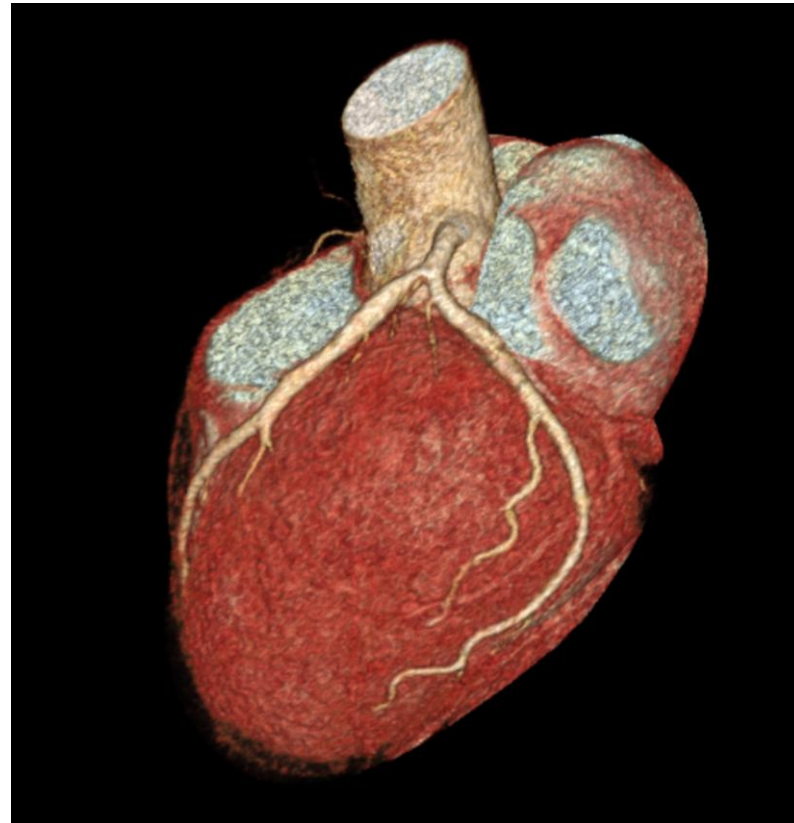
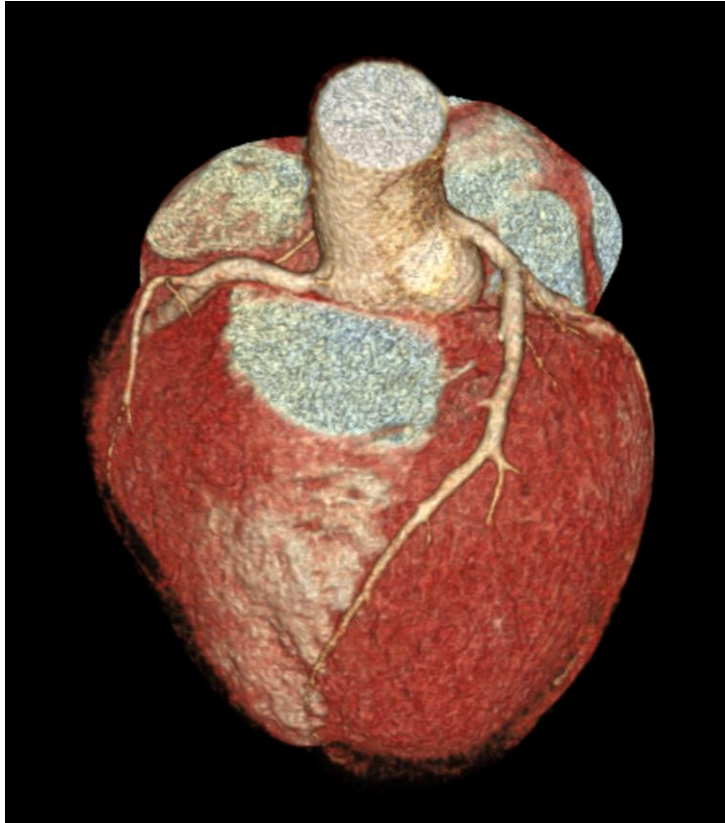
Population Distribution for Calcium Scores



Koronar CT



Koronar CT



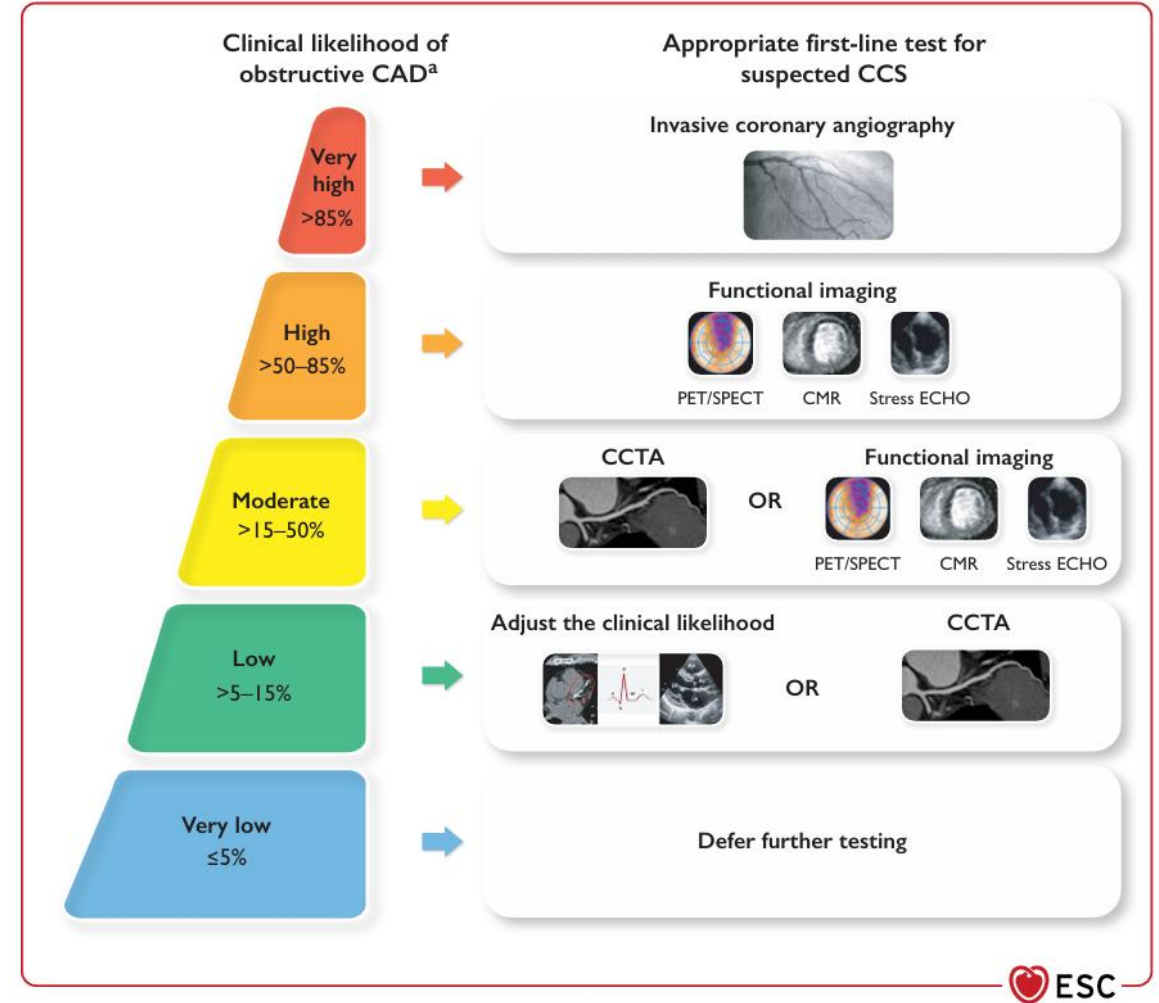
Koronar CT



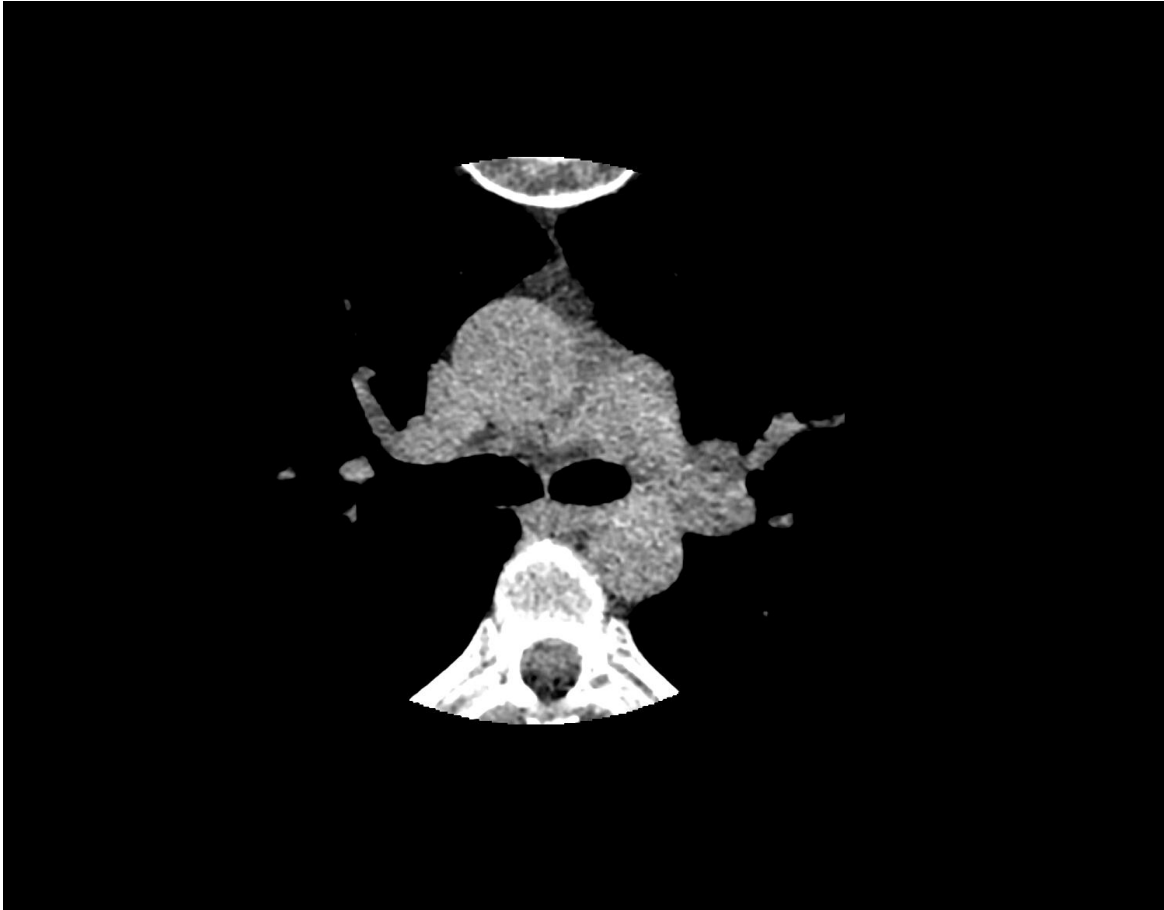
Patientenbeispiel

54-jährige Patientin

- > (A-)typische Thoraxschmerzen
- > cvRF: keine
- > EKG und Echokardiographie normal



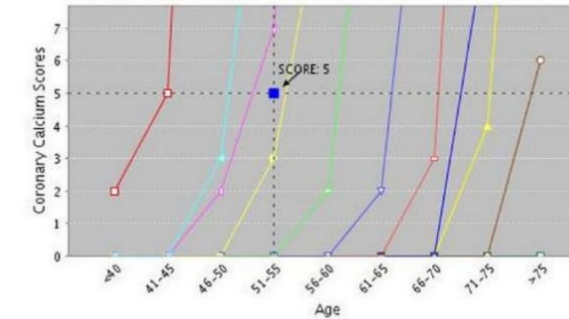
Calciumscore



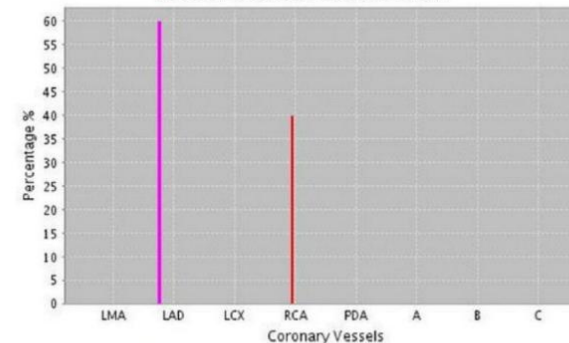
CORONARY	AJ-130	Mass	Volume-130
(LMA) Left Main Artery	0	0	0
(LAD) Left Anterior Descending	3	1	7
(LCX) Left Circumflex	0	0	0
(RCA) Right Coronary Artery	2	0	3
(PDA) Posterior Descending Artery	0	0	0
A	0	0	0
B	0	0	0
C	0	0	0
Total	5	1	10
Total (without additional vessels)	5	1	10

Calibration Factor : 0.743

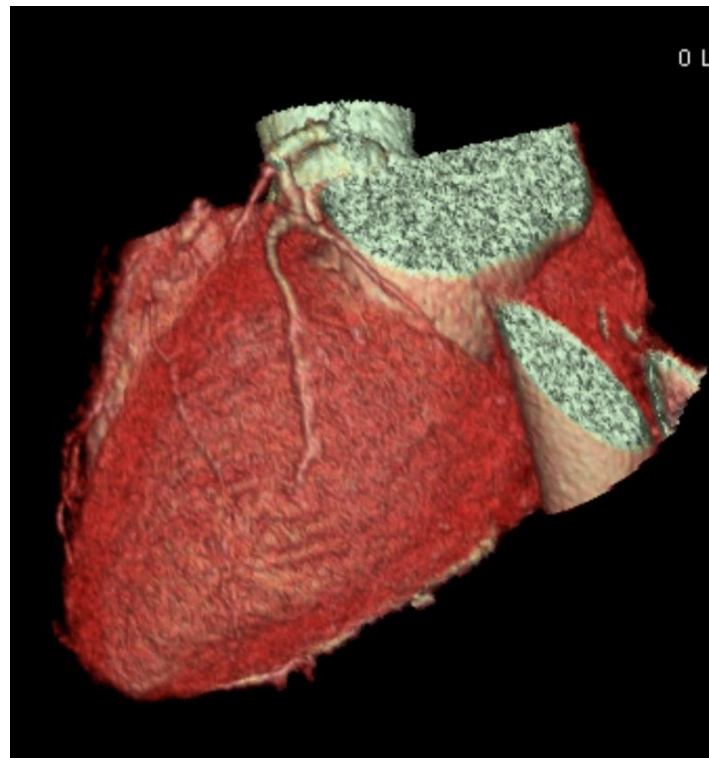
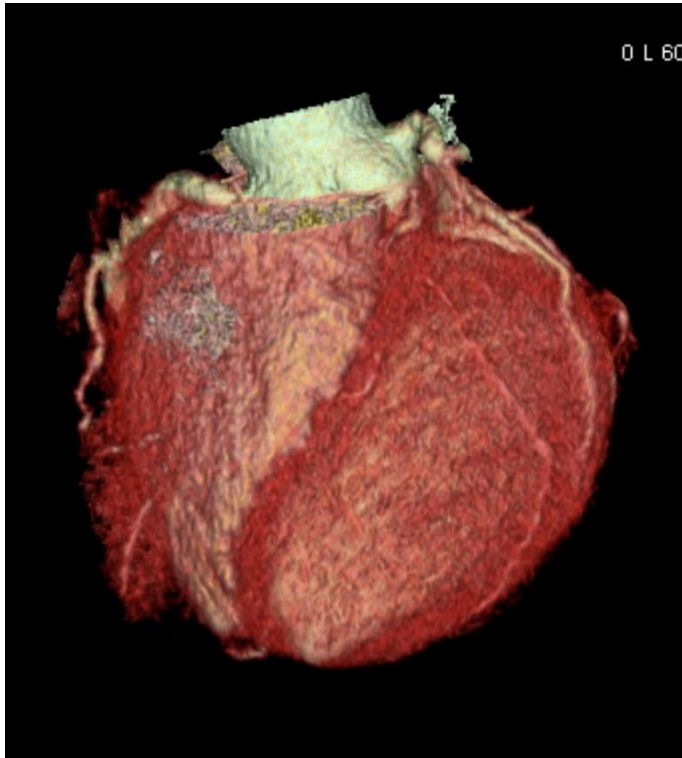
Population Distribution for Calcium Scores



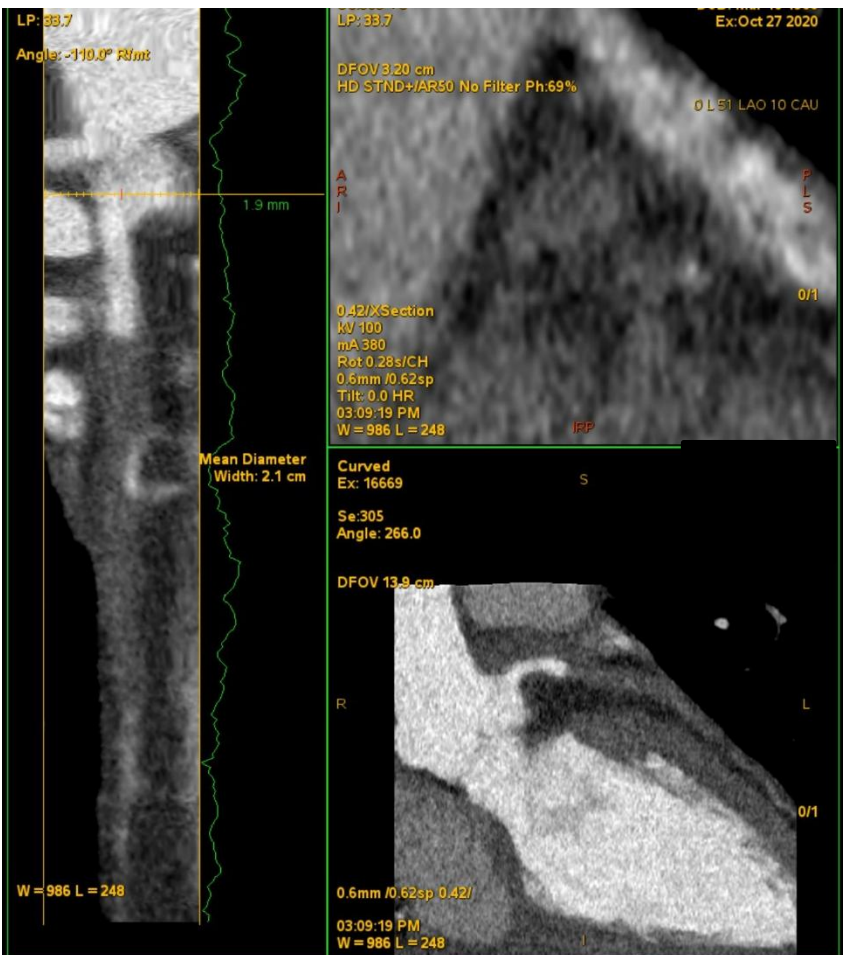
Vessel Scores Distribution



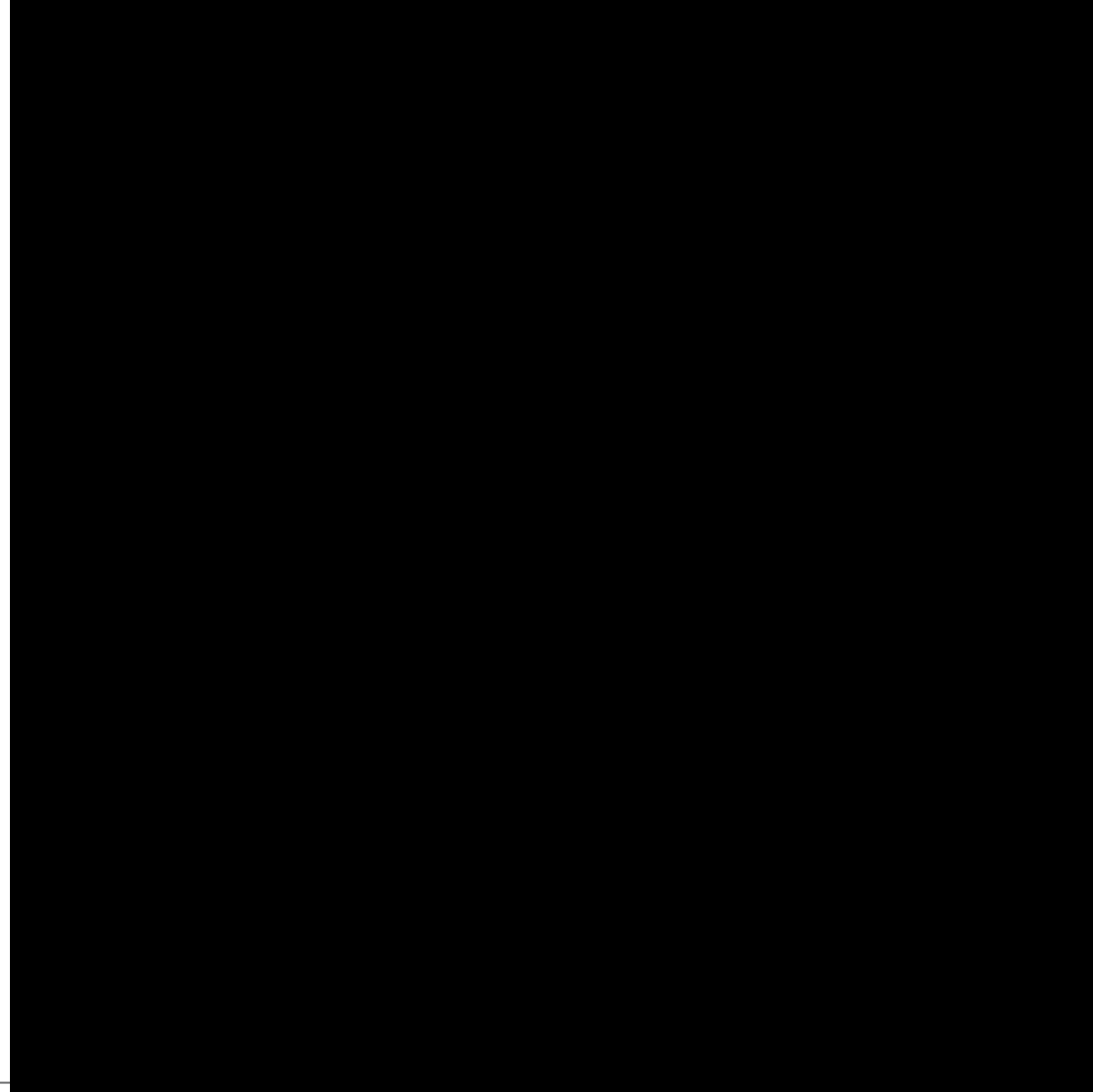
Koronar CT



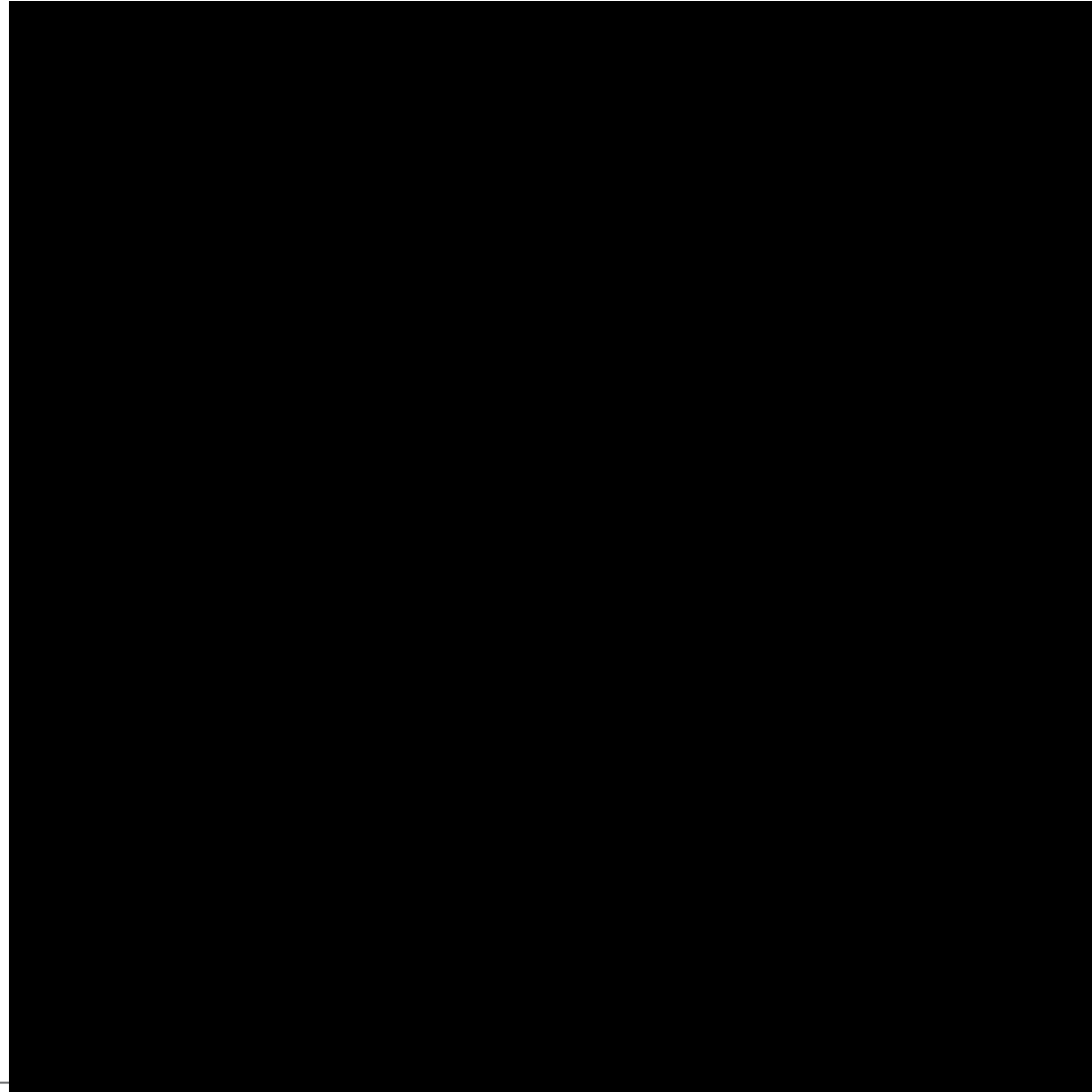
Koronar CT



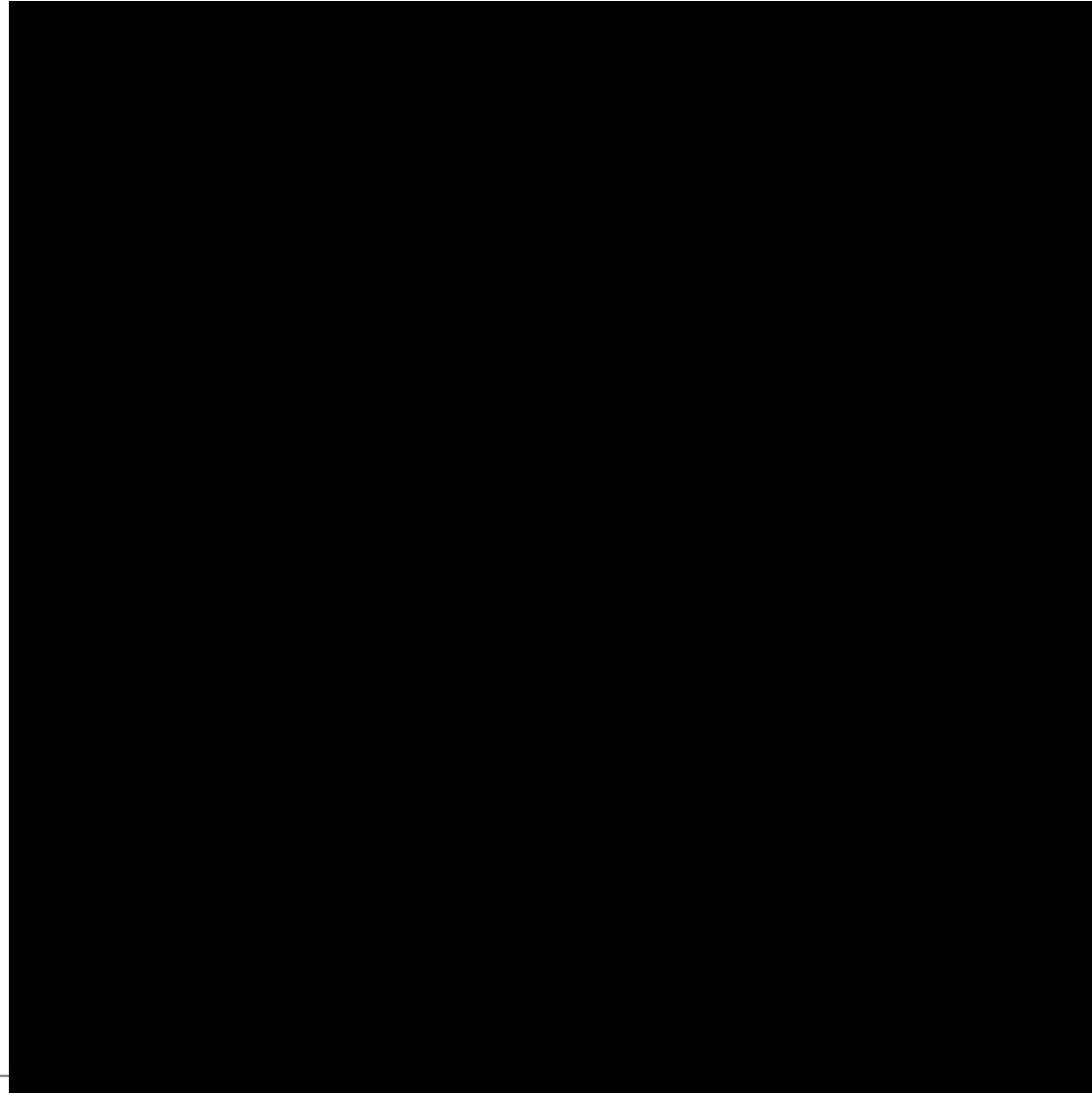
Koronarangiographie



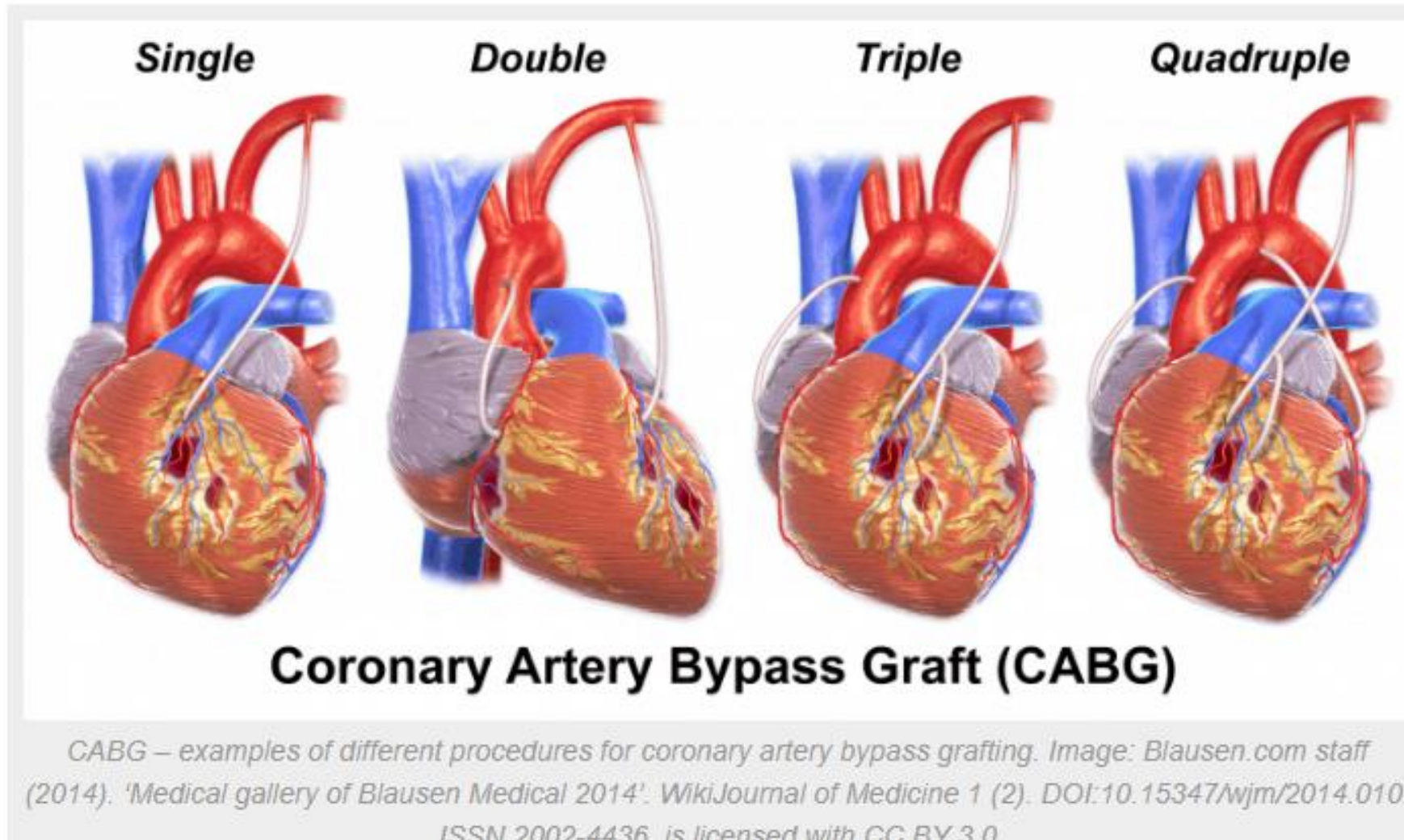
Koronarangiographie



Koronarangiographie



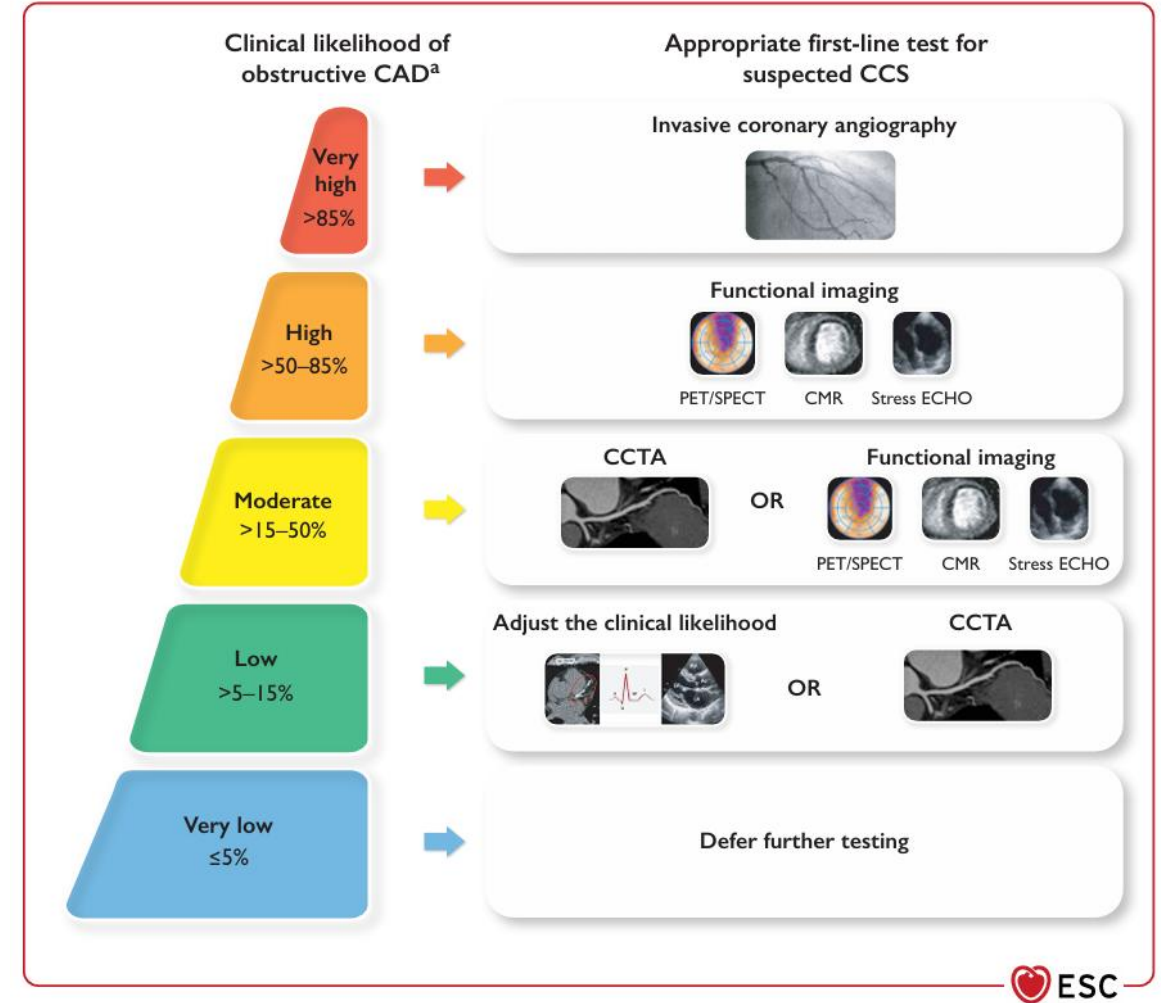
MIDCAB



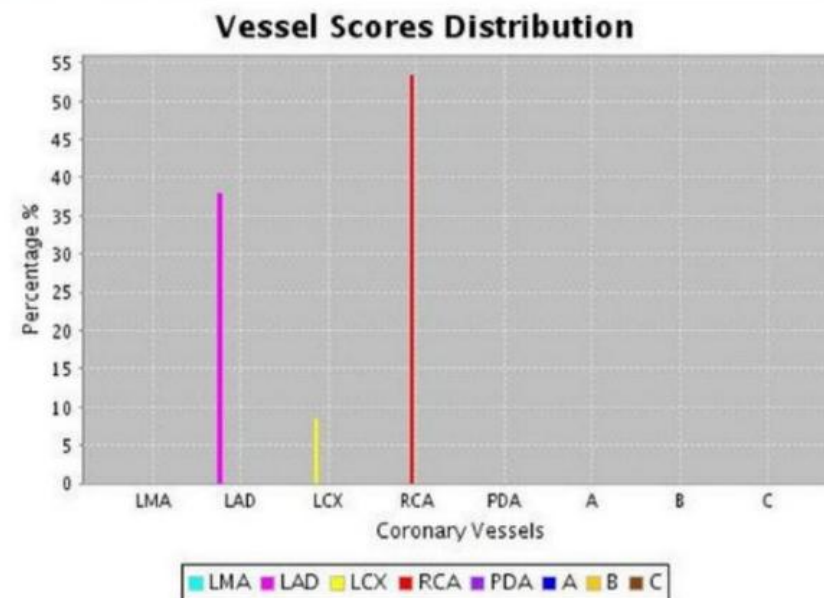
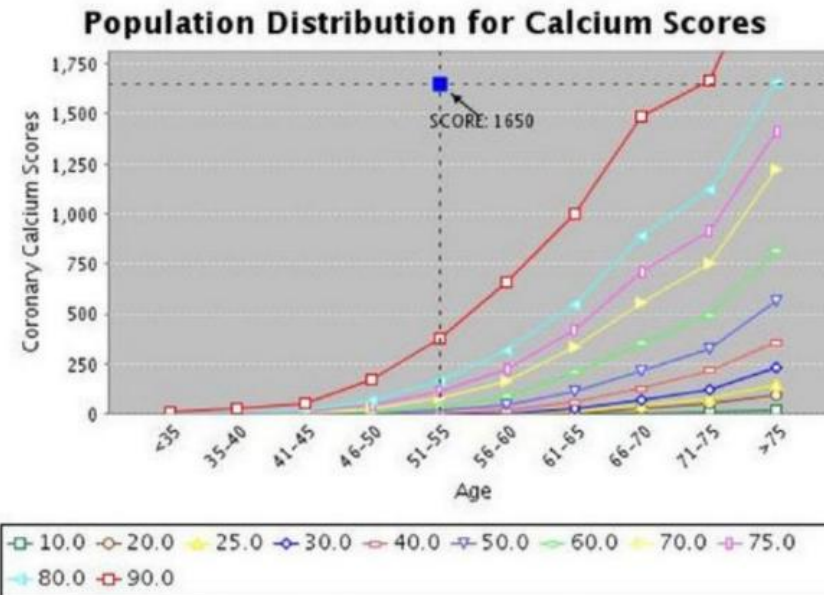
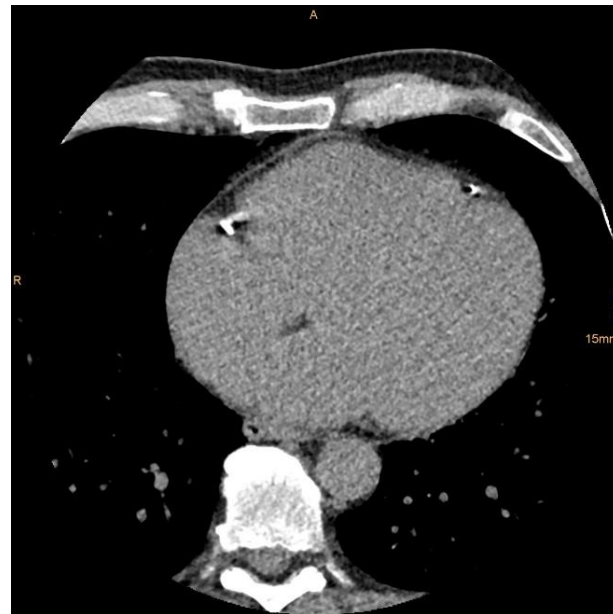
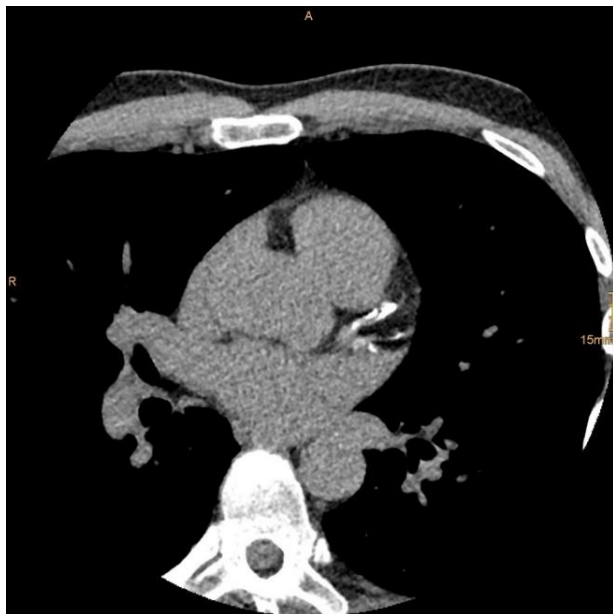
Patientenbeispiel

55-jähriger Patient

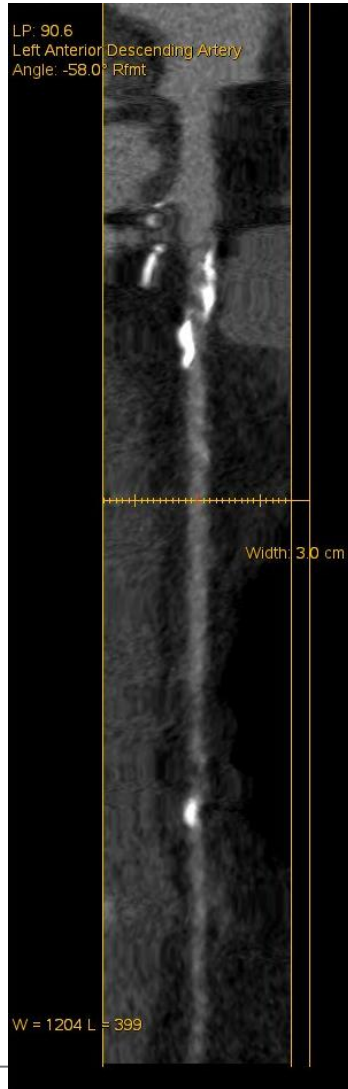
- > Typische Thoraxschmerzen
- > cvRF: Dyslipidämie, Diabetes mellitus
- > EKG, Echokardiographie, Ergo normal



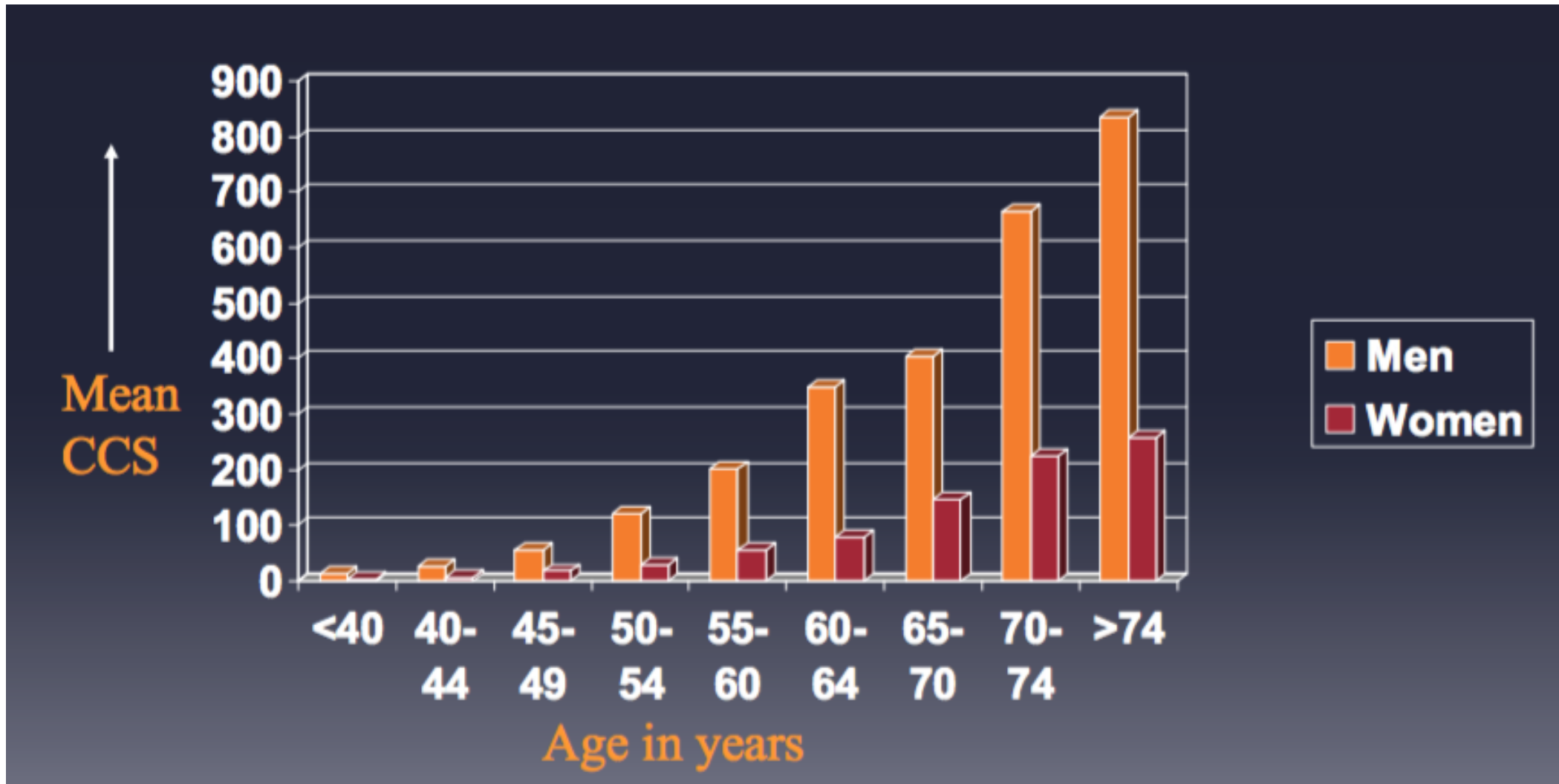
Calciumscore



Koronar CT



Calciumscore – Prävalenz asymptotische Population



Hoff et al, Am J Cardiol 2001, Tarun UK Cardiac CT course 2019

Calciumscore - Prognose

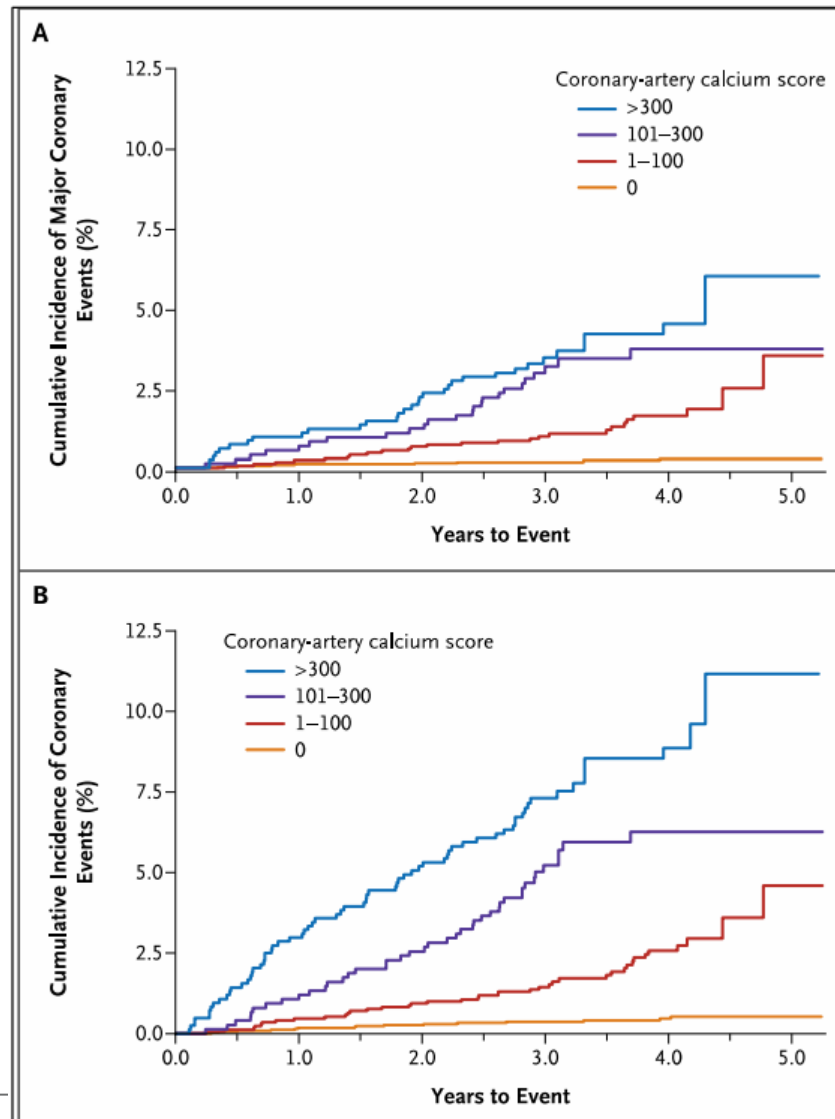
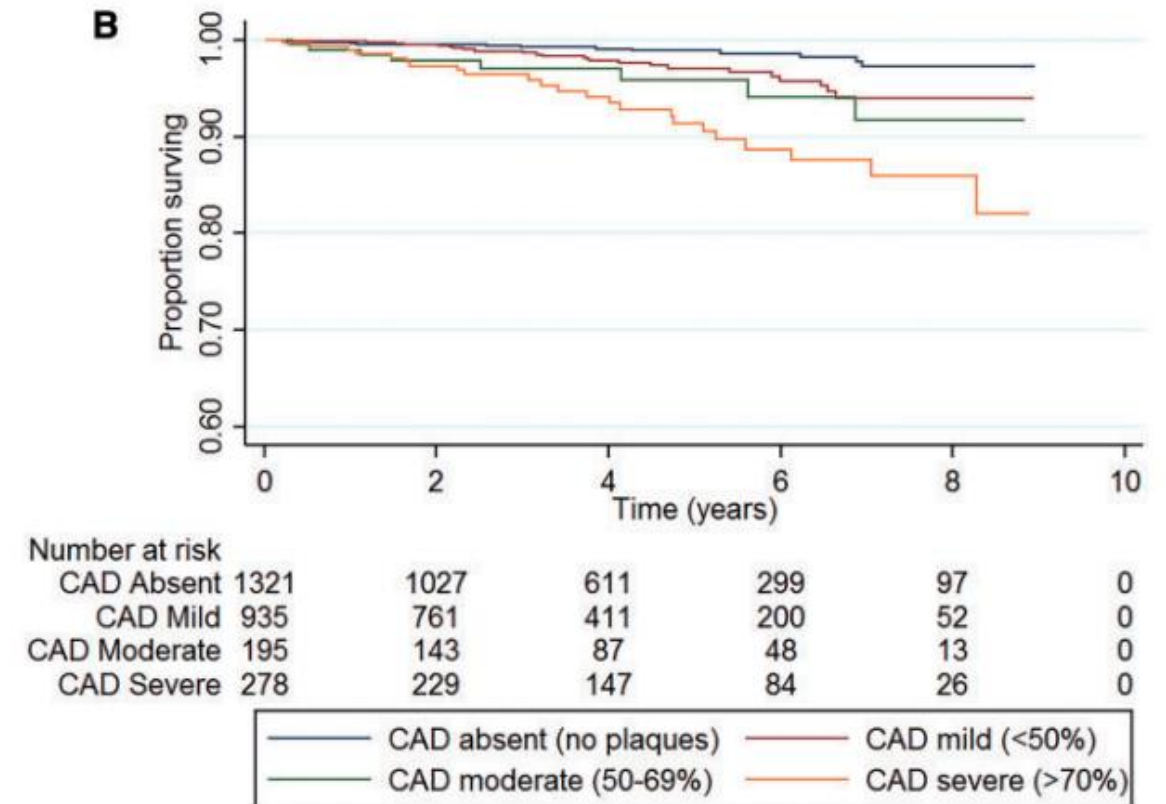
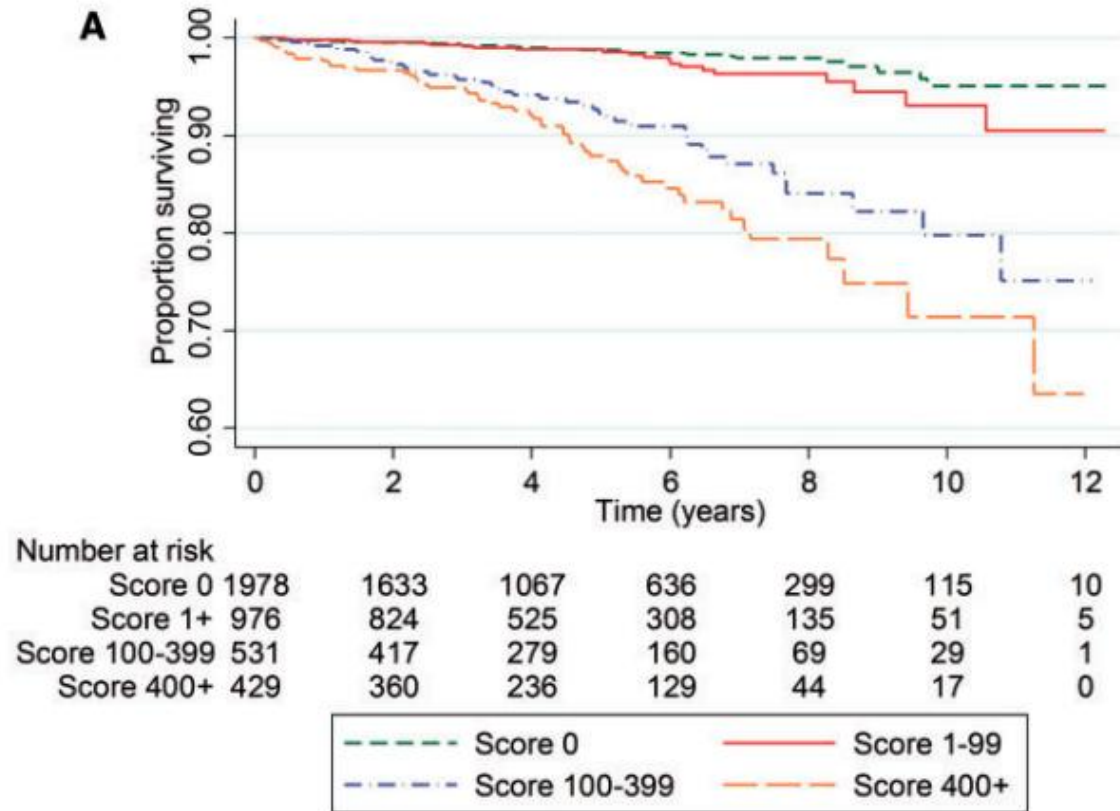


Figure 1. Unadjusted Kaplan–Meier Cumulative-Event Curves for Coronary Events among Participants with Coronary-Artery Calcium Scores of 0, 1 to 100, 101 to 300, and More Than 300.

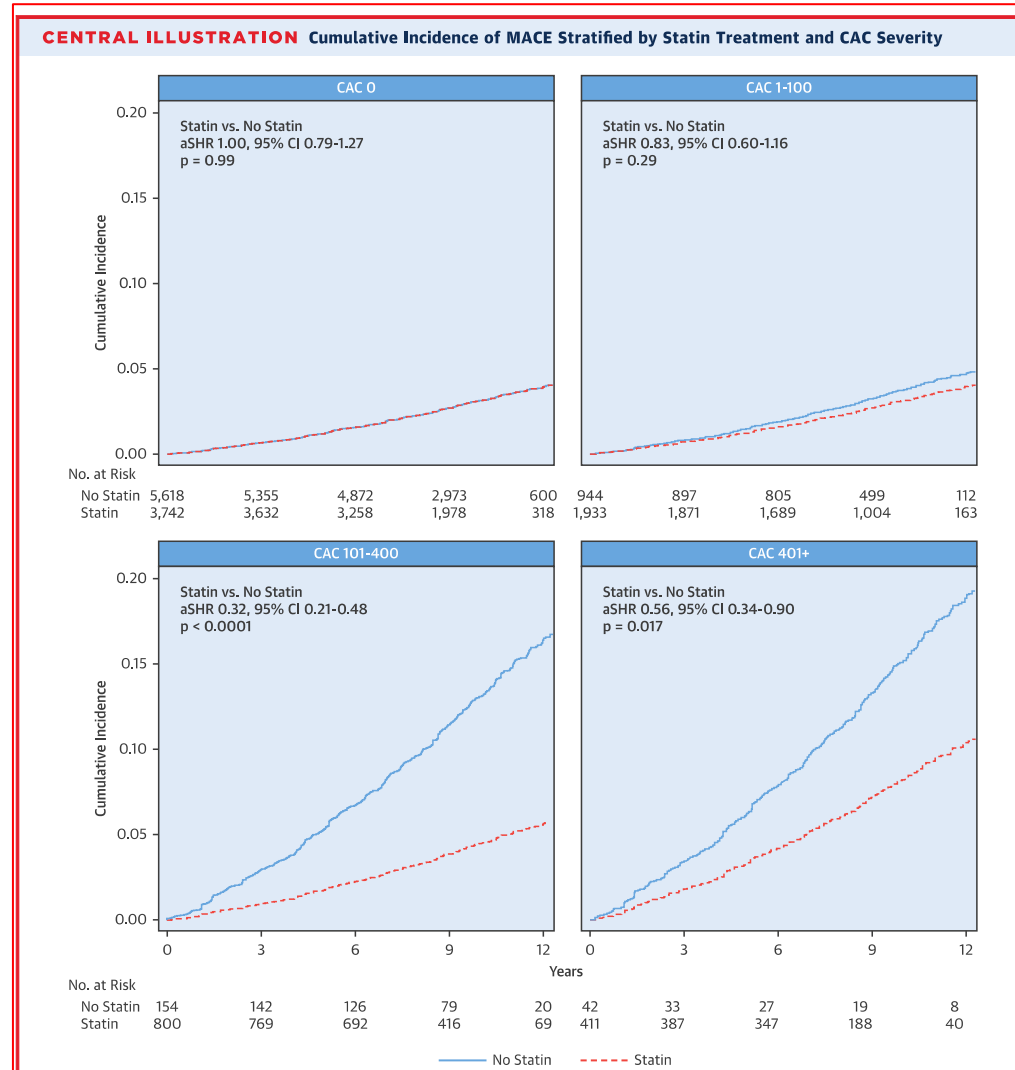
Panel A shows the rates for major coronary events (myocardial infarction and death from coronary heart disease), and Panel B shows the rates for any coronary event. The differences among all curves are statistically significant ($P < 0.001$).

Detrano et al, NEJM 2008

Calciumscore und Koronar-CT - Prognose

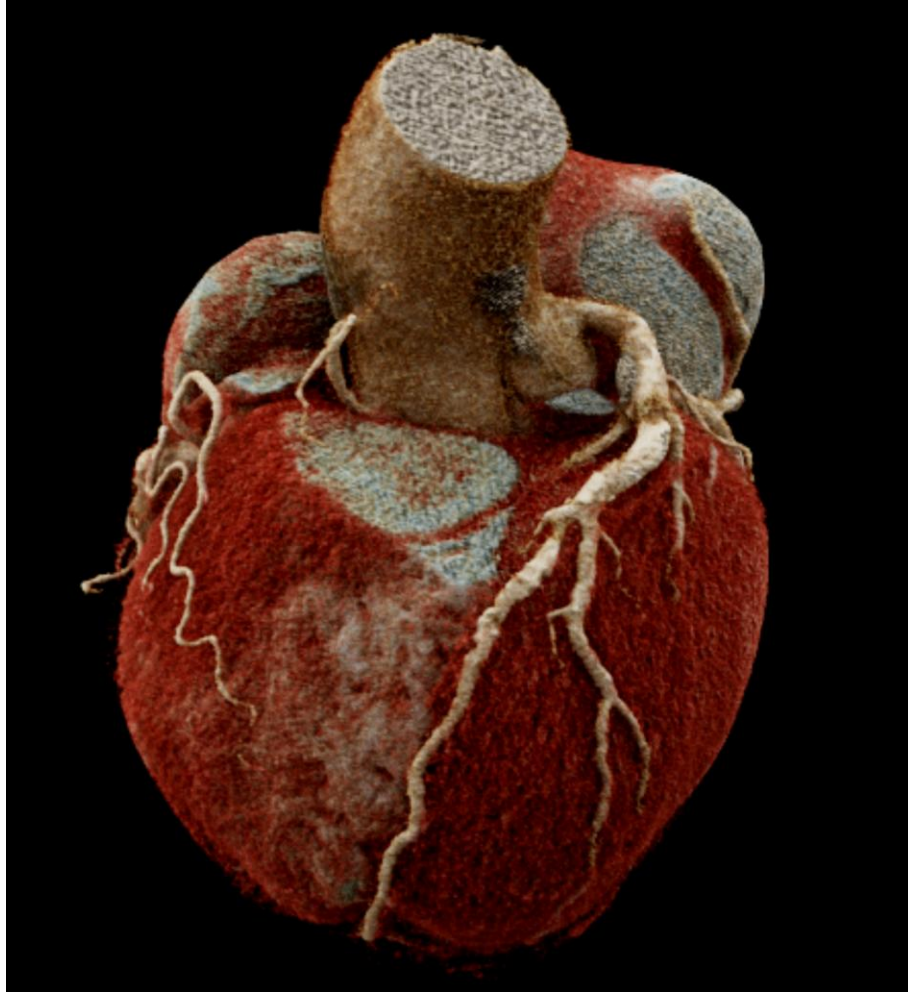


Calciumscore – Präventive Therapie

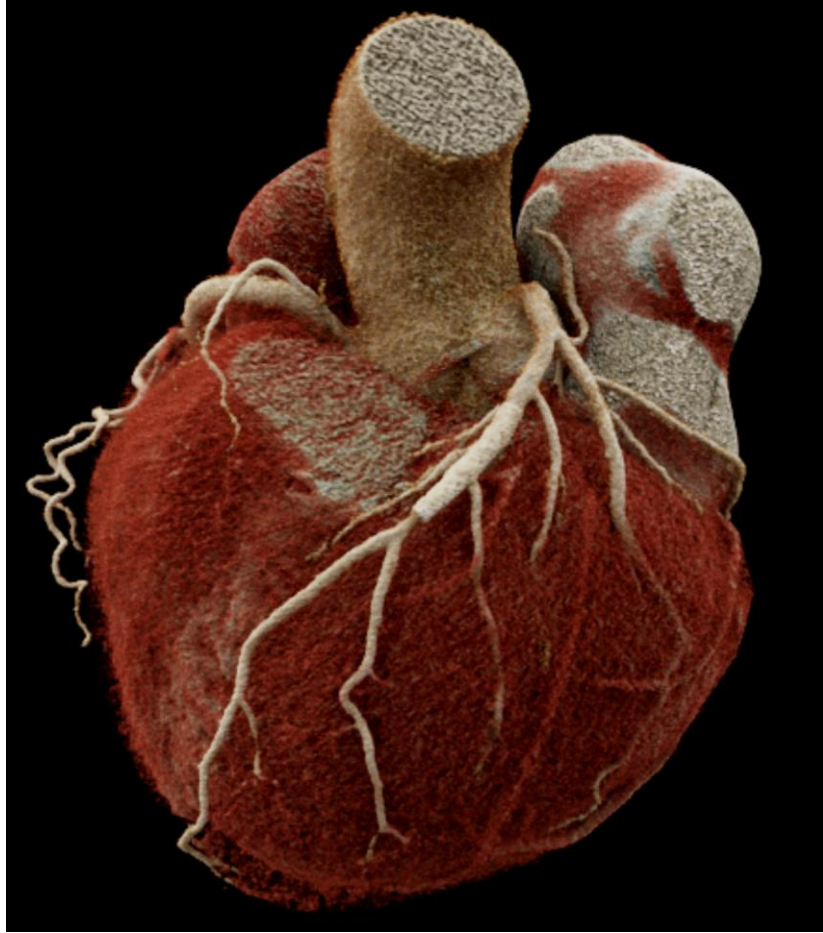


Mitchell et al JACC 2018

Herz CT Zukunft



Herz CT Zukunft



TAVI-CT

Anulus 30.0%

Abstand: 0.0 mm

ID Type	Label	Value
1	Polygon Min. Ø	23.8 mm
	Max. Ø	27.5 mm
	Avg. Ø	25.6 mm
	Area derived Ø	26.1 mm
	Perimeter derived Ø	26.4 mm
	Area	535.5 mm ²
	Perimeter	82.9 mm

Hockey-Puck (MIP) 30.0%

LAO: 108°
Kaudal: 31°

Angio 30.0%

LAO: 10°
Kaudal: 12

Beckenachse re

5.3 mm (16.0 Fr)
Münze Ø

RCA Ostium 30.0%

Basale Ebene

ID Type	Label	Value
1	Gefäßlänge Right Coronary Height	16.5 mm

LM Ostium 30.0%

Basale Ebene

ID Type	Label	Value
1	Gefäßlänge Left Coronary Height	17.0 mm

Beckenübersicht

RAO: 0°
Kaudal: 0°

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Herz MRT: Indikationen

- > LV/RV Volumina, LV Masse, Links-/Rechtsventrikuläre Funktion
- > **KHK: Ischämie, Narben/Viabilität, Thrombus**
- > **Herzmuskelerkrankungen:** Kardiomyopathien (HCM, DCM), Myokarditis, Sarkoidose, Amyloidose, Morbus Fabry, AC, Takotsubo Syndrom
- > Herzklappen: Aortenklappeninsuffizienz
- > Kardiale Tumore
- > Perikarderkrankungen
- > Angeborene Herzfehler: ASD, fehlmündende Pulmonalvenen, Shunt Berechnung
- > Koronaranomalien

Stress-Herz MRT: Was muss ich beachten

- > Keine koffeinhaltigen Getränke/Nahrungsmittel, Theophyllin 12h vor Untersuchung
 - > Kaffee, schwarzen/grünen Tee, Cola, Eistee, Kakao, Schokolade, Energydrinks
- > Stress: Regadenoson/Adenosin, teilweise mit Dobutamin

Einleitung

Die medikamentöse Belastung im kardialen MRI (CMR) wird am häufigsten mit Regadenoson (Rapiscan®) durchgeführt. Regadenoson ist ein selektiver A_{2A}-Adenosinrezeptor Agonist und bewirkt eine koronare Vasodilatation sowie verstärkt den koronaren Blutfluss. Die Affinität für den A₁-Adenosinrezeptor ist gering, sehr geringe oder keine Affinität für den A_{2B}- und A₃-Adenosinrezeptor.

Indikation

Medikamentöse Belastung für Stress CMR

Kontraindikation

- Vorbestehender höhergradiger AV-Block ohne Schrittmacher
- Schwere Hypotonie
- Instabile Angina pectoris
- Dekompensierte Herzinsuffizienz
- Überempfindlichkeit gegenüber Wirkstoff oder Hilfsstoff
- Epilepsie (relative Kontraindikation)

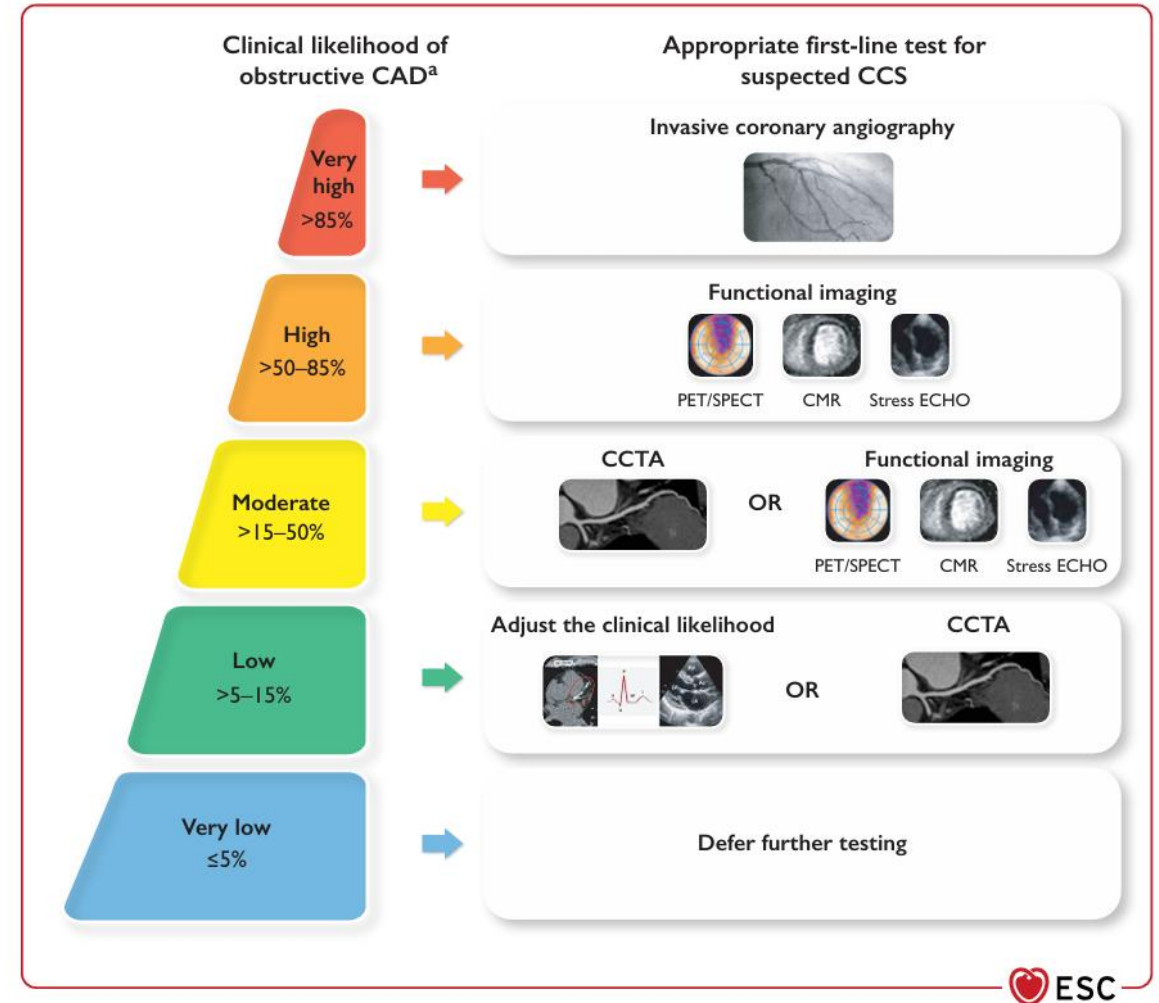
Nebenwirkungen

Thorakaler Druck, Dyspnoe, Flush, Palpitationen, Kopfschmerzen, Bauchschmerzen, epileptischer Anfall, Sinus- und AV-Block, Hypotonie, TIA/Stroke, Bronchokonstriktion

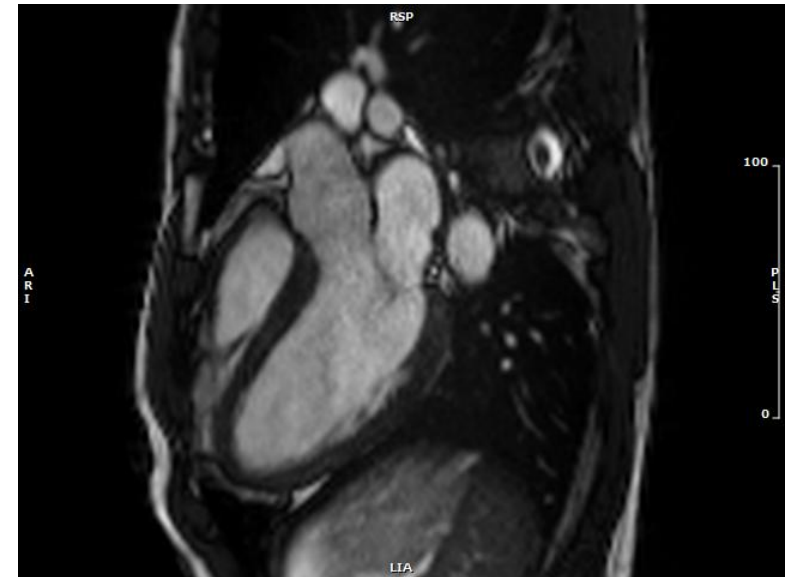
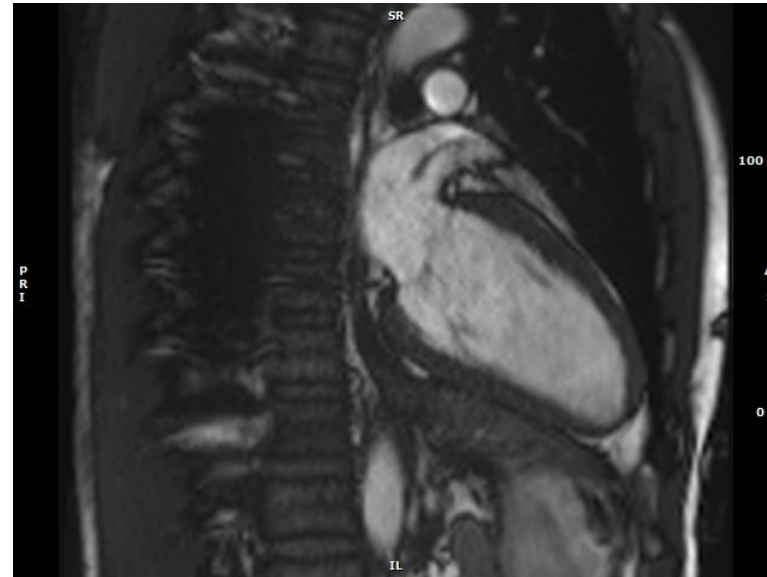
Patientenbeispiel

75-jähriger Patient

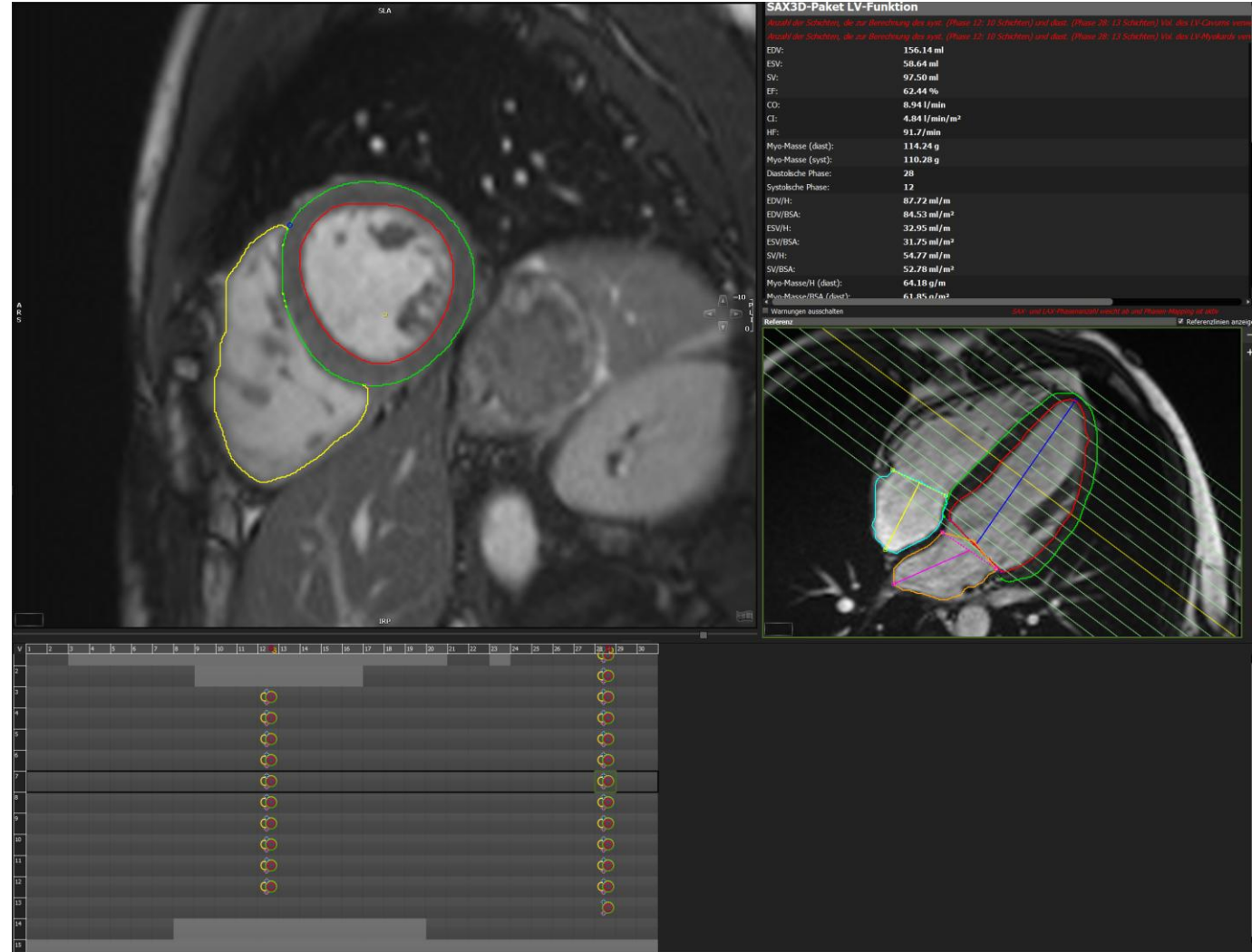
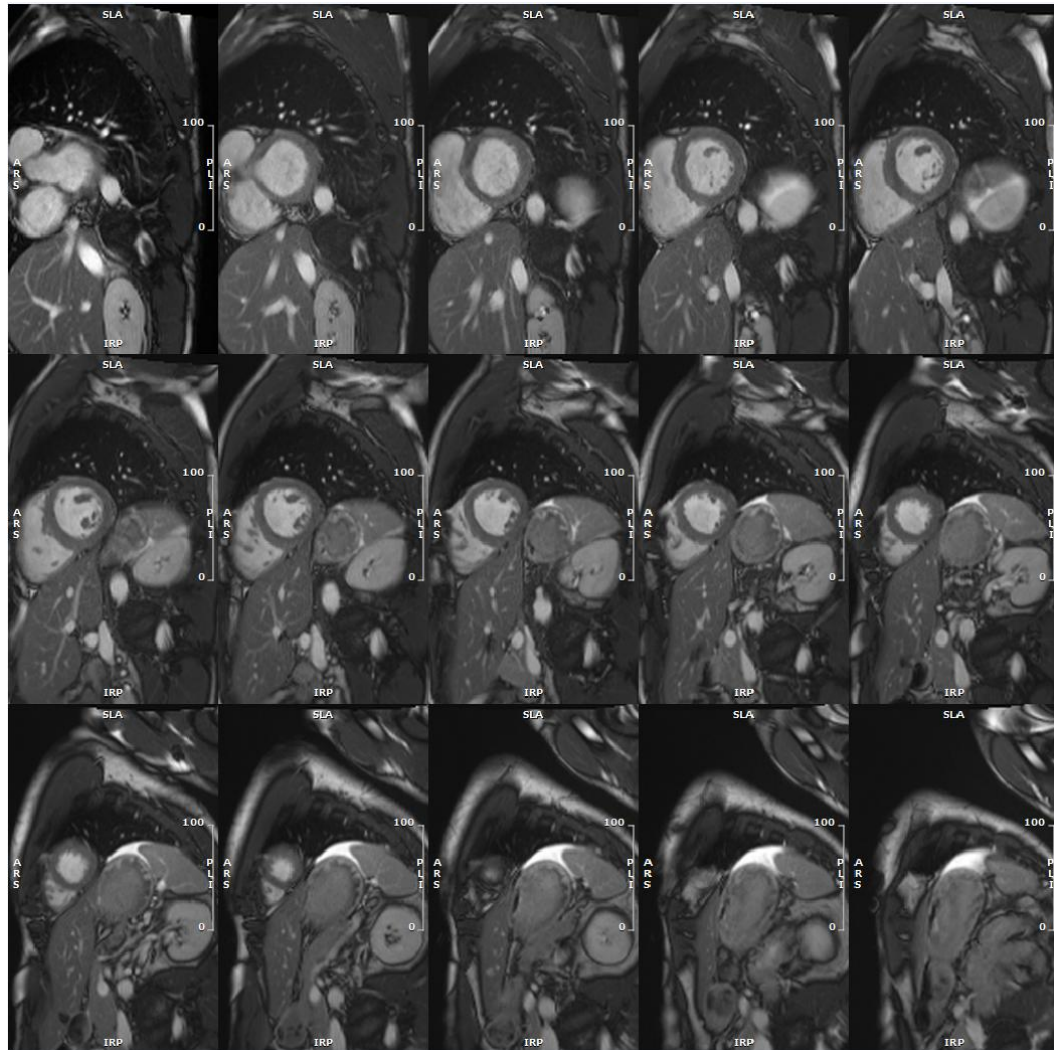
- > Typische Thoraxschmerzen
- > cvRF: Diabetes mellitus, Nikotin
- > EKG, Echokardiographie



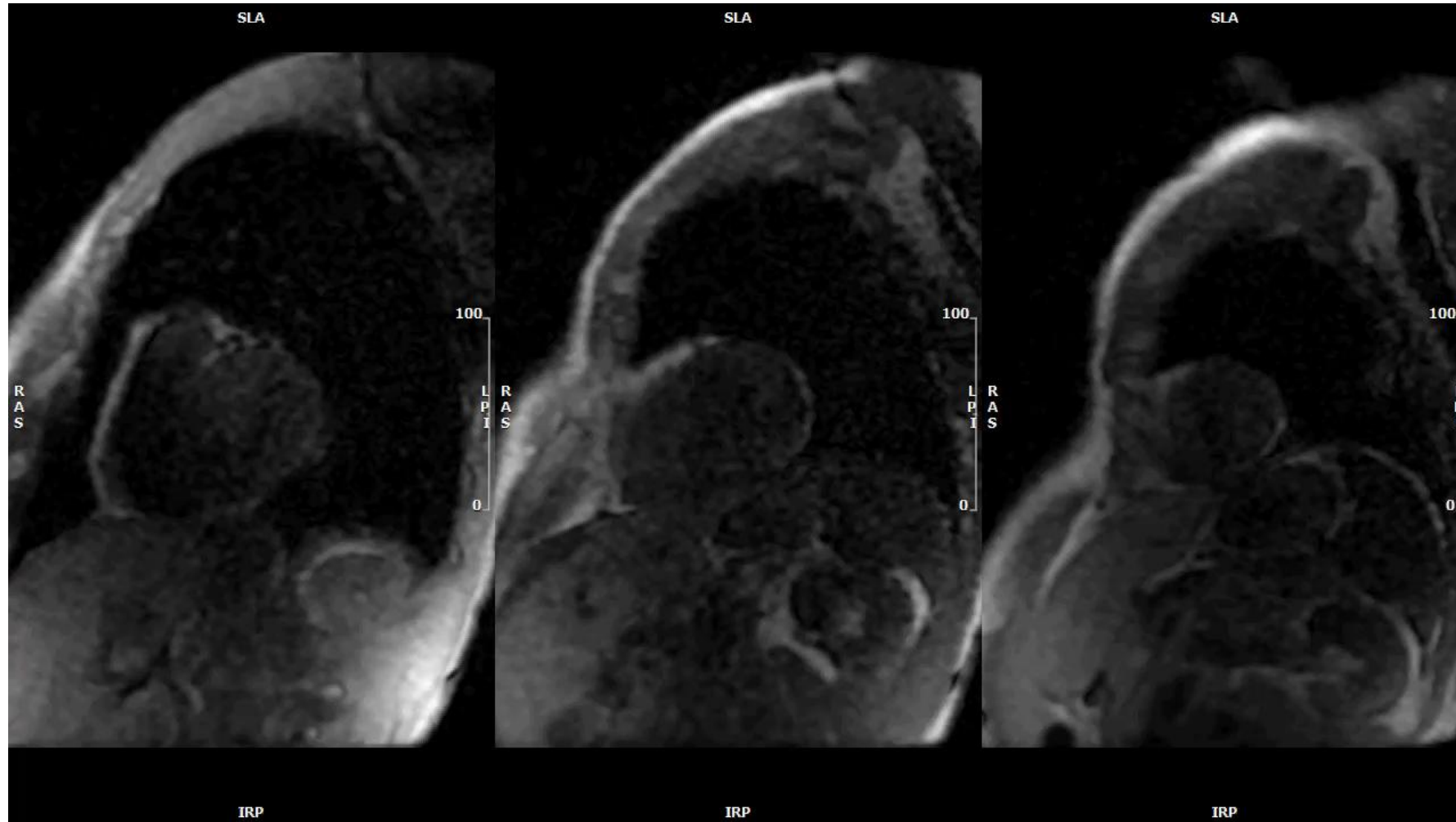
Herz MRT



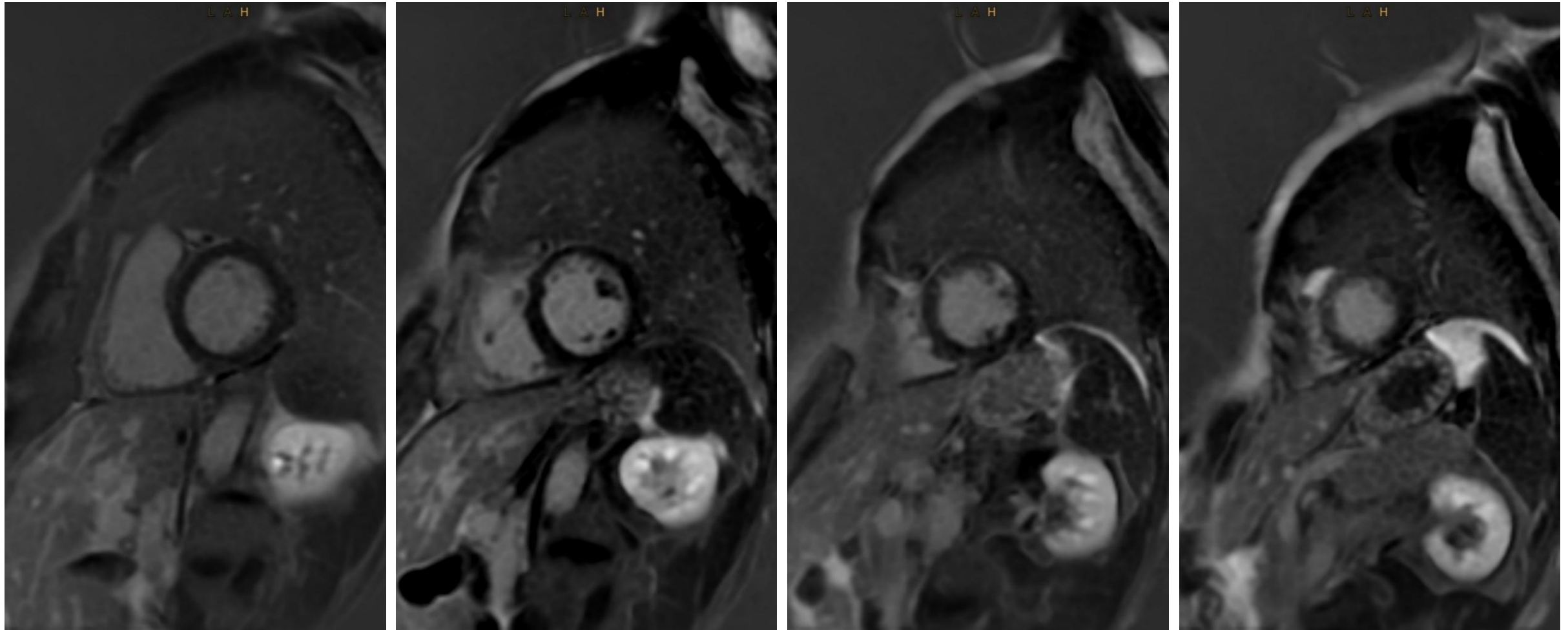
Herz MRT Planung



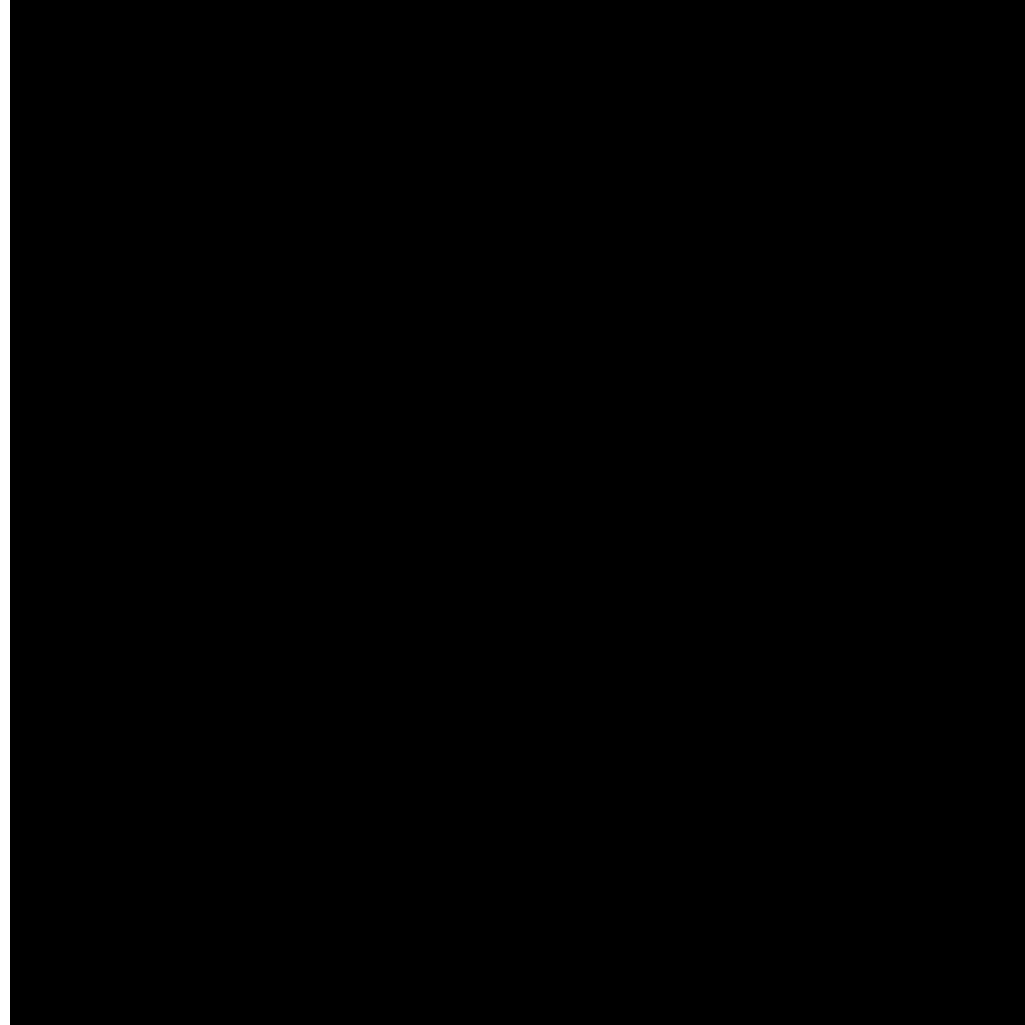
Stress-MRI: Perfusion



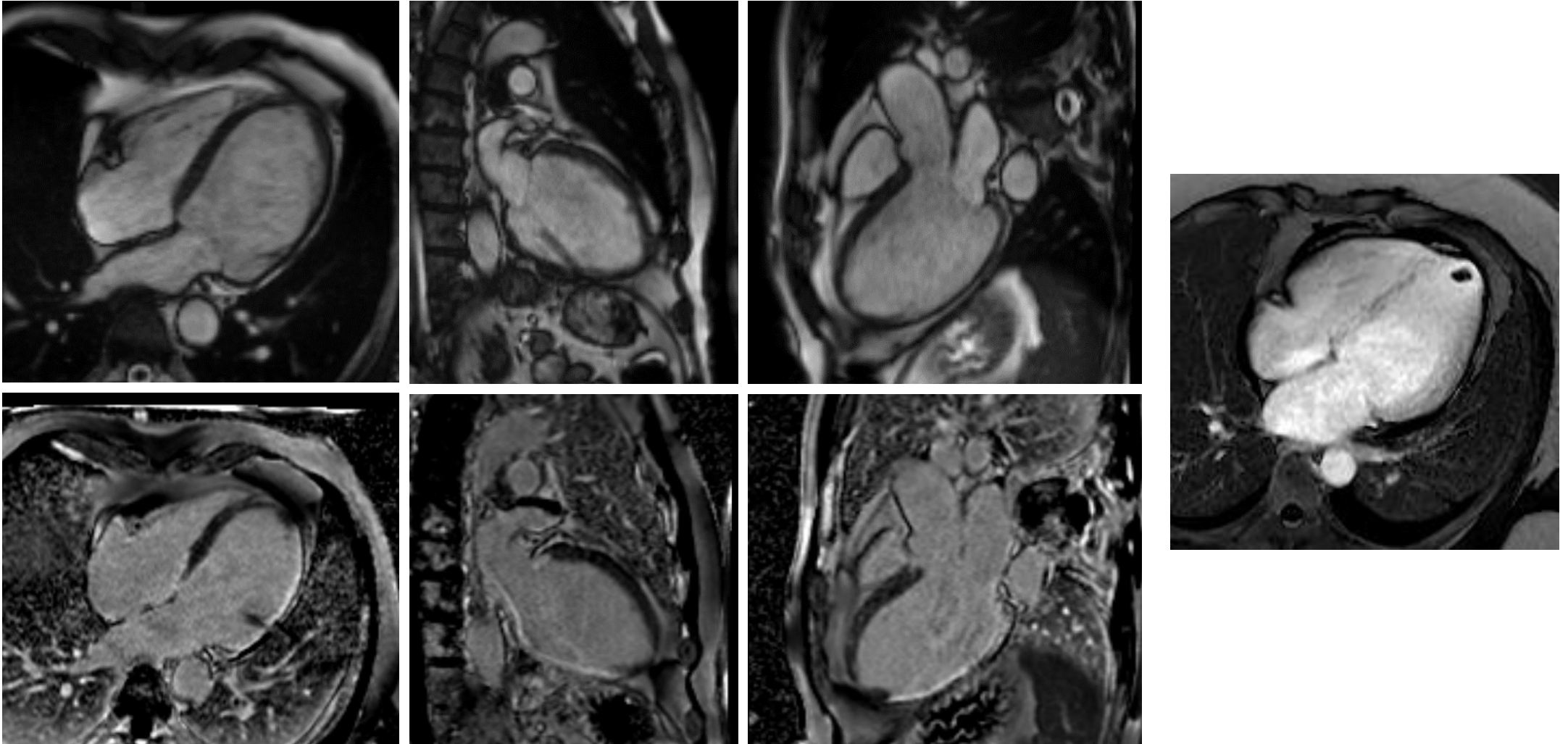
Stress-MRI: Late-Gadolinium Enhancement



Koronarangiographie



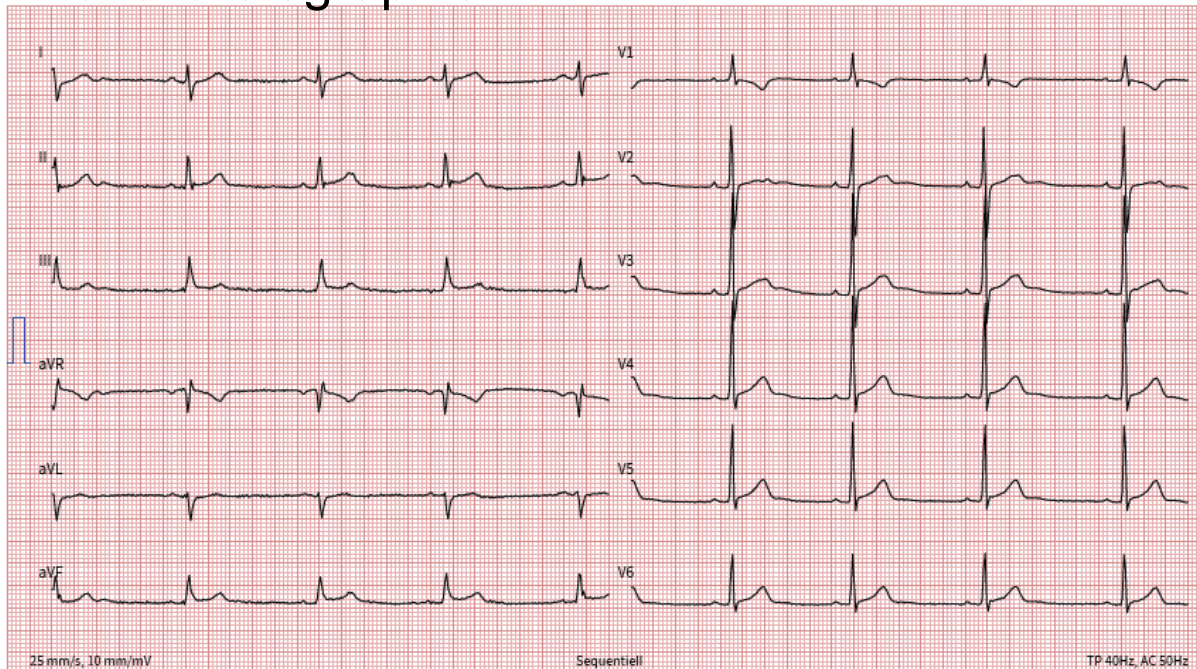
Koronare Herzkrankheit



Patientenbeispiel

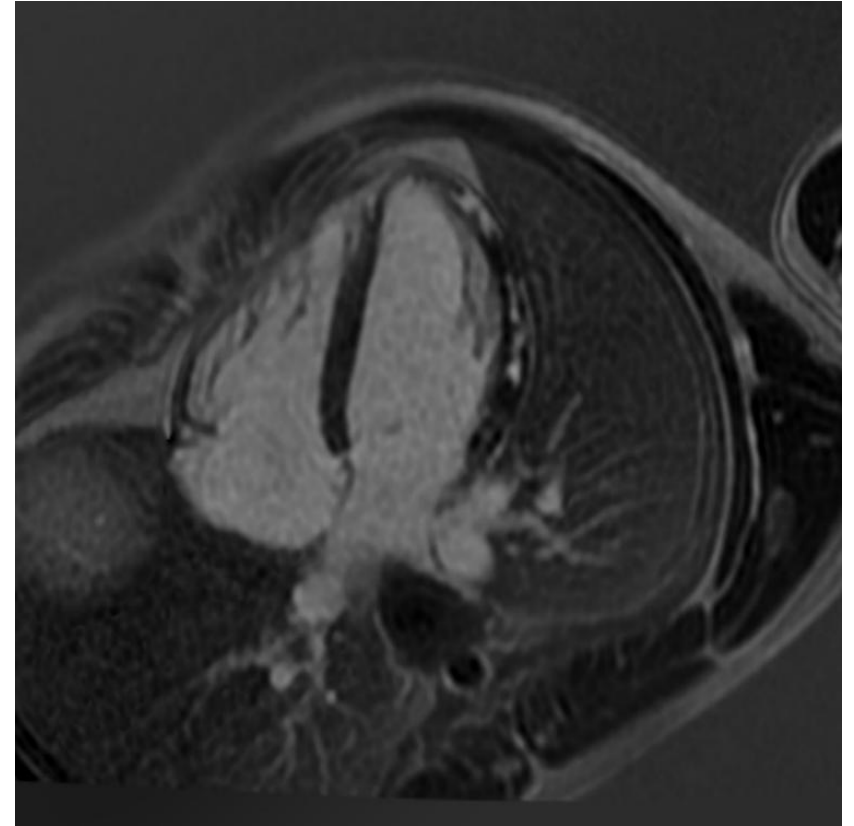
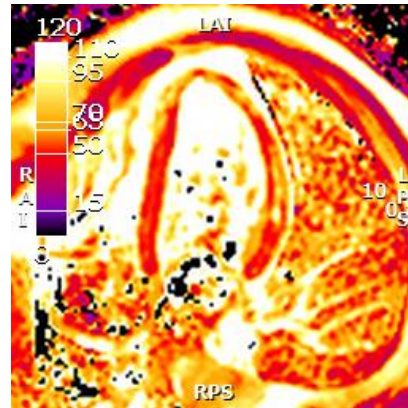
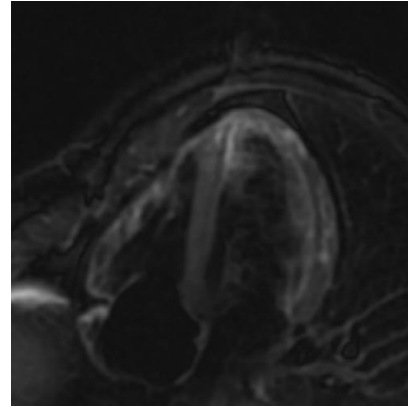
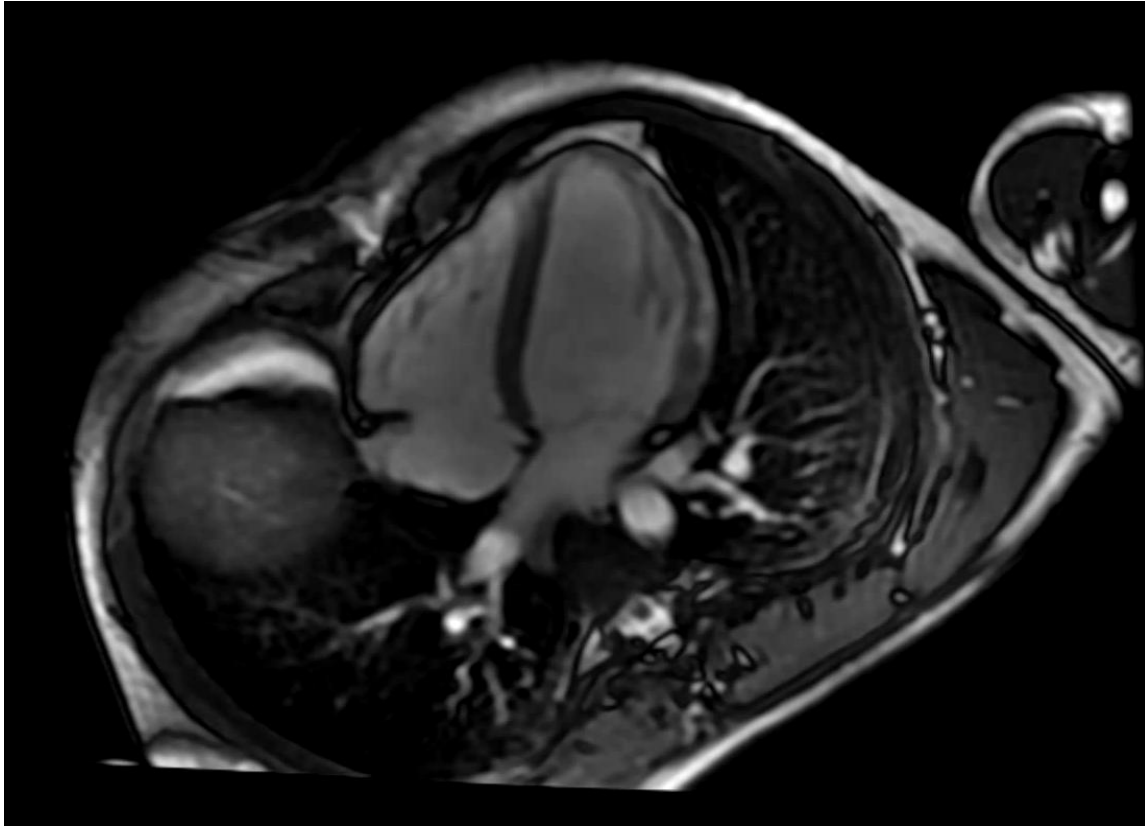
19-jähriger Patient, Notfallstation

- > Thoraxschmerzen
- > Vor 1 Woche erkältet
- > EKG, Labor
- > Echokardiographie



HÄMATOLOGIE					
Hämoglobin	140-180	g/l	156		162
Hämatokrit	0.40-0.52	l/l	0.47		0.49
Erythrozyten	4.30-5.90	tera/l	5.33		5.50
RDW (% Anisozytose)	12-15	%	12		12
MCH	26-34	pg	29		30
MCHC	320-360	g/l	331		334
MCV	82-98	fl	89		88
Leukozyten	4.0-10.0	giga/l	4.0		4.4
Thrombozyten	150-350	giga/l	221		220
Geräte Differenzierung					
gesamt Neutrophile	45.0-75.0	%	43.4 L		48.6
Eosinophile	0.1-5.0	%	2.2		1.1
Basophile	0.0-2.0	%	0.7		0.5
Monozyten	2.0-10.0	%	10.9 H		14.1 H
Lymphozyten	25.0-45.0	%	42.8		35.7
Immature Granulozyten	<1.0	%	0.2		0.2
gesamt Neutrophile	1.80-7.50	giga/l	1.75 L		2.14
Eosinophile	0.02-0.40	giga/l	0.09		0.05
Basophile	0.00-0.20	giga/l	0.03		0.02
Monozyten	0.10-1.00	giga/l	0.44		0.62
Lymphozyten	1.00-4.50	giga/l	1.73		1.57
Immature Granulozyten	<0.10	giga/l	0.01		0.01
GERINNUNG					
Quick		%			100 (1)
INR		Ratio			1.0 (2)
KLINISCHE CHEMIE					
Natrium	136-145	mmol/l			141
Kalium	3.50-5.10	mmol/l			4.04
CRP	<5.0	mg/l			19.7 H
CK gesamt	<190	U/l	69	133	176
hs Troponin T	<17	ng/l	265 H	283 H	256 H
Kreatinin	59-104	µmol/l			78
eGFR (nach CKD-EPI 2021)		ml/min/1.7...			>90
eGFR (nach CKD-EPI 2009)		ml/min/1.7...			>90

Myokarditis



Fallbeispiel Follow Up

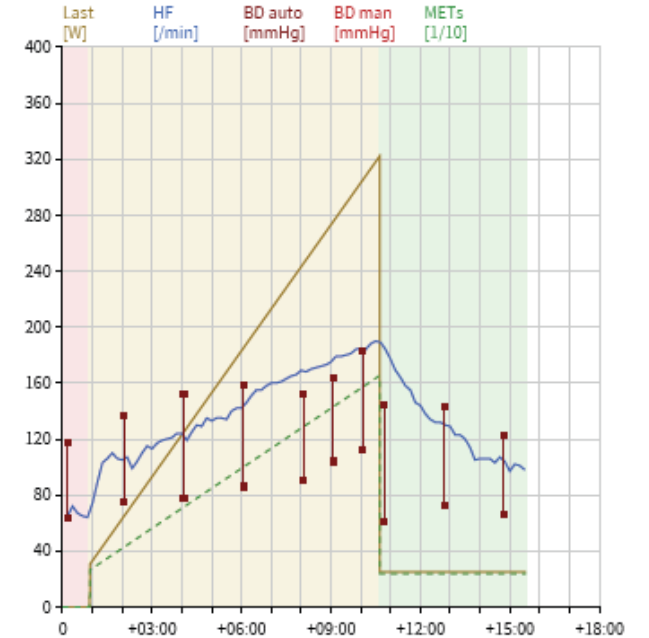


Vorstufe	00:54 min	Max. Last	322 W (145% von 221 W)	Max. HF	190 /min (95% von 200 /min)
Aufwärmen	00:00 min	Max. METs	16.2 (138% von 11.7)	Max. BD	183 / 112 mmHg
Belastung	09:44 min	Leistungsge...	4.5 W/kg	Min. BD x HF	7488 mmHg/min
Erholung	04:54 min			Max. BD x HF	34770 mmHg/min
Gesamt	15:32 min	PWC 130	135 W (1.88 W/kg)	DP-Faktor	4.64
		PWC 150	194 W (2.69 W/kg)		
		PWC 170	256 W (3.56 W/kg)		

Abbruch --

Stufe	Phase [mm:ss]	Last [W]	HF [/min]	BD [mmHg]	J60 I [mm]	J60 I [mV/s]	RPE	Laktat [mmol/l]	VES	SpO2 [%]
Sitzend	00:54	0	64	117/64	0.3	0.6	--	--	--	--
Belastung 1	01:00	60	106	--	0.4	0.6	--	--	--	--
Belastung 2	02:00	90	115	137/75	0.3	0.5	--	--	--	--
Belastung 3	03:00	120	124	--	0.3	0.4	--	--	--	--
Belastung 4	04:00	150	135	152/78	0.2	0.4	--	--	--	--
Belastung 5	05:00	180	142	--	0.1	0.3	--	--	--	--
Belastung 6	06:00	210	158	159/86	0.3	0.3	--	--	--	--
Belastung 7	07:00	240	166	--	0.3	0.7	--	--	--	--
Belastung 8	08:00	270	173	152/90	0.4	0.9	--	--	--	--
Belastung 9	09:00	300	184	164/104	0.4	0.9	--	--	--	--
Belastung 10	09:44	322	190	183/112	0.5	1.0	--	--	--	--
Erholung 1	01:00	25	158	144/61	0.9	1.5	--	--	--	--
Erholung 2	02:00	25	132	--	0.7	1.1	--	--	--	--
Erholung 3	03:00	25	120	143/73	0.5	0.7	--	--	--	--
Erholung 4	04:00	25	103	--	0.3	0.5	--	--	--	--
Testende	04:54	25	98	123/66	0.2	0.4	--	--	--	--

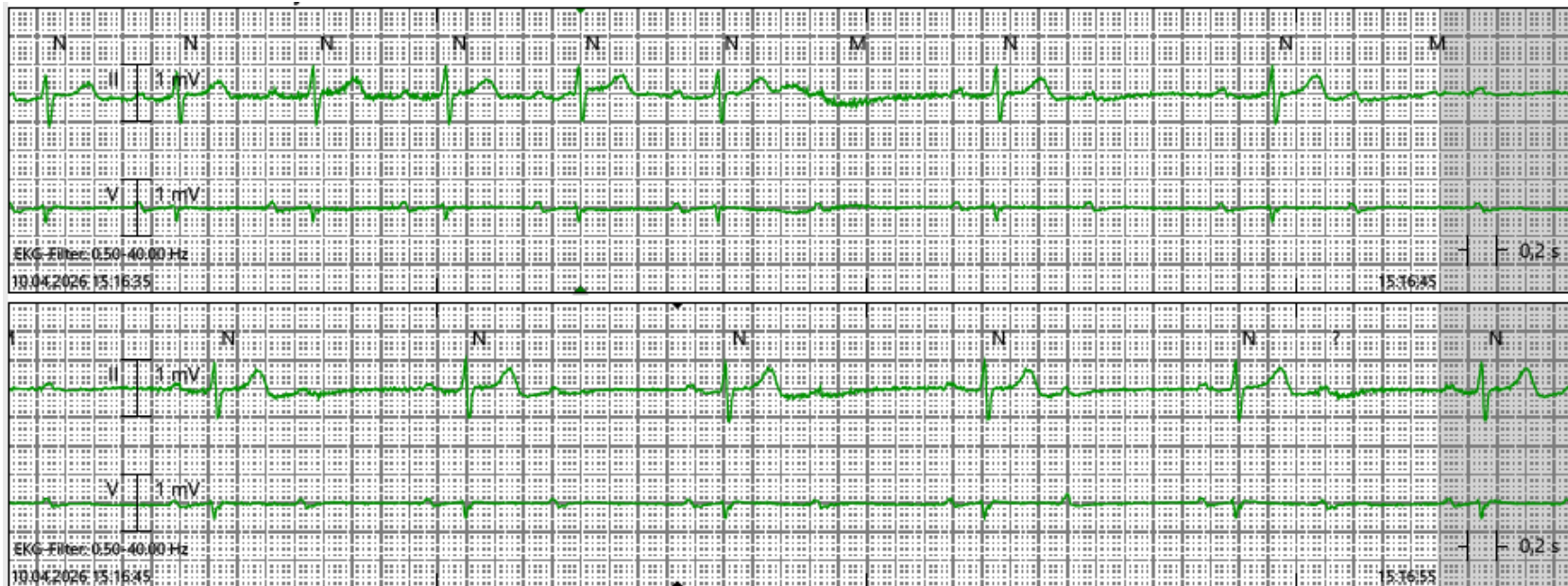
STmax (V2) -0.6 mm | -0.2 mV/s @ +10:00



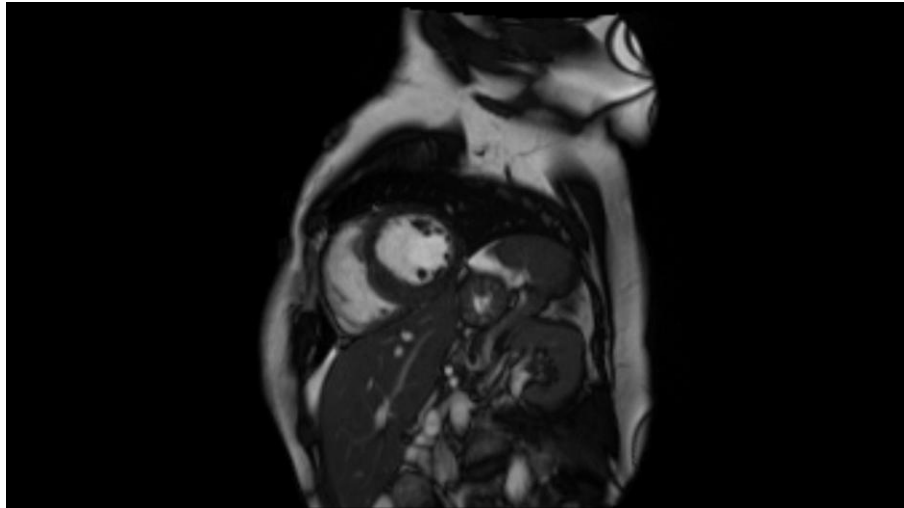
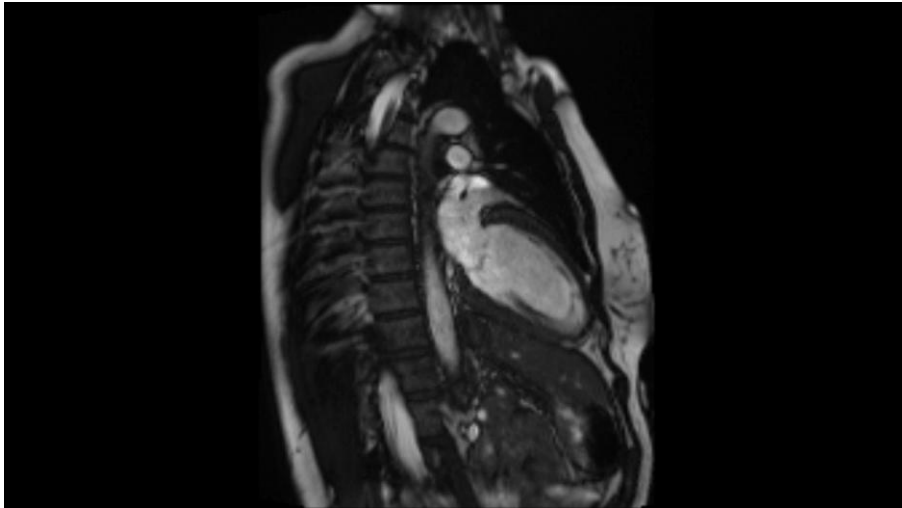
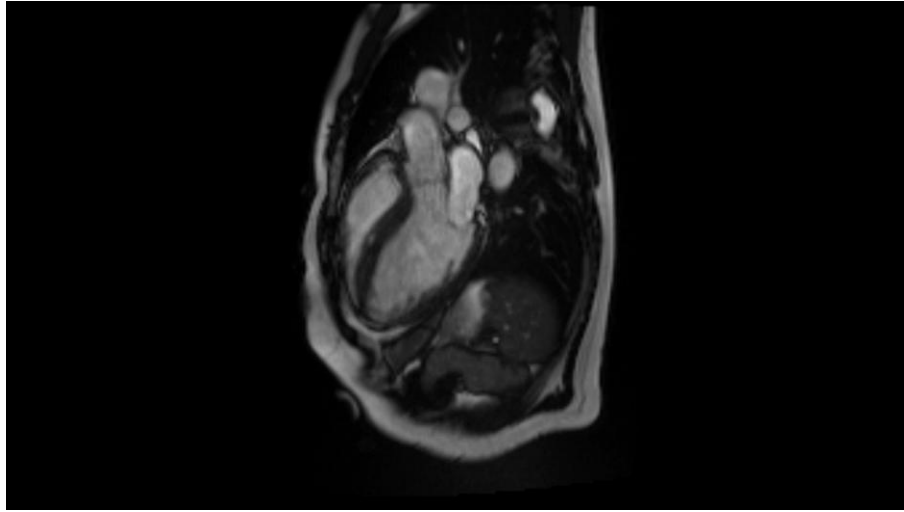
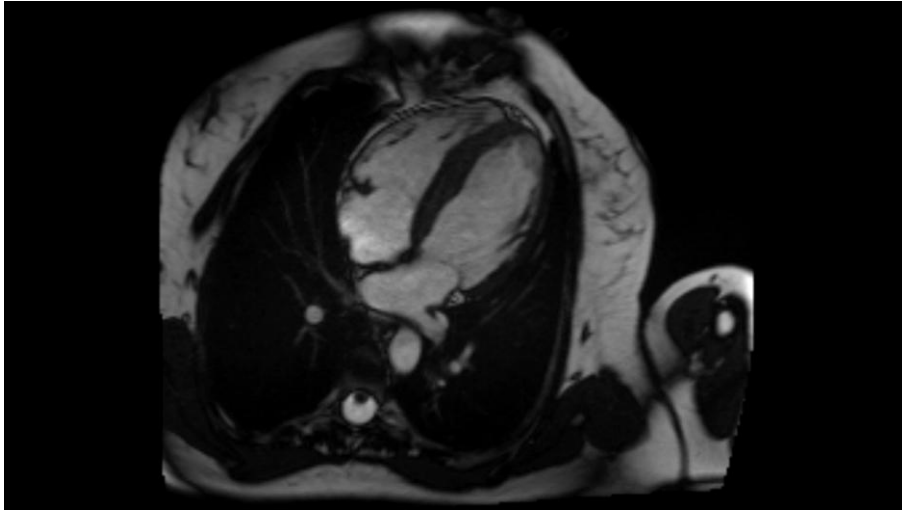
Patientenbeispiel

59-jährige Patientin, Sprechstunde

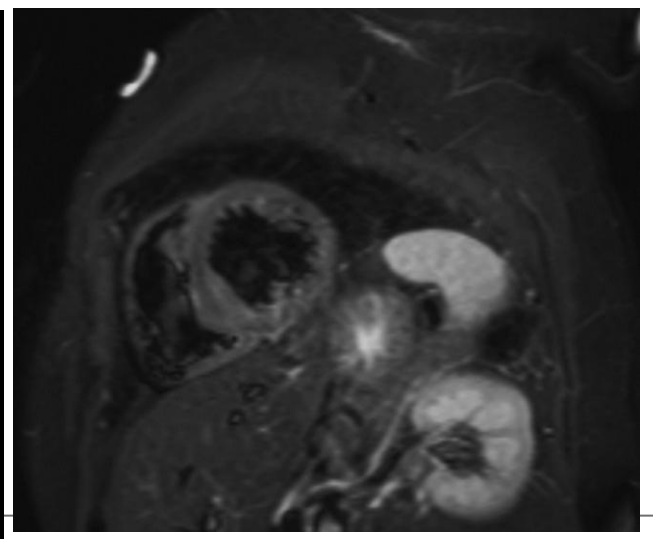
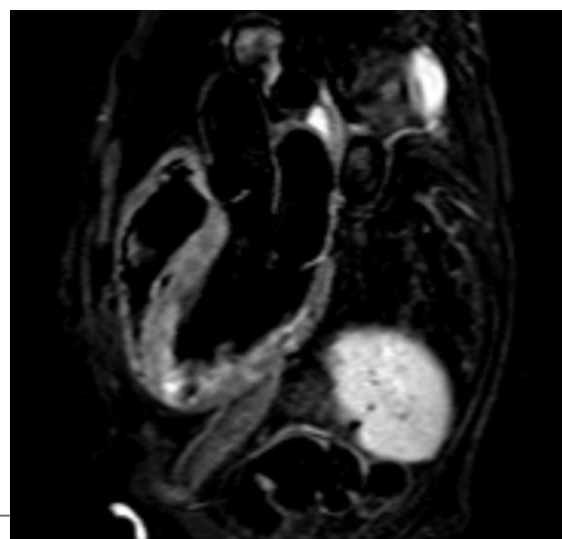
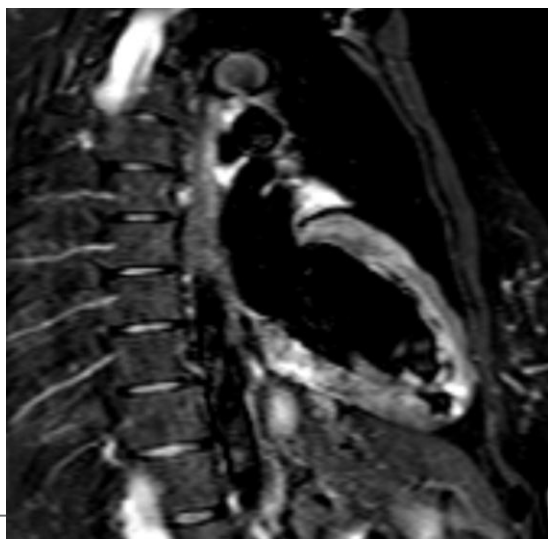
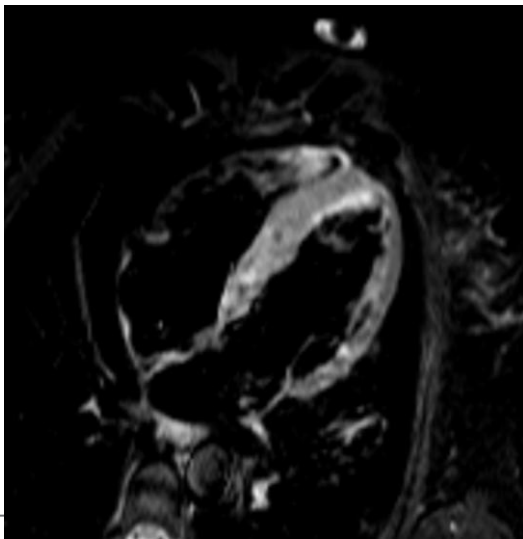
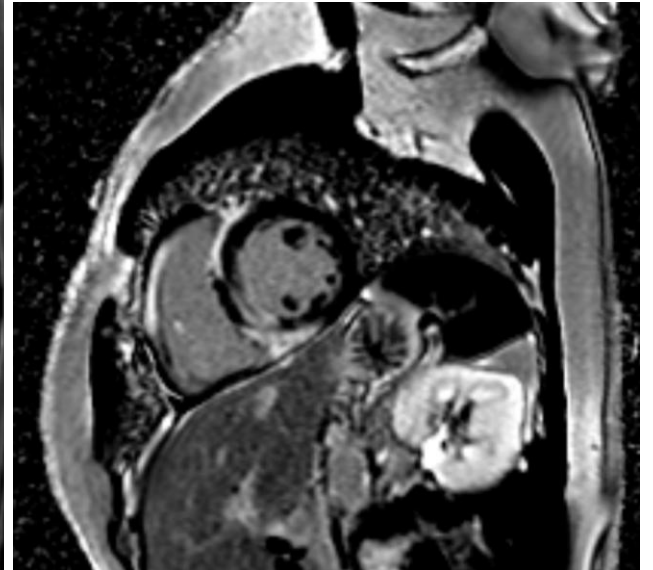
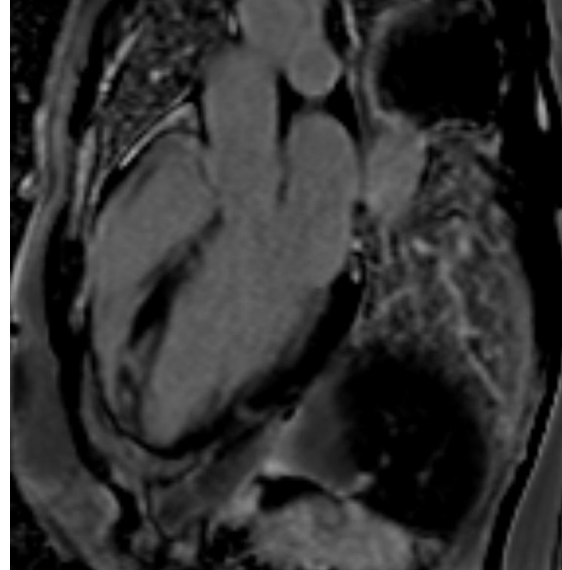
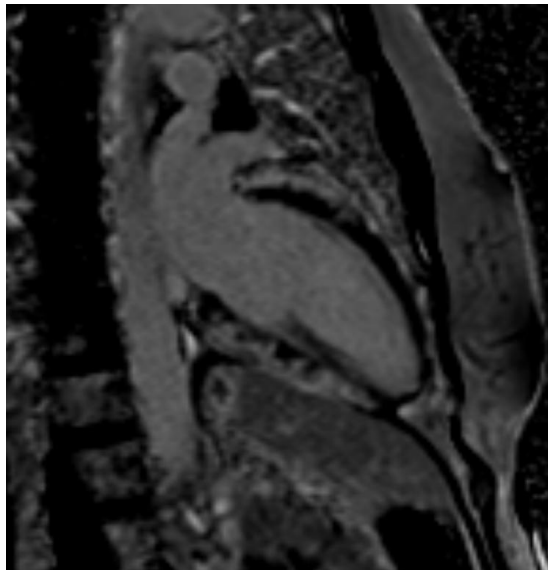
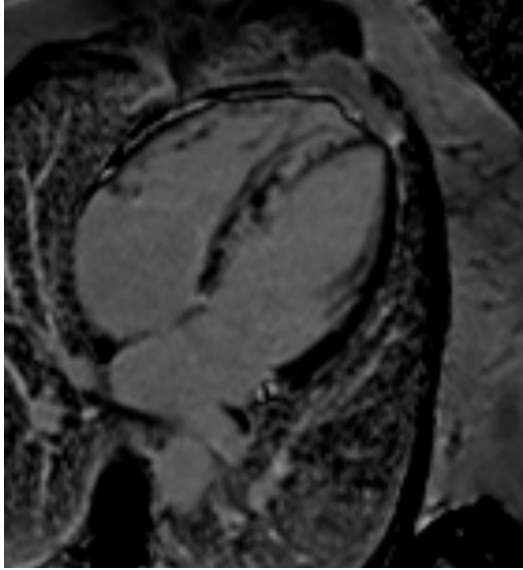
- > Immer wieder Schwindel, Synkopen
- > EKG, Langzeit-EKG, Echokardiographie



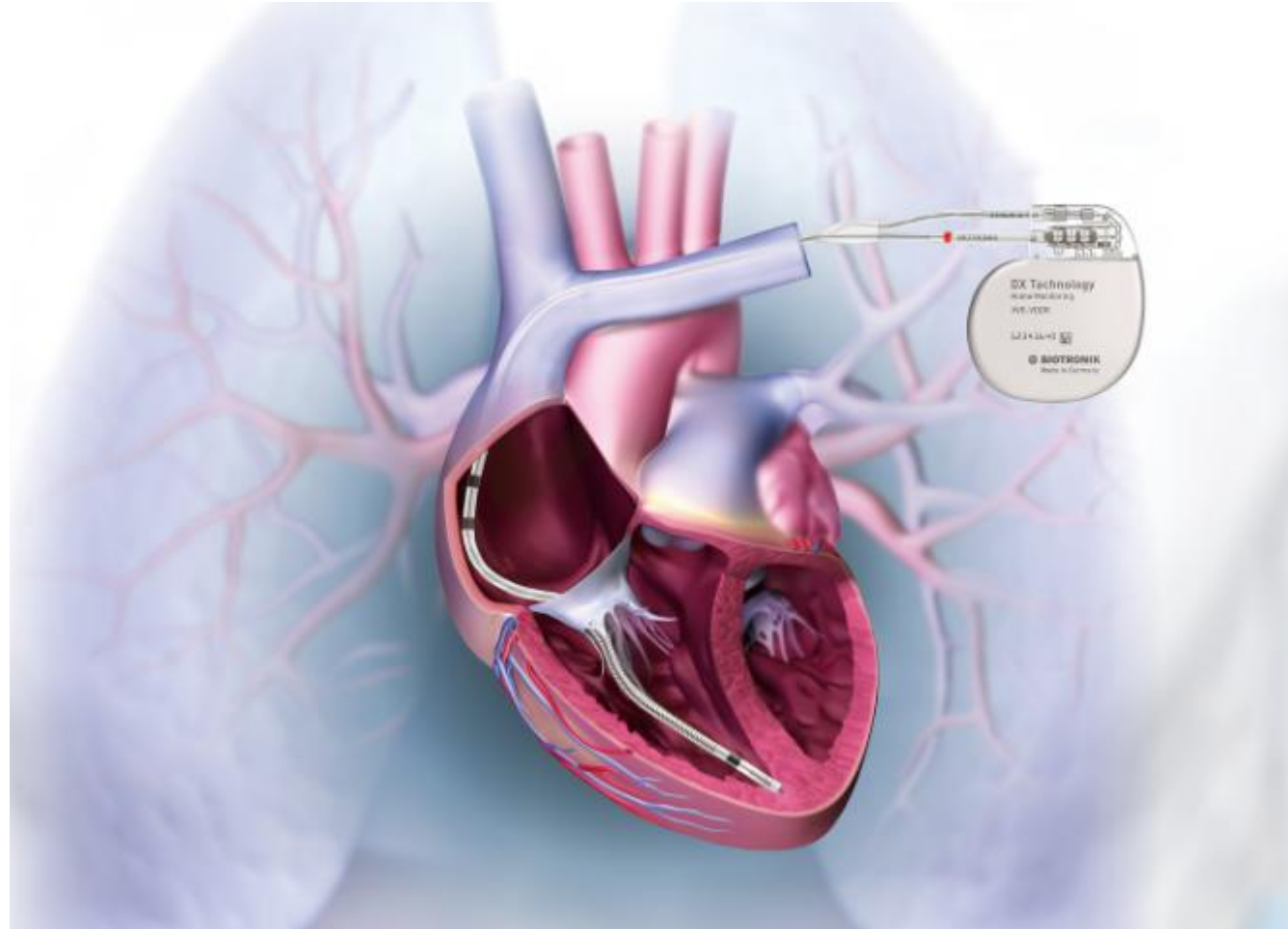
Patientenbeispiel



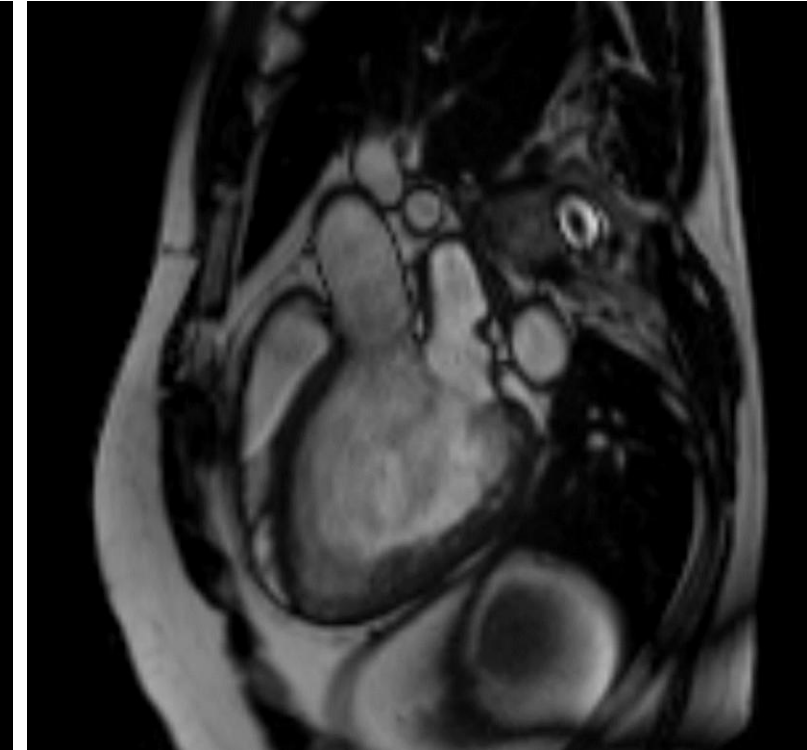
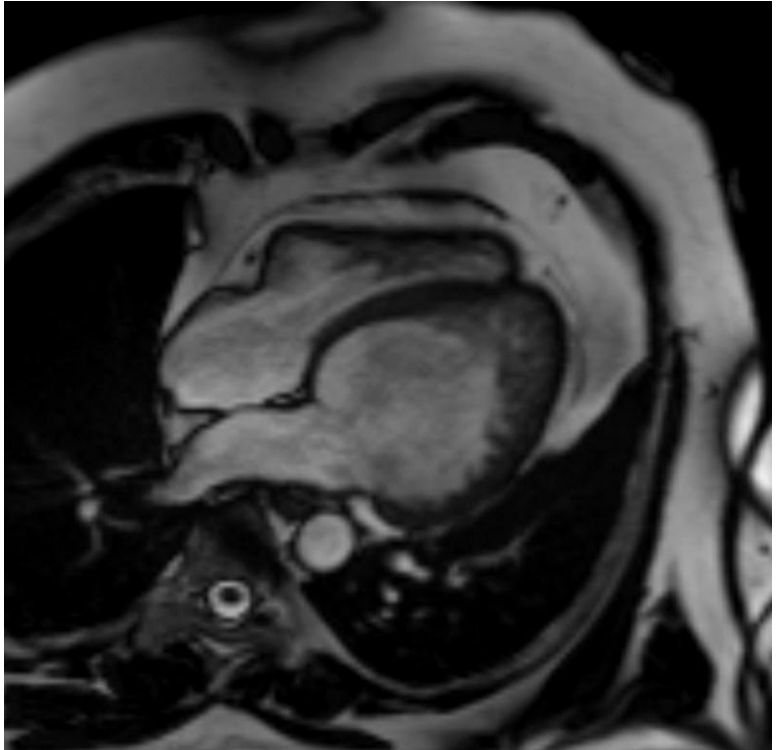
Sarkoidose



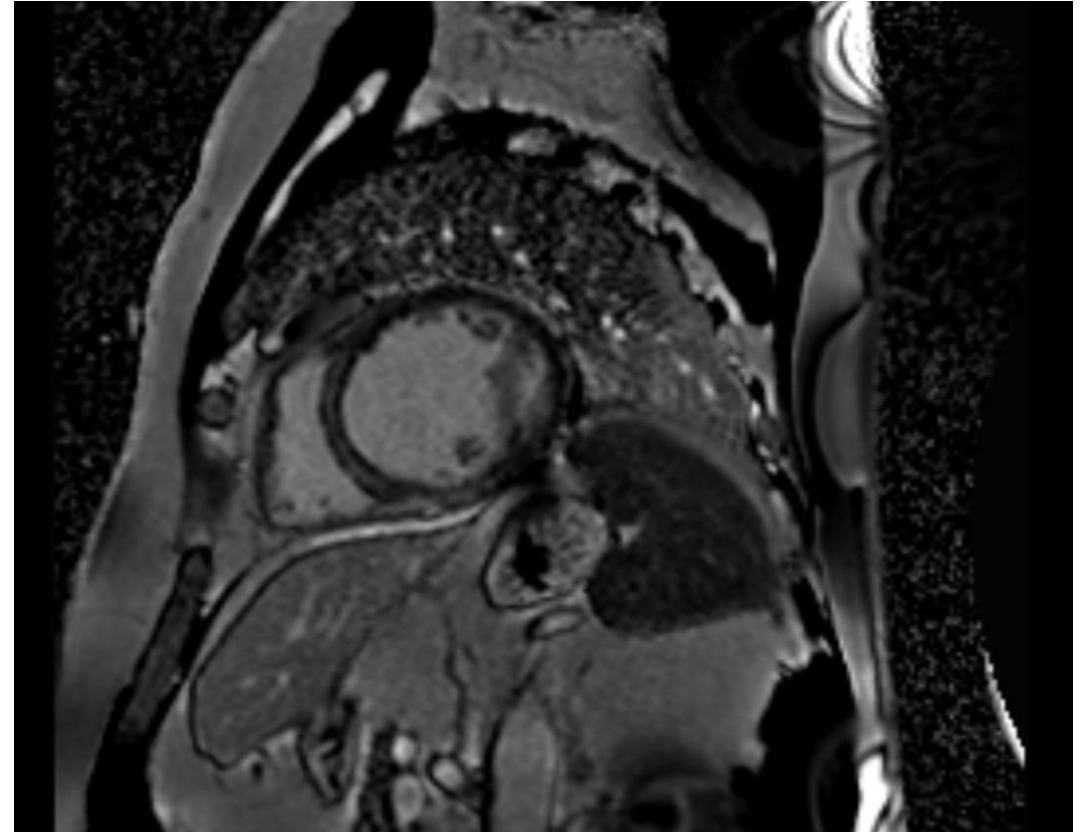
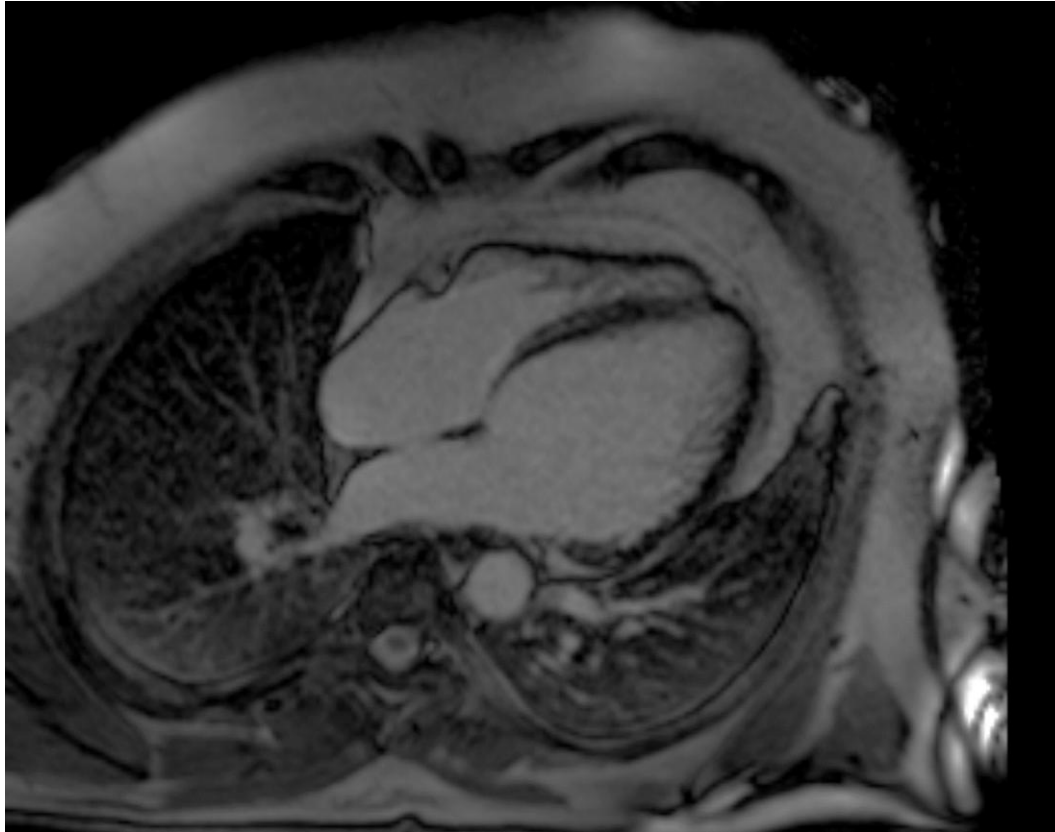
ICD-Implantation



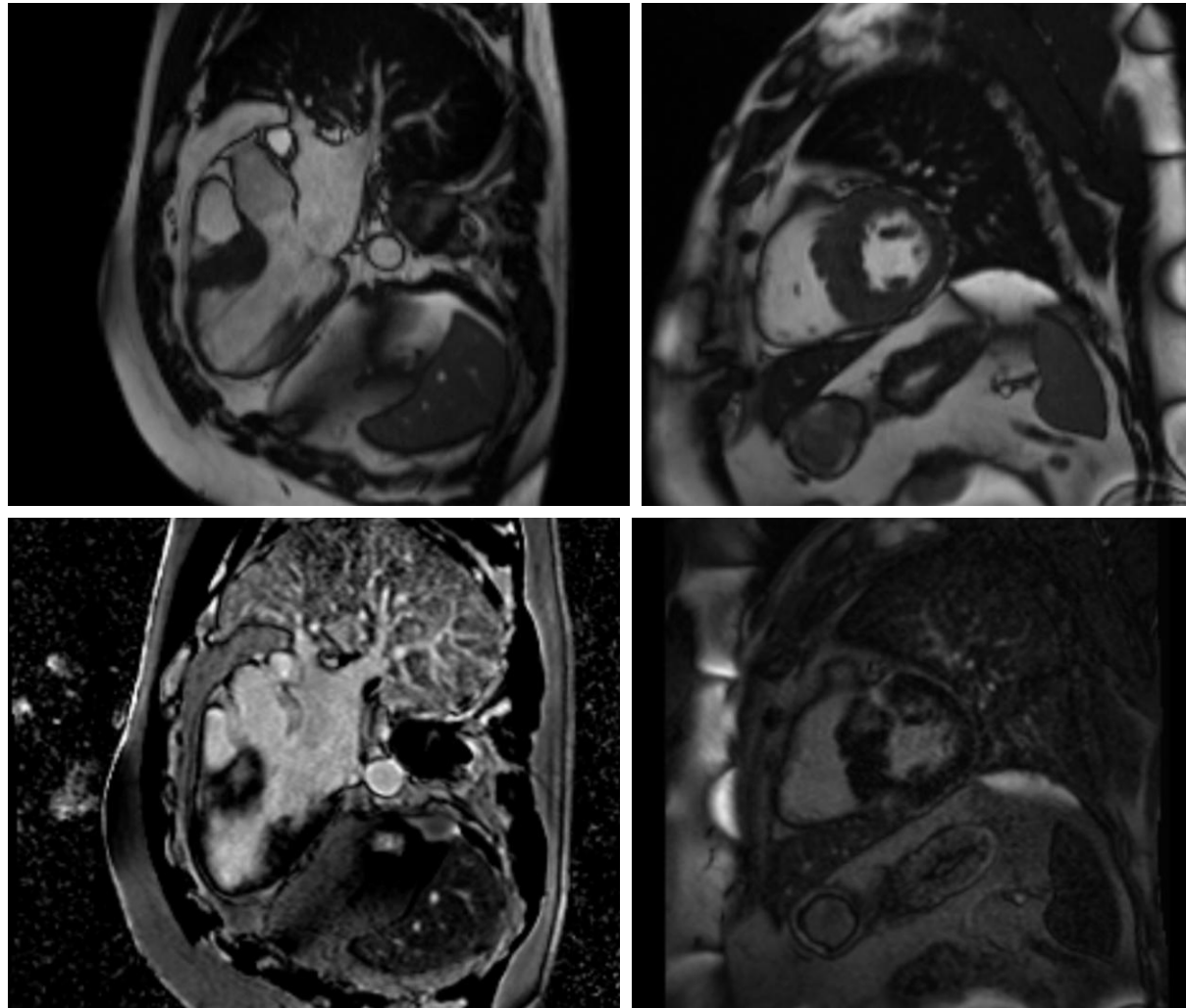
Dilatative Kardiomyopathie



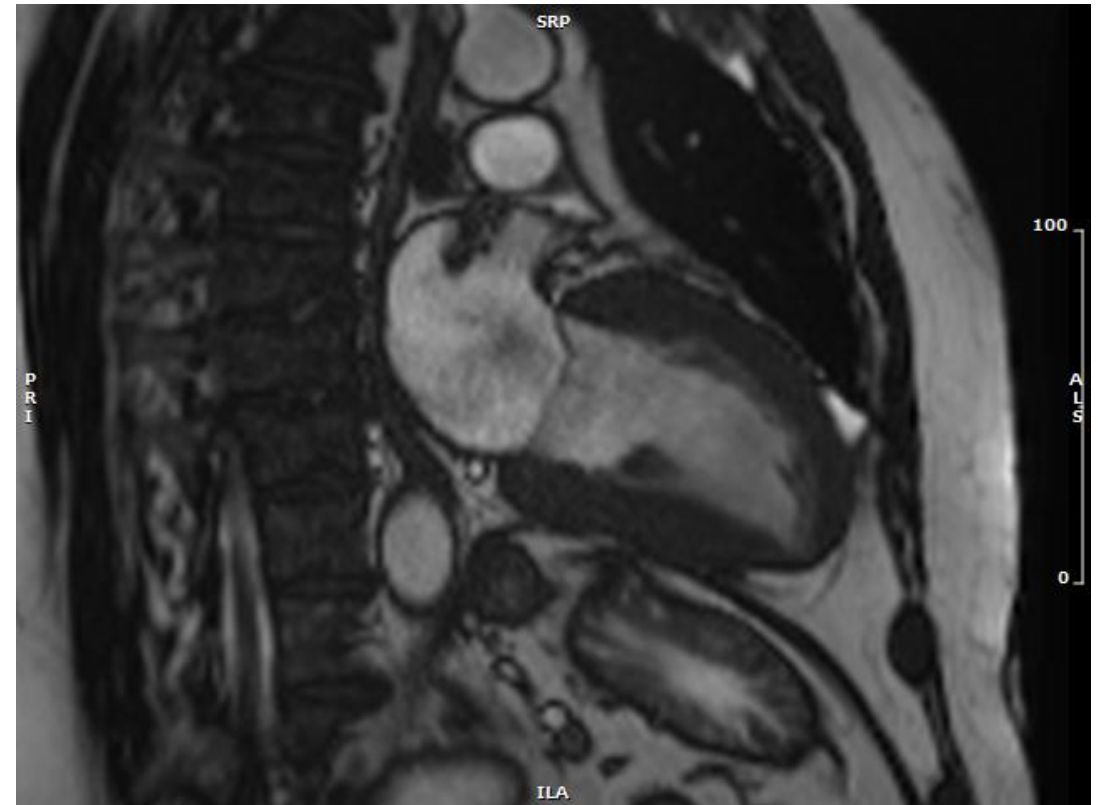
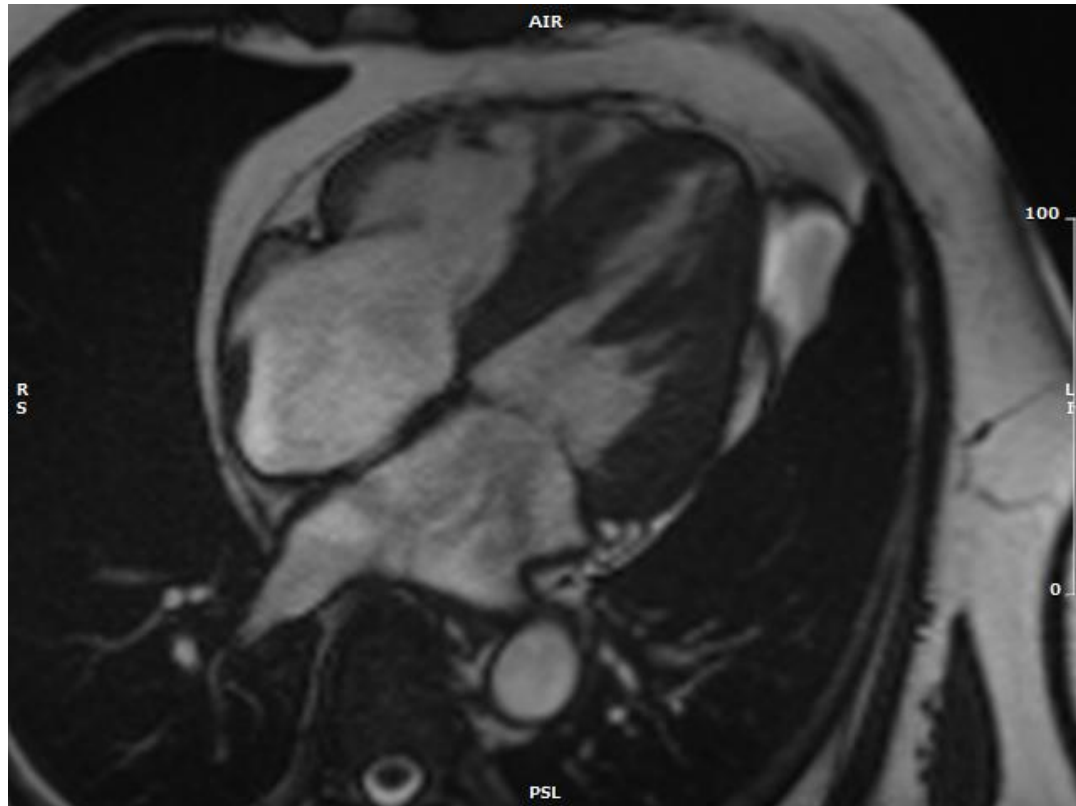
Dilatative Kardiomyopathie LGE



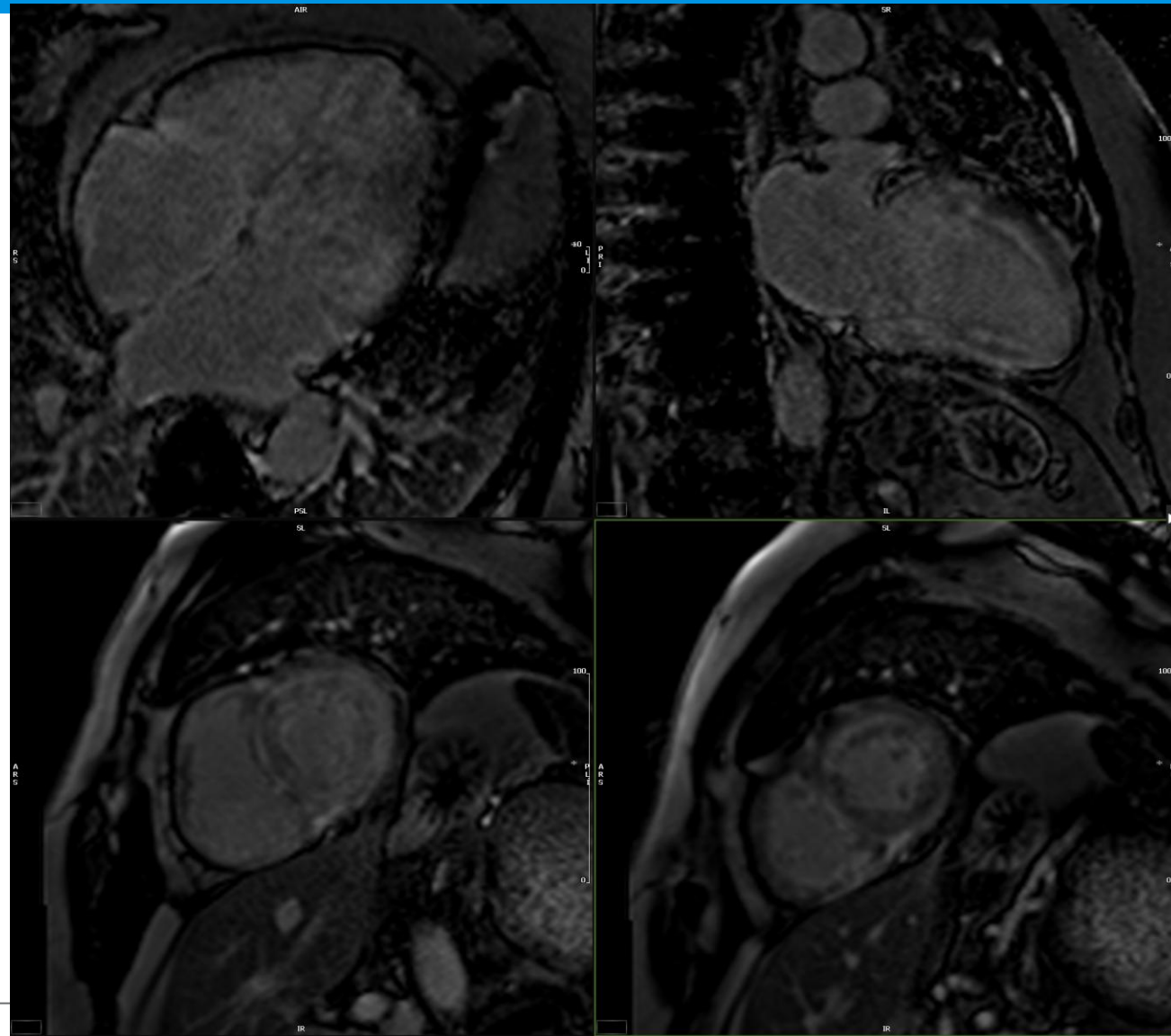
Hypertrophe Kardiomyopathie



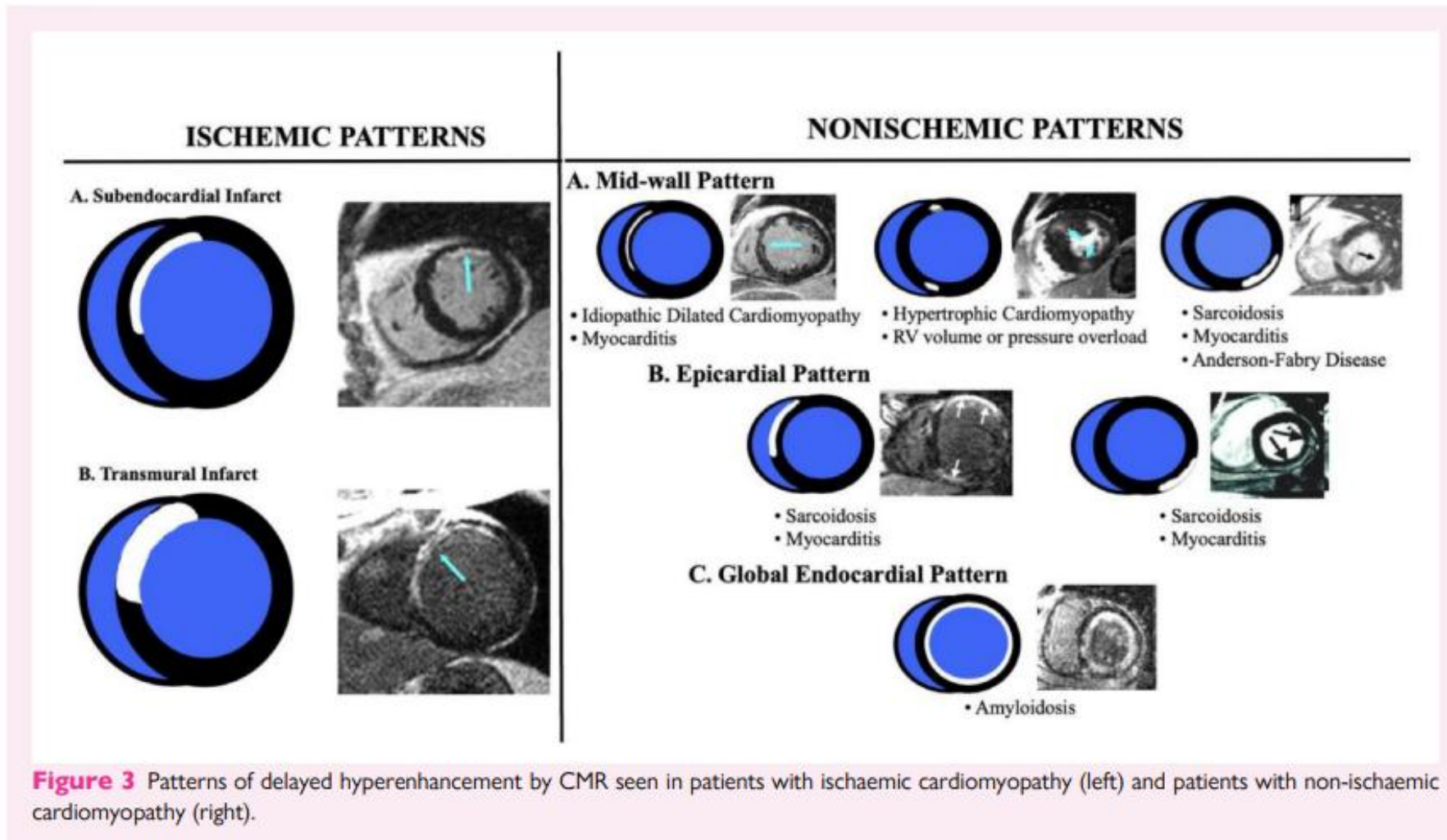
Amyloidose



Amyloidose LGE



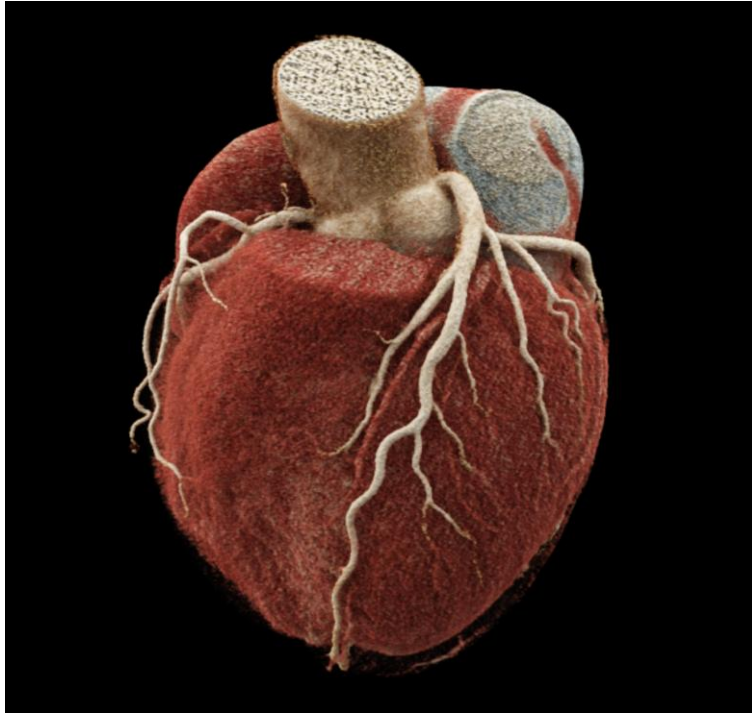
LGE Übersicht



TAKE HOME MESSAGES

Take Home Messages

- > Herz CT:
 - > Indikationen: Ausschluss KHK, Planung Operation/Intervention
 - > Gute Patientenvorbereitung, gute Bildqualität
 - > Calciumscore 0: Exzellente Prognose
 - > Je stärkere Verkalkungen der Koronararterien desto schlechtere Prognose
- > Herz MRT:
 - > Indikationen: Bekannte KHK, hohe Wahrscheinlichkeit KHK, Herzmuskelerkrankungen
 - > Je mehr LGE/Narben, desto schlechter Prognose
- > Herz CT und MRT wichtig für Abklärung und optimale Therapie kardiologischer Patienten



VIELEN DANK FÜR DIE AUFMERKSAMKEIT