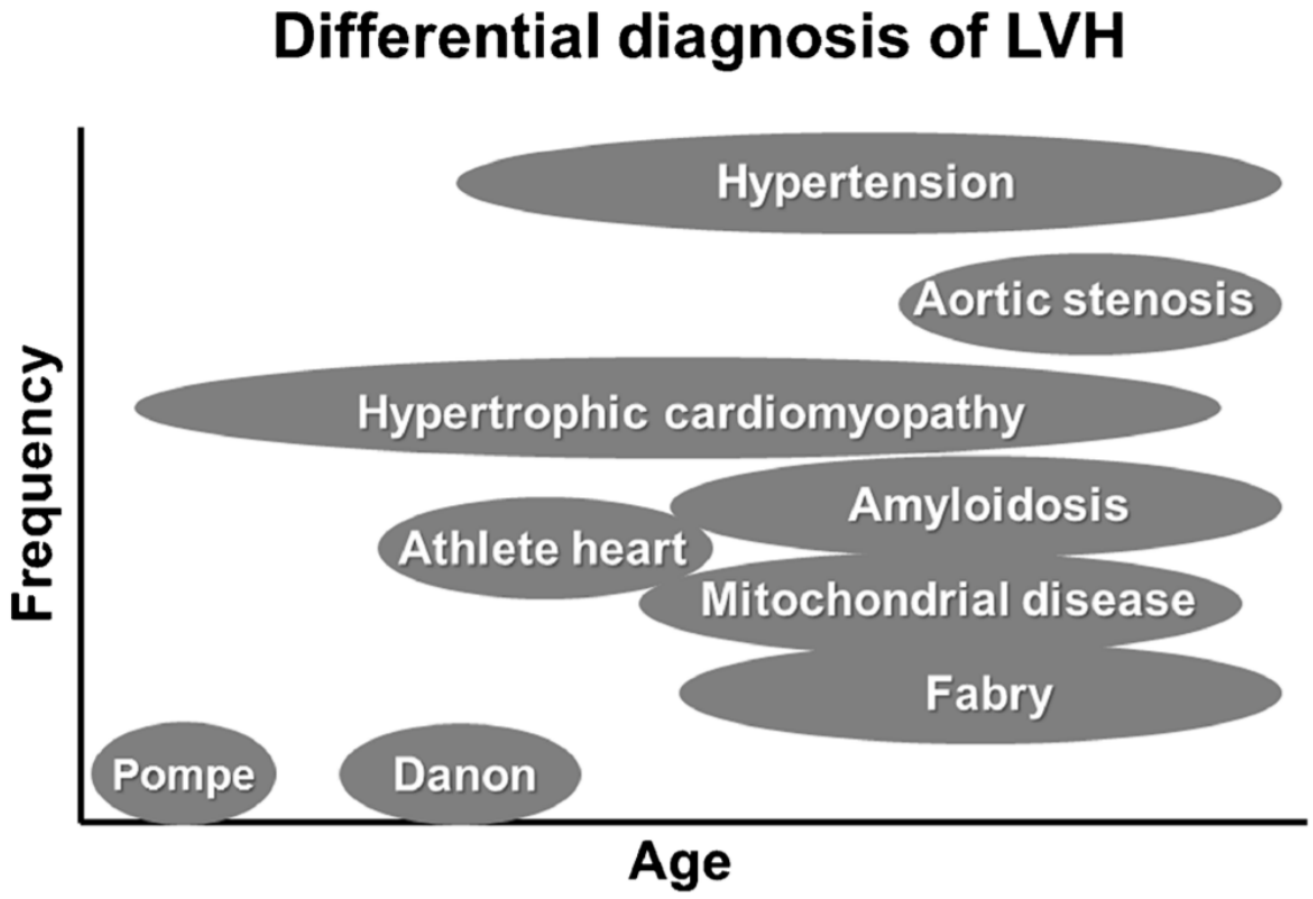
Linksventrikuläre Hypertrophie

Prof. Frank R. Heinzel

Städtisches Klinikum Dresden



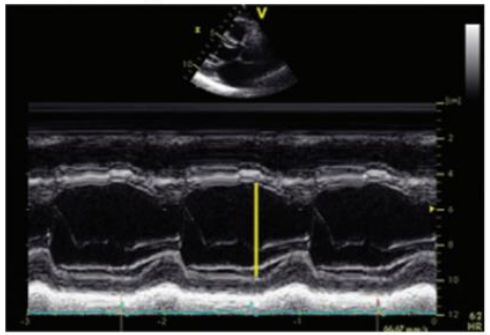
Kubo & Kitaoka. 2017. Curr Cardiol Rep 19: 65

LV Masse

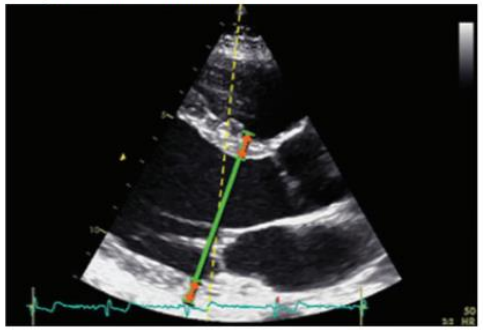
Parasternale Längsachsenansicht

- senkrecht zur LV Längsachse
- gemessen auf Höhe der Mitralklappensegel-Spitzen
- Messung zwischen Myokardwand und Lumen
- sowie an der Schnittstelle zwischen Wand und Perikard (orange Pfeile).

M-mode tracing

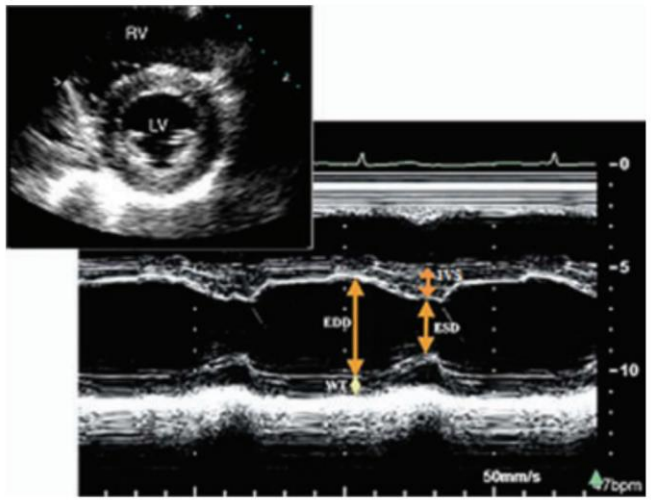


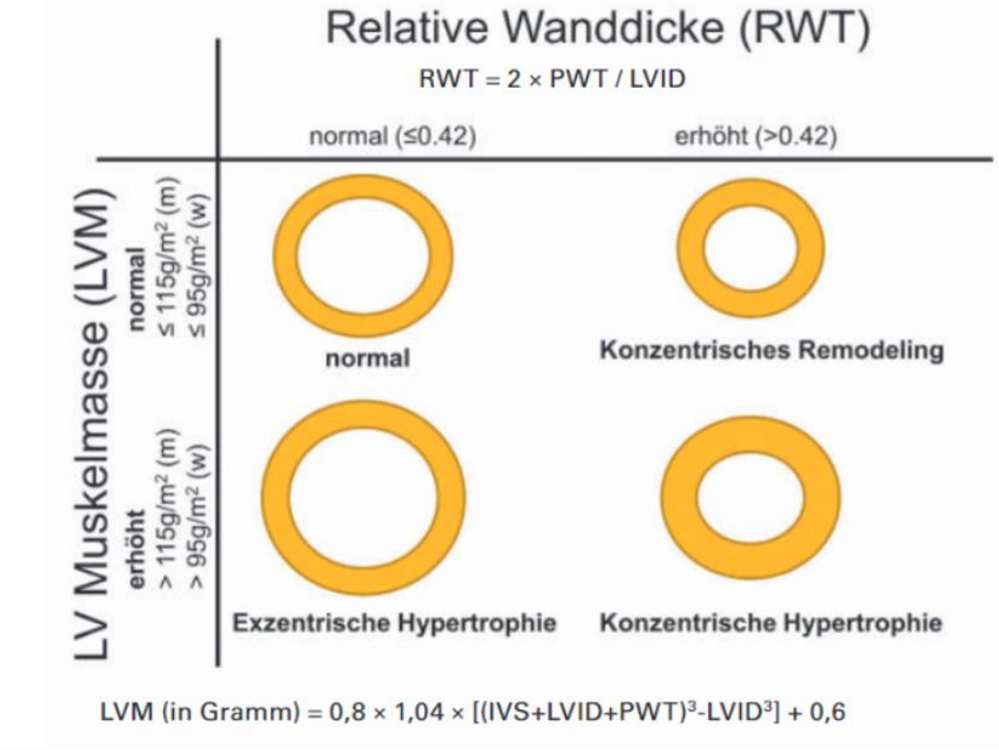
2D-guided linear measurements



Parasternal kurze Achse

M-mode tracing

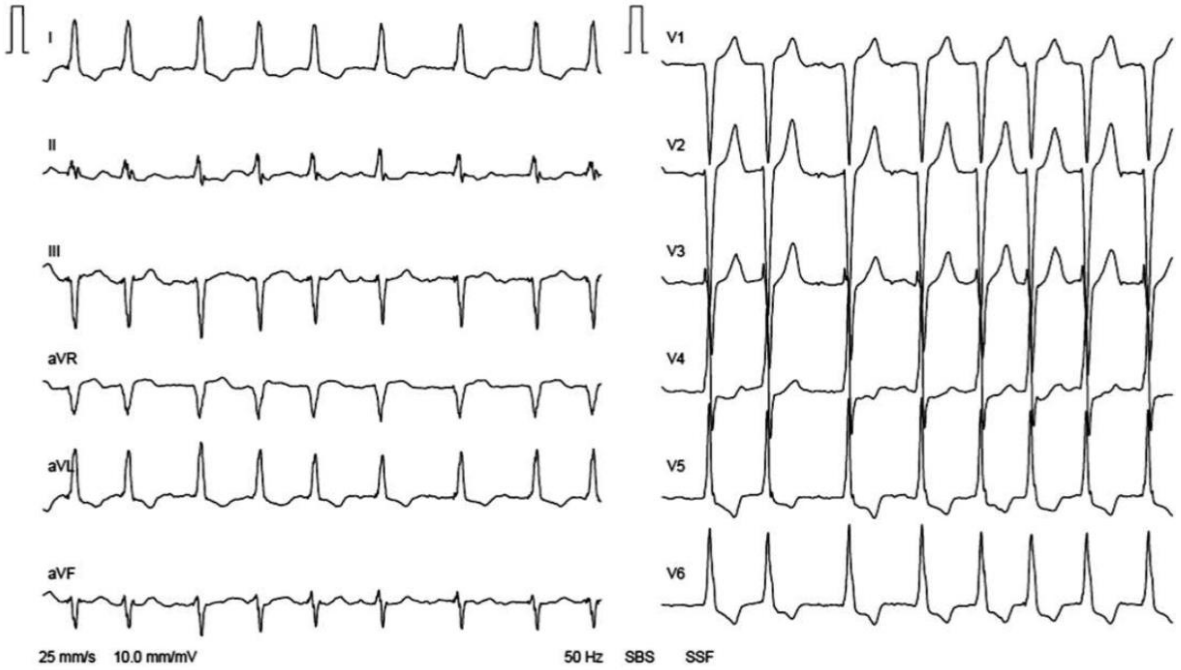




ASE EACI - Eur Heart J – Cardiovascular Imaging (2015) 16, 233–271

KARDIOVASKULÄRE MEDIZIN 2015;18:312–318

Elektrokardiographsiche Hypertrophiezeichen



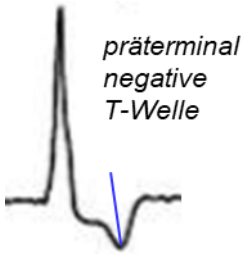
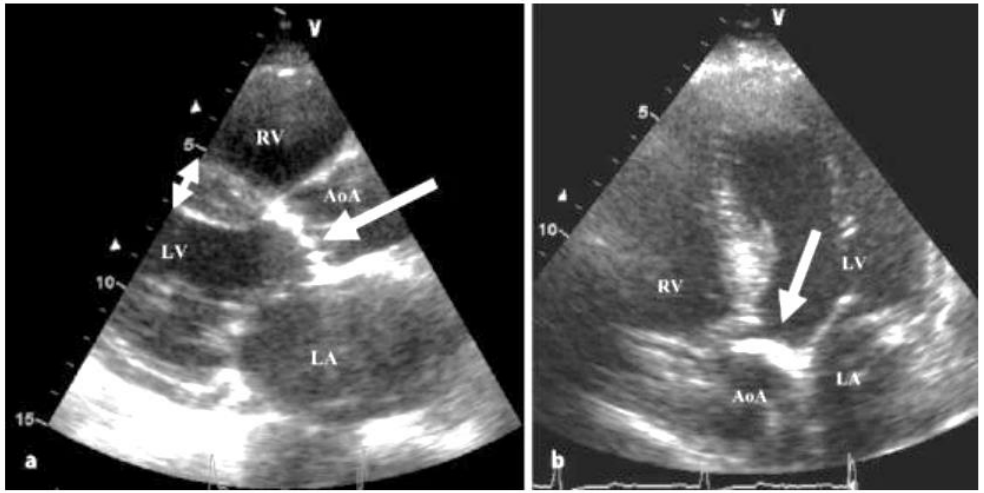


Tabelle 1: Berechnung, Sensitivität und Spezifität der gebräuchlichsten EKG-Indizes zur Diagnose der linksventrikulären Hypertrophie.

Index	Berechnung	Sensitivität	Spezifität
Cornell-Voltage-Duration-Produkt	S V_3 + R aVL (+8 mm bei Frauen) × QRS-Dauer ≥2440 mm × ms	20%	91%
Sokolow-Index	R in Ableitung aVL >1,1 mV	18%	92%
Sokolow-Lyon-Index	S in V_1 + R in V_5 oder V_6 >3,5 mV	21%	89%

KARDIOVASKULÄRE MEDIZIN 2015;18:312–318

Aortenstenose

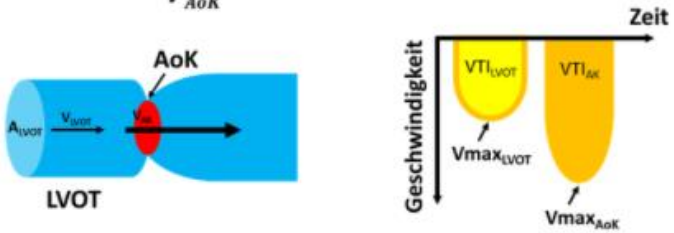


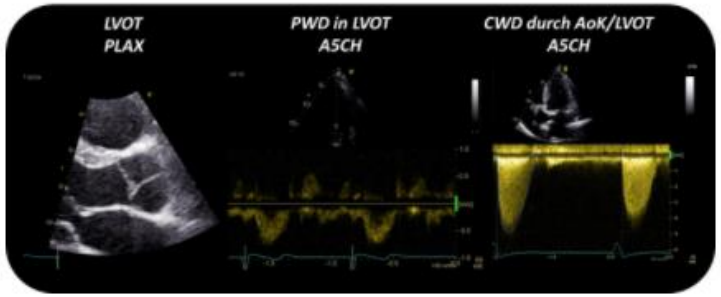
Parasternaler Langachsenschnitt (**a**) und apikaler Fünfkammerblick (**b**) einer schweren verkalkten Aortenstenose (*Pfeil*). Der linke Ventrikel ist konzentrisch hypertrophiert. *LV:* linker Ventrikel, *LA:* linker Vorhof, *AoA:* Aorta ascendens, *RV:* rechter Ventrikel

Kontinuitätsgleichung (Vmax)

$$A_{AoK} * V_{AoK} = A_{LVOT} * V_{LVOT}$$

$$A_{AoK} = \frac{A_{LVOT} * V_{LVOT}}{V_{AoK}}$$





Referenzbereiche

	Mild	Moderat	Schwer
Max. Geschwindigkeit (m/s)	2,6 - 2,9	3.0 - 4,0	≥ 4,0
Mittlerer Gradient (mmHg)	< 20	20 - 40	≥ 40
AÖF (cm²)	> 1,5	1.0 - 1,5	< 1,0
AÖF Index (cm²/m²)	> 0,85	0,60 - 0,85	< 0,6
Velocity Ratio	> 0,50	0,25 - 0,50	< 0,25

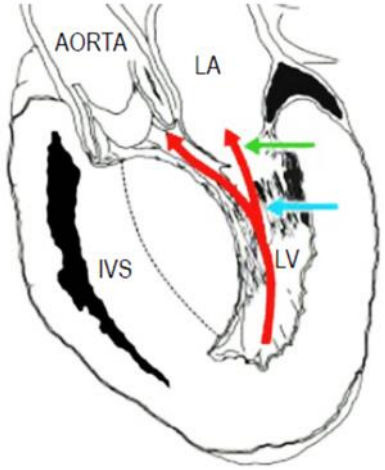
Hypertrophe Kardiomyopathie

Diagnosekriterien

- Wanddicke ≥15 mm in einem oder mehreren LV Segmenten
- unabhängig von der Bildgebungstechnik
  (Echo, cMRT, CT)
- nicht allein durch hämodynamische Belastung (Nachlast: art. Hypertonie) erklärt.

Weitere Befunde im Echo

- asymmetrische Septumhypertrophie
- LVOT Obstruktion bei HOCM
  - erhöhter Fluss (V_{max}) über LVOT/Aortenklappe
  - SAM Phänomen



ESC Guidelines HCM. 2014. Eur Heart J 35, 2733–2779
Dtsch Arztebl Int 2019; 116: 47-53; DOI: 10.3238/arztebl.2019.0047

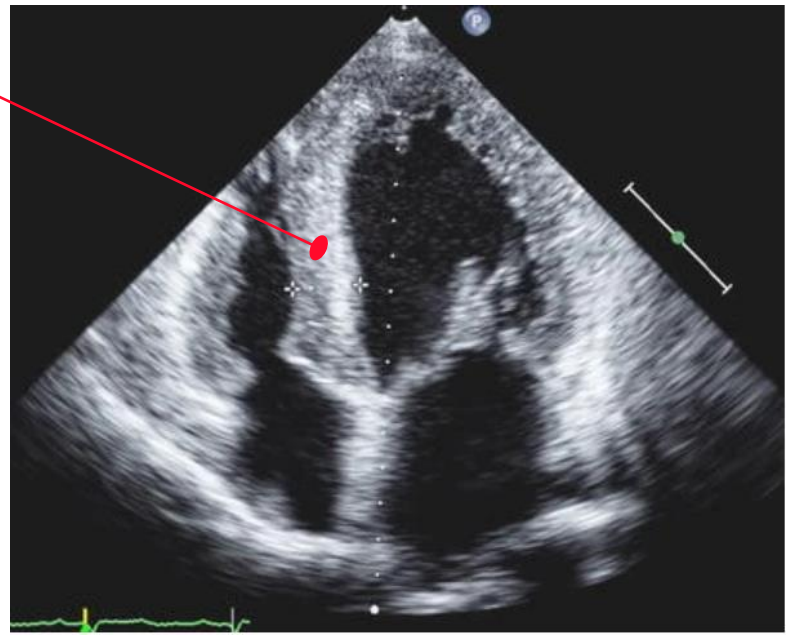
Kardiale Amyloidose

- verdickte Wände (septal >12 mm)
- kleines LV Lumen
- biatriale Vergrößerung
- verdickte Klappensegel
- verdicktes atriales Septum
- erhöhter PAPsys
- restriktives Mitraleinflussprofil
- kleiner Perikarderguss
- granuläres Myokardmuster

- basal-mittlere reduz. GLS

⟷

Niedrige QRS Voltage im EKG
- in 50% der Patienten mit AL Amyloidose
- in 25% der Patienten mit ATTR Amyloidose



Kardiale Amyloidose

LV Longitudinaler Strain - „apical sparing“

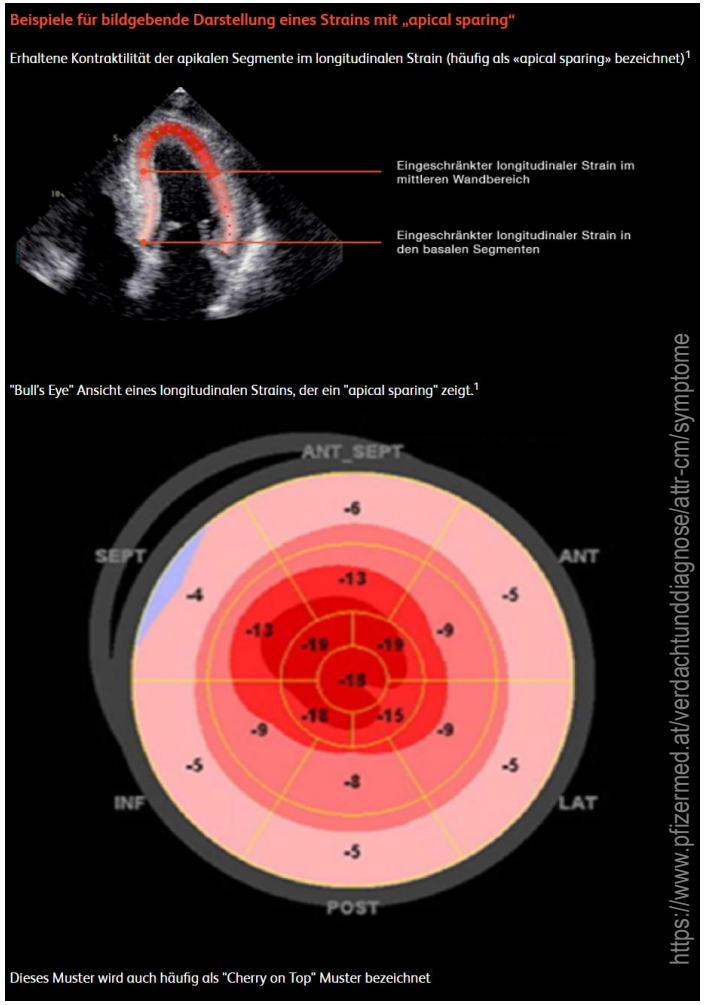


Table 4 Performance characteristics of strain parameters for discriminating patients with confirmed cardiac amyloidosis by cardiac imaging and/or endomyocardial biopsy

	Optimal cut-off[a]	Sensitivity (95% CI)	Specificity (95% CI)	Positive predictive value	Negative predictive value	AUC (95% CI)	*P*-value
ApSpar_Ratio	1.13	-	-	-	-	0.66 (0.54–0.79)	0.011
ApSpar_Ratio > 1.00	-	66 (54–77)	59 (39–76)	80 (71–86)	41 (31–53)	0.62 (0.52–0.73)	0.023
ApSpar_Ratio > 1.13	-	55 (43–67)	72 (53–87)	83 (72–90)	40 (32–48)	0.64 (0.54–0.74)	<0.01
LVEF/GLS	4.95	-	-	-	-	0.72 (0.59–0.84)	<0.001
LVEF/GLS > 4.10	-	93 (84–98)	38 (21–58)	79 (73–83)	69 (46–85)	0.65 (0.56–0.75)	0.001
LVEF/GLS > 4.95	-	75 (62–84)	66 (46–82)	84 (76–90)	50 (39–61)	0.69 (0.59–0.80)	<0.001
SA/SB	2.40	-	-	-	-	0.72 (0.60–0.84)	<0.001
SA/SB > 2.10	-	80 (69–89)	55 (36–74)	81 (74–87)	53 (39–67)	0.68 (0.57–0.78)	<0.001
SA/SB > 2.40	-	76 (65–85)	66 (46–82)	84 (76–90)	53 (41–65)	0.71 (0.61–0.81)	<0.001
ApSpar_Visual	-	80 (69–89)	34 (18–54)	75 (69–80)	42 (26–59)	0.57 (0.47–0.67)	0.15

ApSpar_Ratio, apical sparing assessed through the formula; ApSpar_Visual, apical sparing annotated by the echocardiographer after visual assessment of the bullseye peak segmental strain pattern; AUC, area under the curve; CI, confidence interval; LVEF/GLS, ratio of left ventricular ejection fraction to global longitudinal strain; SA/SB, ratio of septal apical strain to septal basal strain.
Results of receiver-operating characteristic analysis for the discrimination of cardiac amyloidosis by echocardiographic strain parameters (ApSpar_Ratio, LVEF/GLS, and SA/SB) evaluated as continuous variables and using cut-off values. Cut-off values used were those that were data driven determined by the Youden method and those from prior literature (ApSpar_Ratio ≥ 1, LVEF/GLS > 4.1, and SA/SB > 2.4). LVEF/GLS and SA/SB showed better discriminating capability than ApSpar_Ratio. ApSpar_Visual did not improve discrimination for cardiac amyloidosis in the univariable model ($P = 0.15$).
[a]Optimal cut-off by the Youden method (data driven).

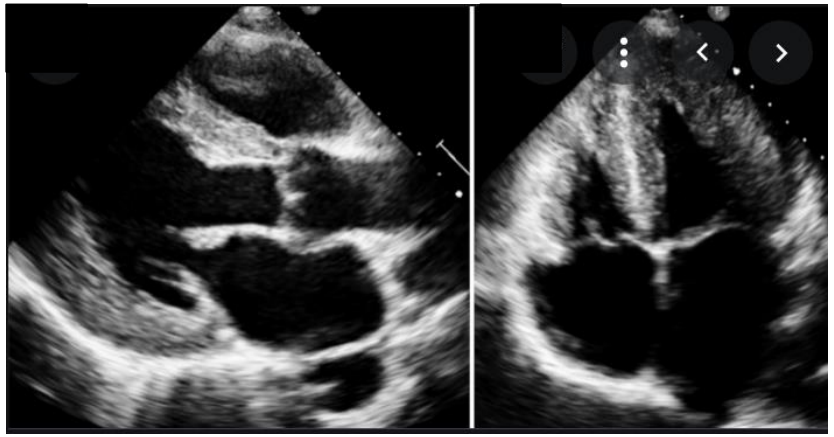
Weiterführende Kardiale Bildgebung bei LVH

Table 1 The features of cardiac imaging in patients with disorders causing or associated with LVH

Disease	Category	Imaging
Hypertensive heart disease	Hypertension	Echo: concentric LVH
		CMR: non-specific
Aortic stenosis	Valvular disease	Echo: valvular calcification and decreasing the opening, transaortic valve pressure gradient, concentric LVH
		MDCT: pre-procedural assessment for TAVI
		CMR: non-specific
Hypertrophic cardiomyopathy	Primary cardiomyopathy	Echo: usually ASH (also concentric, apical LVH), LVOT obstruction, SAM, mitral apparatus abnormality, apical aneurysm
	Unexplained LVH	
	Mainly sarcomere mutations	CMR: LGE in intra-myocardium (mainly at the junction of the right ventricle and the interventricular septum), mitral apparatus abnormality, apical aneurysm
Amyloidosis	Secondary cardiomyopathy	Echo: concentric LVH, biatrial dilatation, restrictive physiology, thickened inter-septum, granular appearance, pericardial effusion
	Amyloidosis	
	Mainly AL type and ATTR type	CMR: global subendocardial LGE, prolonged native T1
		Tc-PYP scintigraphy: uptake in ATTR type
Mitochondrial disease	Secondary cardiomyopathy	Echo: concentric LVH
	Mitochondrial disease	CMR: non-specific, maybe different LGE pattern in different subtypes
Fabry disease	Secondary cardiomyopathy	Echo: predominant concentric LVH
	Lysosomal storage disease	CMR: LGE in basal infero-lateral segments in LV, shortened native T1
	GLA mutations	
Pompe disease	Secondary cardiomyopathy	Echo: concentric LVH
	Lysosomal storage disease	CMR: non-specific
	GAA mutations	
Danon disease	Secondary cardiomyopathy	Echo: concentric LVH
	Lysosomal storage disease	CMR: non-specific

Beispiel: M. Fabry

α-Galactosidase A Mangel



- Brennende Schmerzen in Händen/Füßen? Vermindertes Schwitzen?
- Magen-Darm-Beschwerden?
- Kleine rote Flecken auf der Haut? Nierenerkrankung bekannt? Schlaganfall/transitorische ischämische Attacke (TIA)?