

échocardiographie et insuffisance cardiaque

Modérateurs : Patrick Khanoyan, Arnaud Maudière

- Comment suivre un insuffisant cardiaque en échocardiographie ?

Arnaud Maudière (Marseille)

- Insuffisance mitrale et insuffisance cardiaque : quel mécanisme ?

David Attias (St Denis)

- Strain : quelle utilité dans l'insuffisance cardiaque ?

Catherine Szymanski (Boulogne Billancourt)



Comment suivre un insuffisant cardiaque en échocardiographie ?

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Statement of Financial Interest

I currently have, or have had over the last two years, an affiliation or financial interests or interests of any order with a company or I receive compensation or fees or research grants with a commercial company :

Speaker's name : Arnaud Maudière, Marseille

I do not have any potential conflict of interest



DEFINITIONS OF HEART FAILURE

Definition of heart failure with preserved (HFpEF), mid-range (HFmrEF) and reduced ejection fraction (HFrEF)

Type of HF		HFrEF	HFmrEF	HFpEF
CRITERIA	1	Symptoms ± Signs ^a	Symptoms ± Signs ^a	Symptoms ± Signs ^a
	2	LVEF <40%	LVEF 40–49%	LVEF ≥50%
	3	–	1. Elevated levels of natriuretic peptides ^b ; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).	1. Elevated levels of natriuretic peptides ^b ; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).

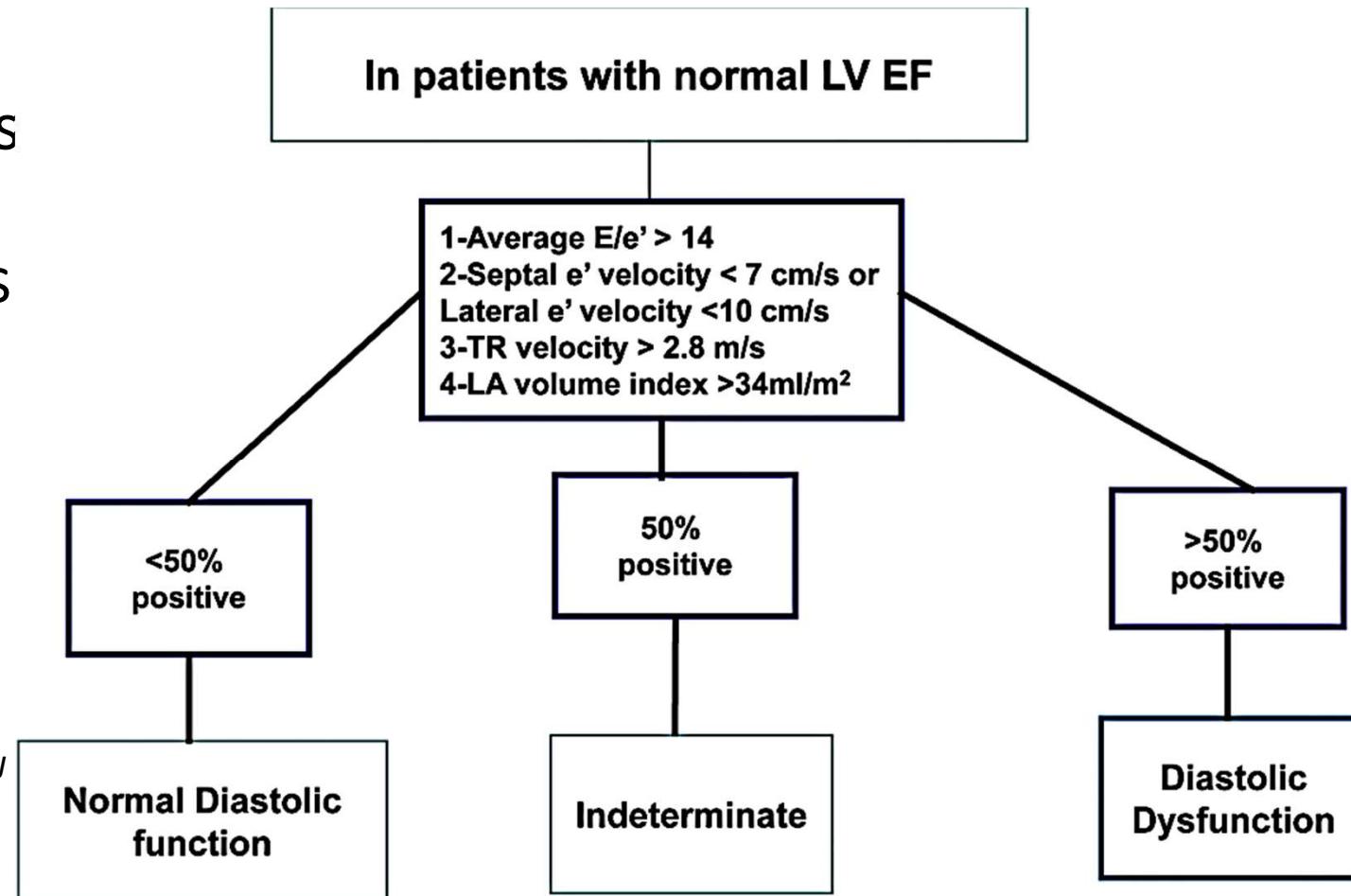
BNP = B-type natriuretic peptide; HF = heart failure; HFmrEF = heart failure with mid-range ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; LAE = left atrial enlargement; LVEF = left ventricular ejection fraction; LVH = left ventricular hypertrophy; NT-proBNP = N-terminal pro-B type natriuretic peptide.

^aSigns may not be present in the early stages of HF (especially in HFpEF) and in patients treated with diuretics.

^bBNP>35 pg/ml and/or NT-proBNP>125 pg/mL.

Ponikowski 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur J Heart Fail, 18: 891-975. <https://doi.org/10.1002/ejhf.592>

Algorithm for diagnosis of LV diastolic dysfunction in subjects with normal LVEF

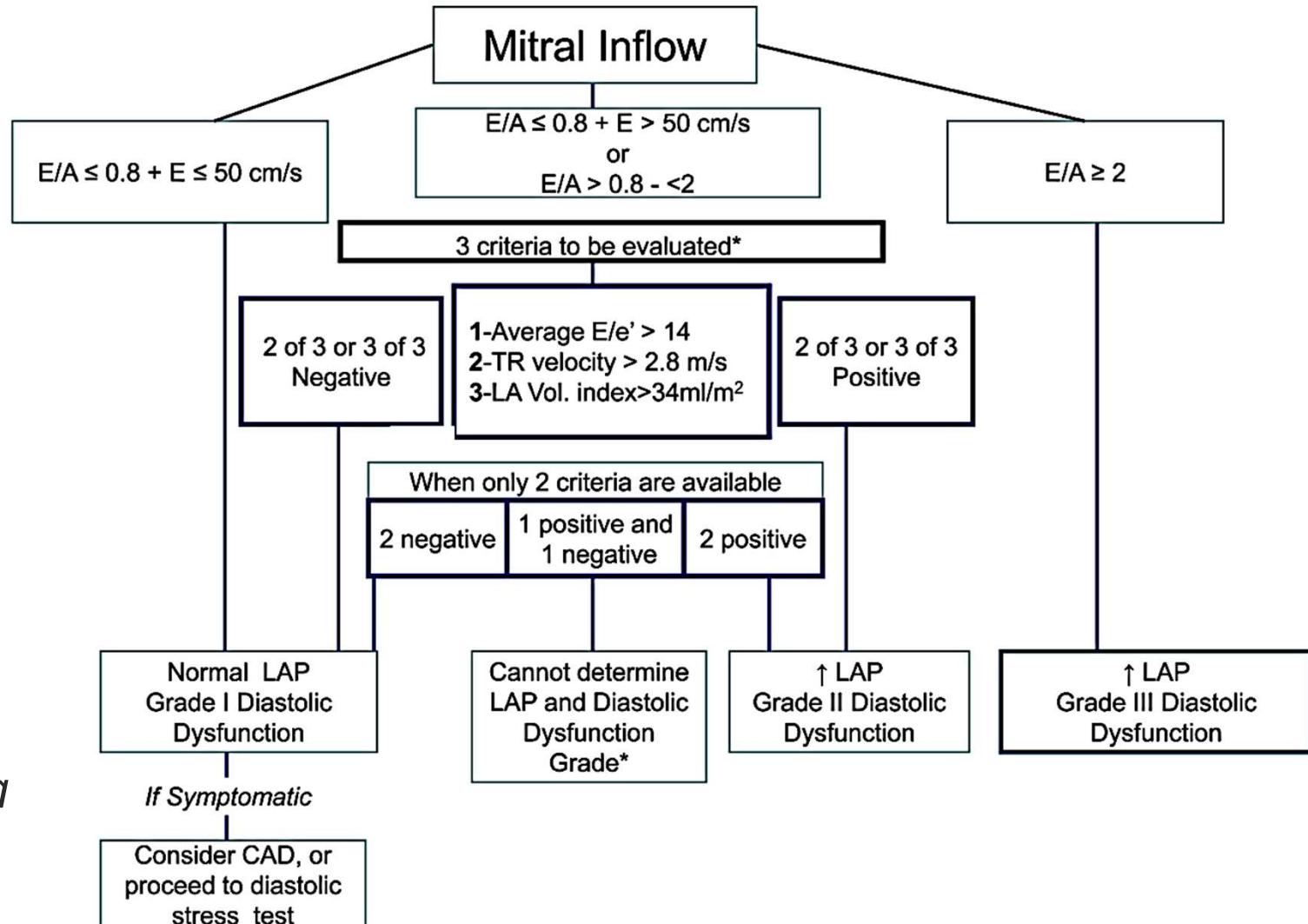


Nagueh SF, Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: Eur Heart J Cardiovasc Imaging. 2016 Dec;17(12):1321-1360. doi: 10.1093/ehjci/jew082.

Estimation of LV filling pressures and grading LV diastolic function

-depressed LVEFs

-myocardial disease
and normal LVEF
*after consideration of
clinical and other 2D data*



Nagueh SF, Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: Eur Heart J Cardiovasc Imaging. 2016 Dec;17(12):1321-1360. doi: 10.1093/ehjci/jew082.

EACVI proposal for an echo report Left ventricle

Chamber	Parameter	Observed value	Normal Value
Left Ventricle	LV end-diastolic dimension (mm)		≤ 58.4 (M) ≤ 52.2 (F)
	LV end-systolic dimension (mm)		≤ 39.8 (M) ≤ 34.8 (F)
	Relative wall thickness (cm)		≤ 0.42
	LV mass/BSA (g/m ²)		≤ 102 (M) ≤ 88(F)
	LV EDD/BSA (mm/m ²)		<75 (M) < 62(F)
	LV ESD/BSA (mm/m ²)		<32 (M) <25(F)
	LV EF biplane (%)		>52 (M) > 54(F)
	LV SVI by Doppler (mL/m ²)		> 35
	LV GLS (%)		> 20
LV diastolic function	Transmural E/a ratio		>0.8 or <2.0
	E velocity DT (msec)		>160 and <220
	Transmural E velocity DT (cm/sec)		< 120
	e' velocity (septal and lateral) (cm/sec)		> 7 and > 10
	E/e' ratio		< 8
Left Atrium	Maximal LAVi (mL/m ²)		≤ 34
Estimated LV filling pressure (mmHg)			Normal, Abnormal, Indeterminate
Aortic root dimension (indexed value)	Annulus (cm/m ²)		≤ 1.4 (M & F)
	Sinus of Valsalva		≤ 1.9 (M) ≤ 2.0 (F)
	Sinotubular junction		≤ 1.7 (M & F)
	Proximal ascending aorta		≤ 1.7 (M) ≤ 1.9 (F)
Right Ventricle	Basal diameter (mm)		< 42
	Mid diameter (mm)		< 36
	RVOT proximal diameter (mm)		< 36
	RVOT distal diameter (mm)		< 28
	TAPSE (mm)		> 17
	Fractional area change (%)		< 35
	Free wall GLS (%)		> 23
Right atrium	RA volume (mL/m ²)		< 30 (M) < 28 (F)
Inferior Vena Cava	IVC diameter (cm)		<2.1
	IVC collapsibility (%)		>50
Tricuspid regurgitation (if any)	Regurgitant jet velocity (m/sec)		<2.8
	Estimated sPAP (mmHg)		<31

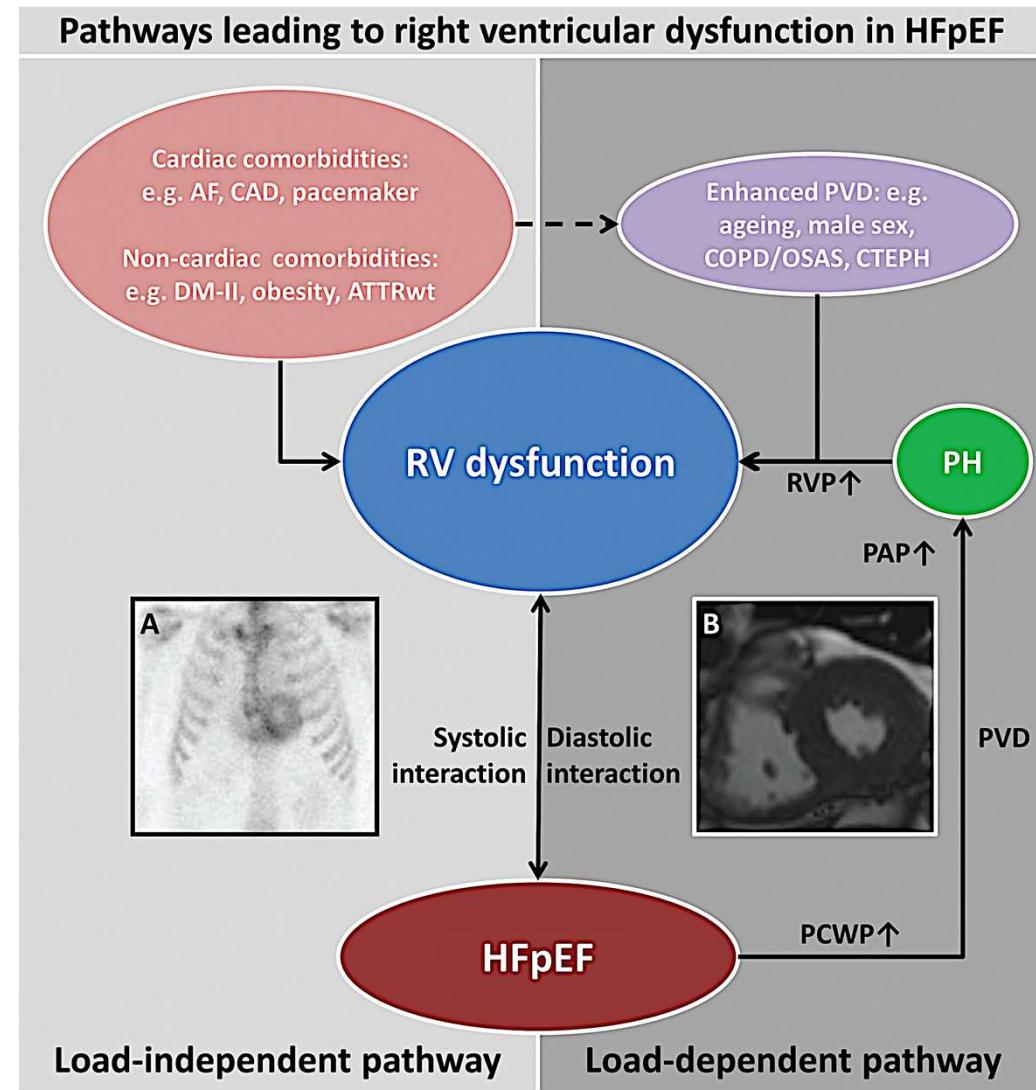
Chamber	Parameter	Normal values
Left ventricle	LV GLS (%)	>20% ^a
	3D EDV index (mL/m ²)	<80 (M), <72 (F)
	3D ESV index (mL/m ²)	<33 (M), <29 (F)
	3D LVEF (%)	>54 (M), >57 (F)
Right ventricle	Free wall GLS	>23% ^a

EACVI proposal for an echo report left Ventricle

Chamber	Parameter	Normal values	Left atrium	Maximal LAVi (mL/m ²)	≤ 34	Chamber	Parameter	Normal values	
Left ventricle	LV end-diastolic dimension (mm)	≤ 58.4 (M), ≤ 52.2 (F)	Right ventricle	Thoracic aorta	Annulus (cm/m ²)	≤ 1.4 (M and F)	Left ventricle	LV GLS (%)	$>20\%^a$
	LV end-systolic dimension (mm)	≤ 39.8 (M), ≤ 34.8 (F)		Sinus of Valsalva (cm/m ²)	≤ 1.9 (M), ≤ 2.0 (F)	3D EDV index (mL/m ²)	<80 (M), <72 (F)		
	LV EDV index (mm/m ²)	<75 (M), <62 (F)		Sinotubular junction (cm/m ²)	≤ 1.7 (M and F)	3D ESV index (mL/m ²)	<33 (M), <29 (F)		
	LV ESV index (mm/m ²)	<32 (M), <25 (F)		Proximal ascending aorta (cm/m ²)	≤ 1.7 (M), ≤ 1.9 (F)	3D LVEF (%)	>54 (M), >57 (F)		
	Relative wall thickness	≤ 0.42		RV basal diameter (mm)	<42	Right ventricle	Free wall GLS	$>23\%^a$	
	LVM index (g/m ²)	≤ 102 (M), ≤ 88 (F)		RV mid diameter (mm)	<36				
	LVEF, biplane (%)	≥ 52 (M), ≥ 54 (F)		RVOT proximal diameter (mm)	<36				
	Transmitral E velocity (cm/s)	<50		RVOT distal diameter (mm)	<28				
	Transmitral E velocity DT (ms)	>160 to <220		TAPSE (mm)	>17				
	Transmitral E/A ratio	>0.8 to <2.0		Tricuspid annular s' velocity (cm/s)	>9.5				
Right atrium	Septal annular e' velocity (cm/s)	>7		Fractional area change (%)	>35				
	Lateral annular e' velocity (cm/s)	>10		RAVi (mL/m ²)	<30 (M), <28 (F)				
	LV E/e' (average) ratio	<14							

Galderisi EACVI, Volume 18, Issue 12, December 2017, Pages 1301-1310, <https://doi.org/10.1093/ehjci/jex244>

Right heart dysfunction and failure in heart failure with preserved ejection fraction: mechanisms and management



Gorter, T.M., (2018), Right heart dysfunction and failure in heart failure with preserved ejection fraction: mechanisms and management. Eur J Heart Fail, 20: 16-37. <https://doi.org/10.1002/ejhf.1029>

INTEGRATED APPROACH TO THE ASSESSMENT OF RIGHT VENTRICULAR FUNCTION

ECHOCARDIOGRAPHY Right heart morphology	
RV diameter, surface, hypertrophy	Radial 33 basal 28 mid, H 71 mm, TD 25 cm ² , TS 14 cm ² , wall 5 mm
RV Es remodelling index	Risk; > 1,6
RV/LV ratio	>1
TR	Severe VC 0,7
RV systolic function	
TAPSE	< 17 mm
TAPSE/sPAP mm/mmHg	<0,19 risk, > 0,55 no risk
S'	< 10 cm/s
IVCv cm/sec	< 9
RVFAC	< 36,5%
Right Ventricle free wall strain (3 sgt)	> -23%, GLS 20 (15) %, Basal 19, mid 27, apical 32
Strain rate	1,5 basal, 1,7 mid, 2 apex
RVMPI mmHg/ml	0,28
RVEF 3D echo	mild 40-45% moderate 30-40 % severe < 30 %
RV filling pressure	
Pericardial effusion	Risk; RV post systolic strain pattern 2-3
RAP>7	IVC 21 mm, collaps 50 %, Odr strain 15 %, E/e' 10, Vol OD, 1.7(E/e')+0,8
RV dysynchrony	
RV-SD4 msec	>23 msec
Lang R. JASE 2015;28:1 Rudski L. JASE 2010;23:685	

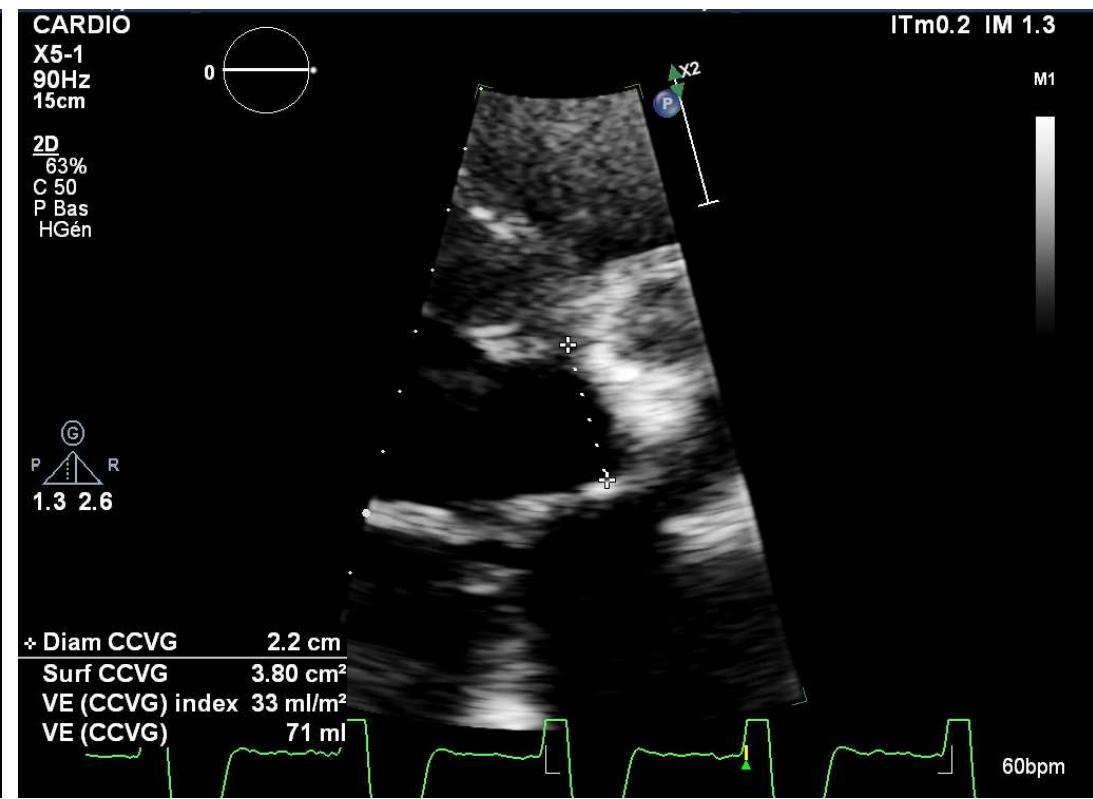
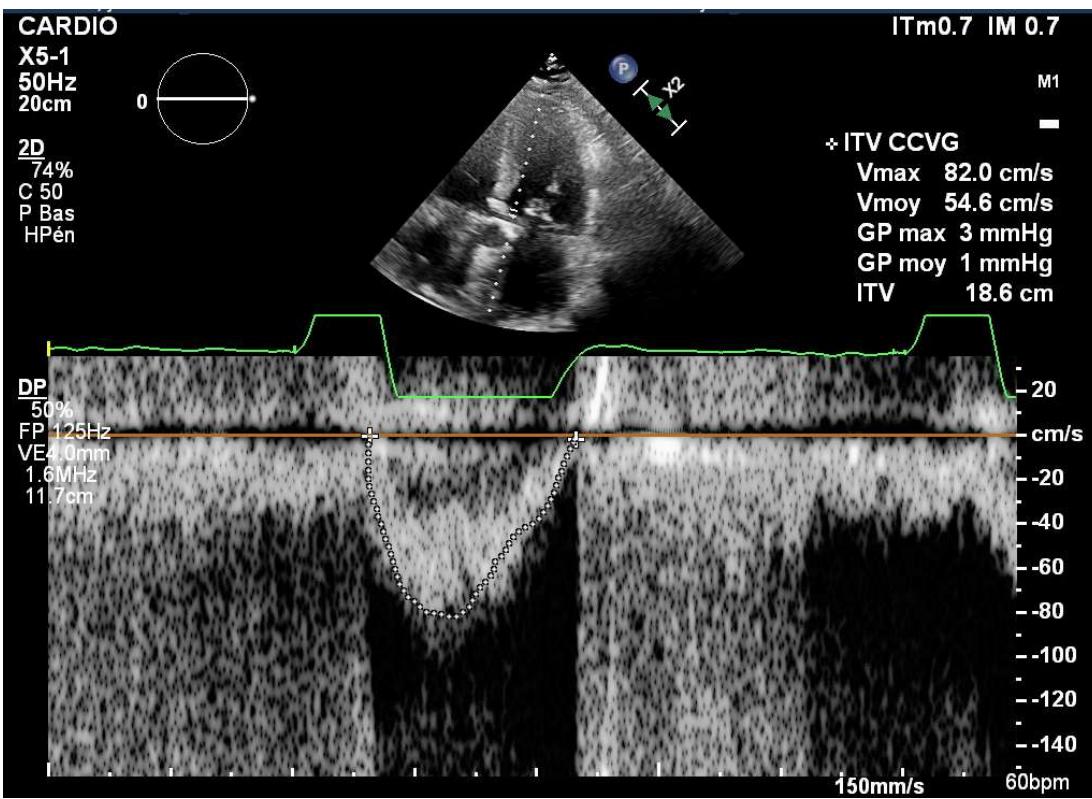
Humbert <https://doi.org/10.1093/eurheartj/ehac237>

EACVI proposal for an echo report valve disease

Mitral valve				
Valve apparatus description (degenerative, dilation, calcification, prolapse)				
Regurgitation	EROA (mm ²)		Degree of MR	
	Vena Contracta (mm)			
Stenosis	PHT (msec)		Degree of MS	
	Peak and mean pressure gradient (mmHg)			
	Mitral valve area (anatomic/functional) (cm ²)			
Aortic Valve				
Valve apparatus description (degenerative, dilation, calcification, prolapse)				
Regurgitation	PHT (msec)		Degree of AR	
	Vena Contracta (mm)			
Stenosis	Peak and mean pressure gradient (mmHg)		Degree of AS	
	Peak velocity (m/sec)			
	Aortic valve area (anatomic/functional) (cm ²)			
Tricuspid valve				
Valve apparatus description (degenerative, dilation, calcification, prolapse)				
Regurgitation	EROA (mm ²)		Degree of TR	
	Vena Contracta (mm)			
Stenosis	Mean pressure gradient (mmHg)		Degree of TS	
Pulmonary valve				
Valve apparatus description (degenerative, dilation, calcification, prolapse)				
Regurgitation	PHT (msec)		Degree of PR	
Stenosis	Peak pressure gradient (mmHg)		Degree of PS	

QUELQUES ASPECTS PRATIQUES

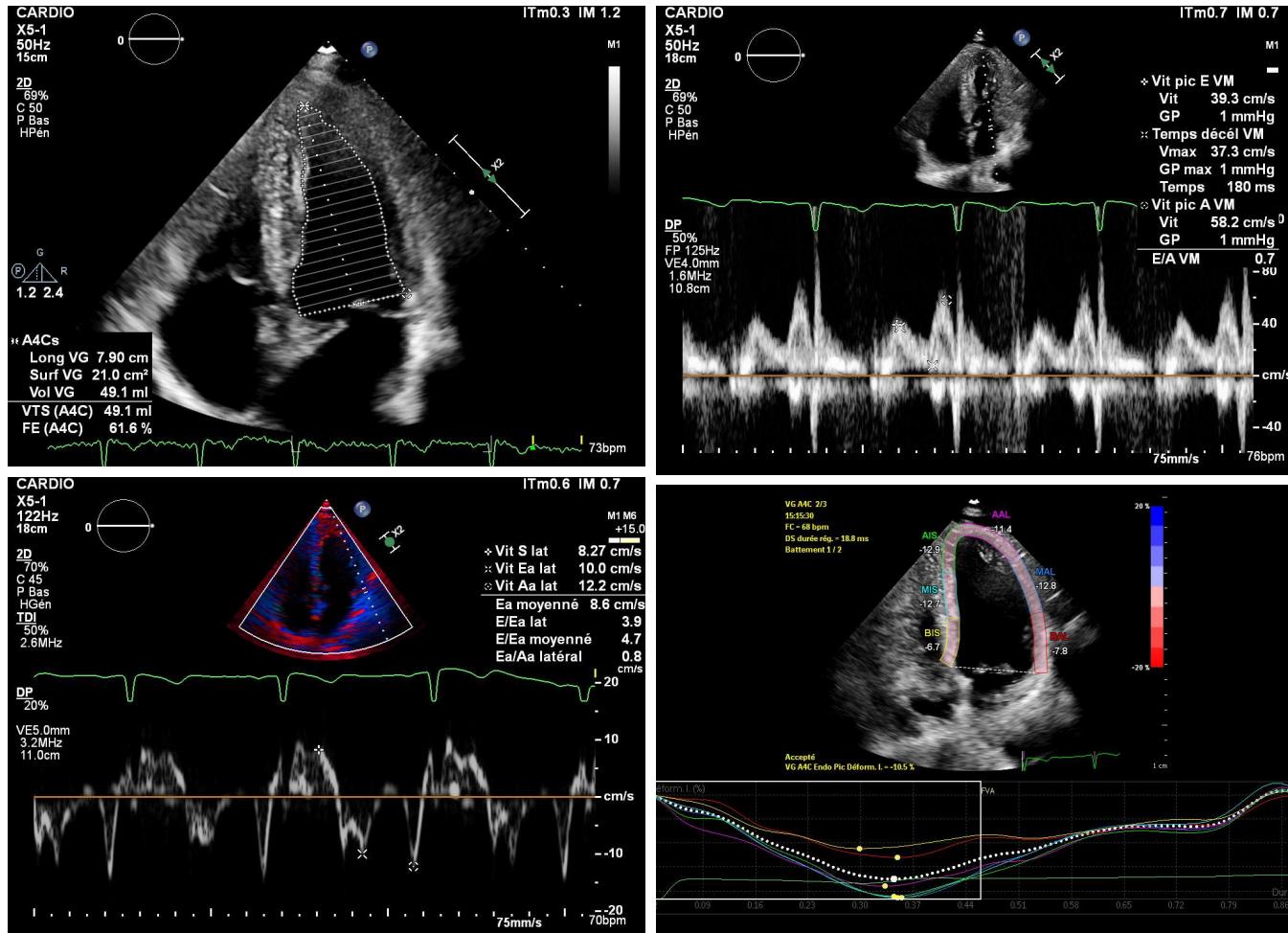
Débit cardiaque



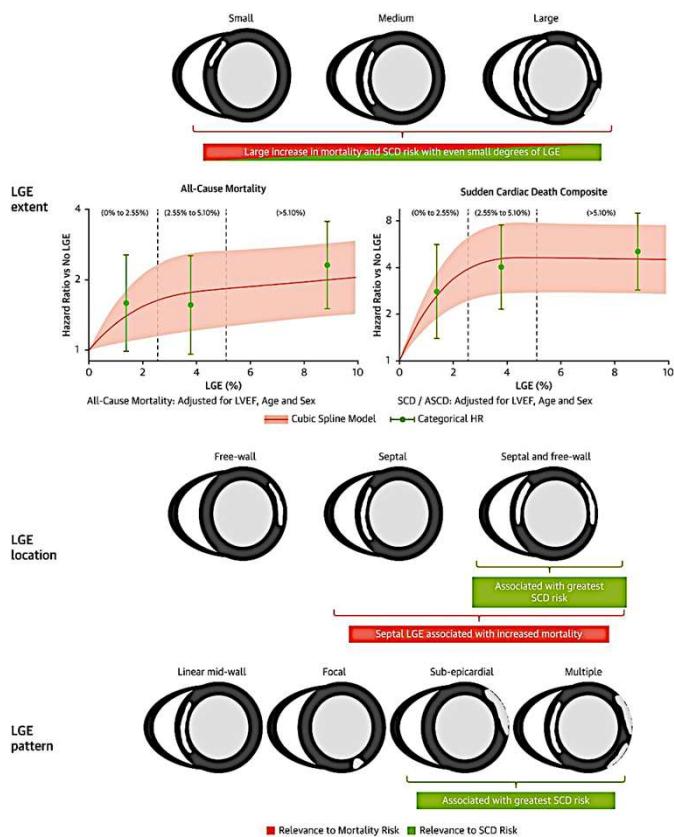
PRONOSTIC VALUE OF ECHOCARDIOGRAPHY

Myocardial fibrosis: why image, how to image and clinical implications

TEE functionnal imaging



Outcome in Dilated Cardiomyopathy Related to the Extent, Location, and Pattern of Late Gadolinium Enhancement



Brian P. Halliday et al. JIMG 2019;12:1645-1655

Cut off value of LGE 7%; A Barison,
International Journal of Cardiology (2017), doi:10.1016/j.ijcard.2017.10.043

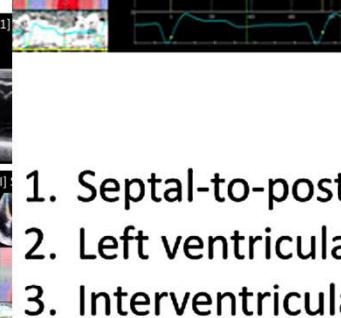
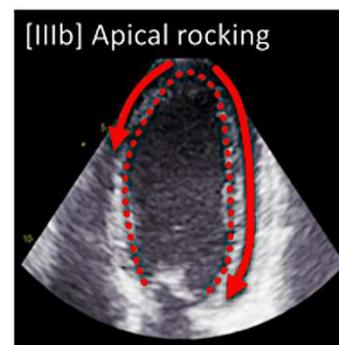
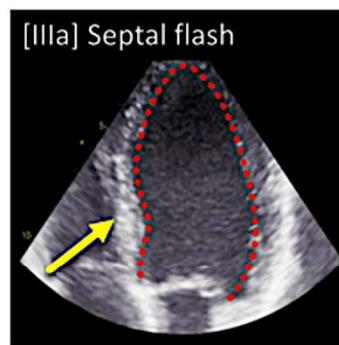
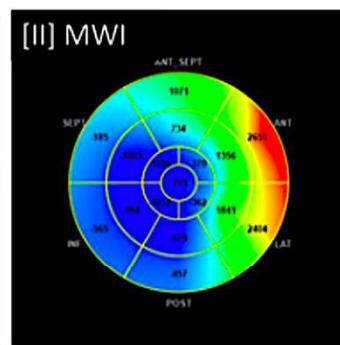
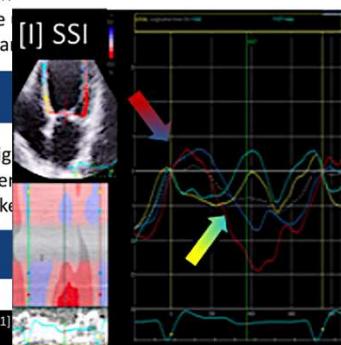
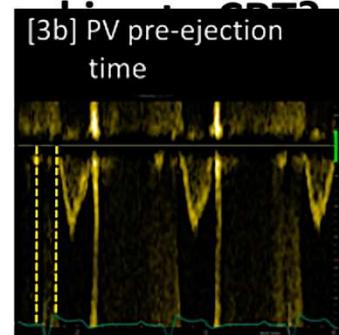
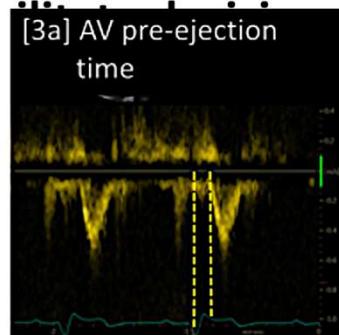
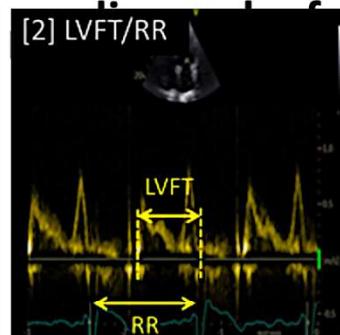
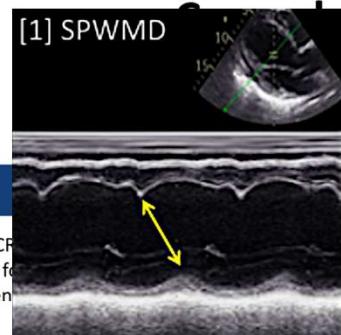
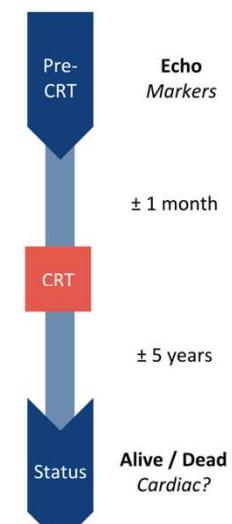
In DCM,
the presence of septal LGE is associated with a large
increase in the risk of death and SCD events,
even when the extent is small.
SCD risk is greatest with concomitant septal and free-wall
LGE.

The incremental value of LGE extent beyond small amounts
and LGE pattern is limited
Overall, the various models using LGE and adjusting for age,
sex, and LVEF had moderate discriminative ability, with a c-
statistic close to 0.70 for both mortality and SCD outcomes.
Using presence and location of LGE enhancement led to a
modest improvement of model discrimination compared to
that using the presence of LGE alone (raised c-statistic by
w0.02 and w0.01 after adjusting further for New York Heart
Association functional class, right ventricle EF [RVEF], LV
mass, and LV and LA volumes). (R.Y KWONG edit JIMG 2019)
Takin in account T1 study

Cardiac resynchronization therapy (CRT) is effective in patients with heart failure and dyssynchrony. However, (1) the failure to recognize the need for CRT leads to unnecessary therapy costs. A better patient screening is needed.

The presence of mechanical dyssynchrony is a marker of CRT benefit. Several markers of dyssynchrony were identified, but they were performed poorly. Promising new markers have been developed.

Within a heart failure population eligible for CRT, the goal is to (1) confirm the correlation between old and new markers and (2) compare the old and new markers.



1. Septal-to-posterior wall motion delay
2. Left ventricular filling time over cardiac cycle
3. Interventricular mechanical delay

- 1.
2. I. Systolic stretch index
3. II. Myocardial work index
- II. III. Septal flash or apical rocking

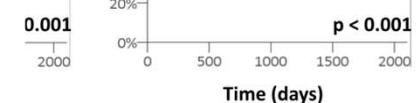
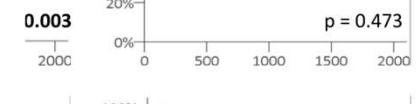
(SPWMD)
(LVFT/RR)
(IVMD)

(SSI)
(MWI)
(SFoAR)

“Old” Marker

“New” Marker

Contact: alexis.puvrez@kuleuven.be

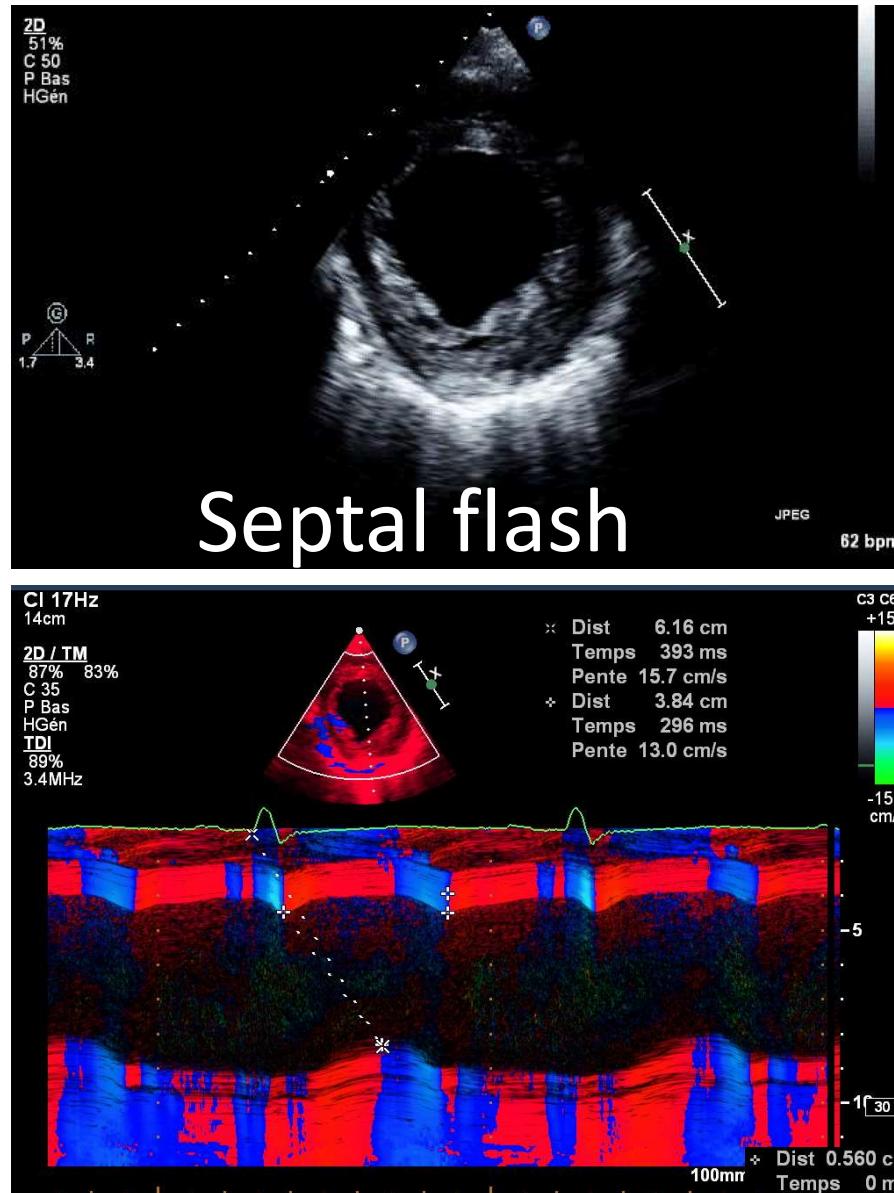


	HR (95% CI)	P value
	0.57 (0.30 – 1.10)	0.094
	0.38 (0.19 – 0.75)	0.005
	0.78 (0.40 – 1.53)	0.474
	0.30 (0.15 – 0.57)	<0.001
	0.26 (0.12 – 0.54)	<0.001
	0.28 (0.14 – 0.53)	<0.001

10

In patients with a broad QRS (>120ms) and reduced LVEF (<35%), clinicians should refer for or proceed to CRT.

Contraction pré-éjectionnelle du SIV non opposée par la paroi latérale activée tardivement



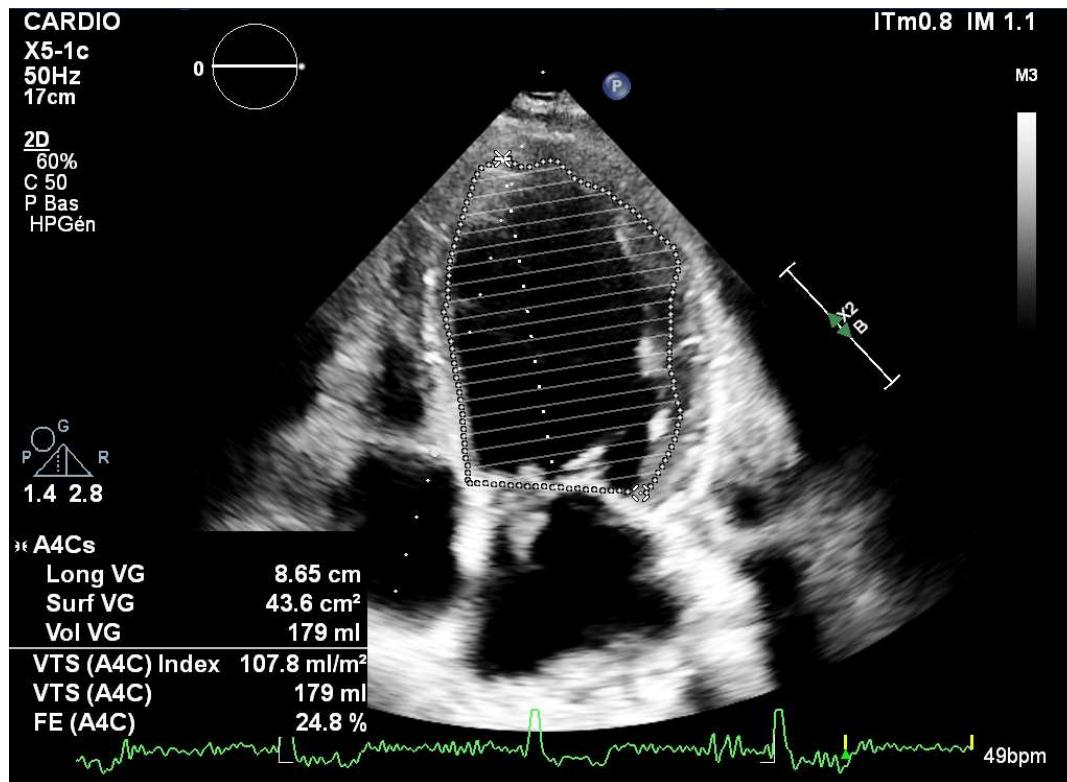
Gjesdal, ..Smiseth
circ cardiovasc imaging
2011; 4;264-273

Contraction septale
① pré-éjection
20 msec post R
① mid-éjection

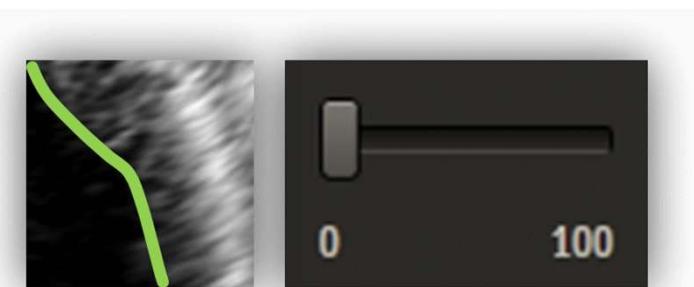
Faisabilité, technique, volumes, IA



Corrélation ETT/IRM



Pour avoir une évaluation de volumes cohérente avec l'IRM il faut décaler la frontière interne pour supprimer les trabéculations qui ont un fort signal acoustique



Franck Levy, Performance of new automated transthoracic three-dimensional echocardiographic software for left ventricular volumes and function assessment in routine clinical practice: Comparison with 3 Tesla cardiac magnetic resonance, Archives of Cardiovascular Diseases, Volume 110, Issue 11, 2017, Pages 580-589, ISSN 1875-2136, <https://doi.org/10.1016/j.acvd.2016.12.015>.

RV 3D EF

Acquisition

(4-6 consecutive apnea beats; 1 single cycle)

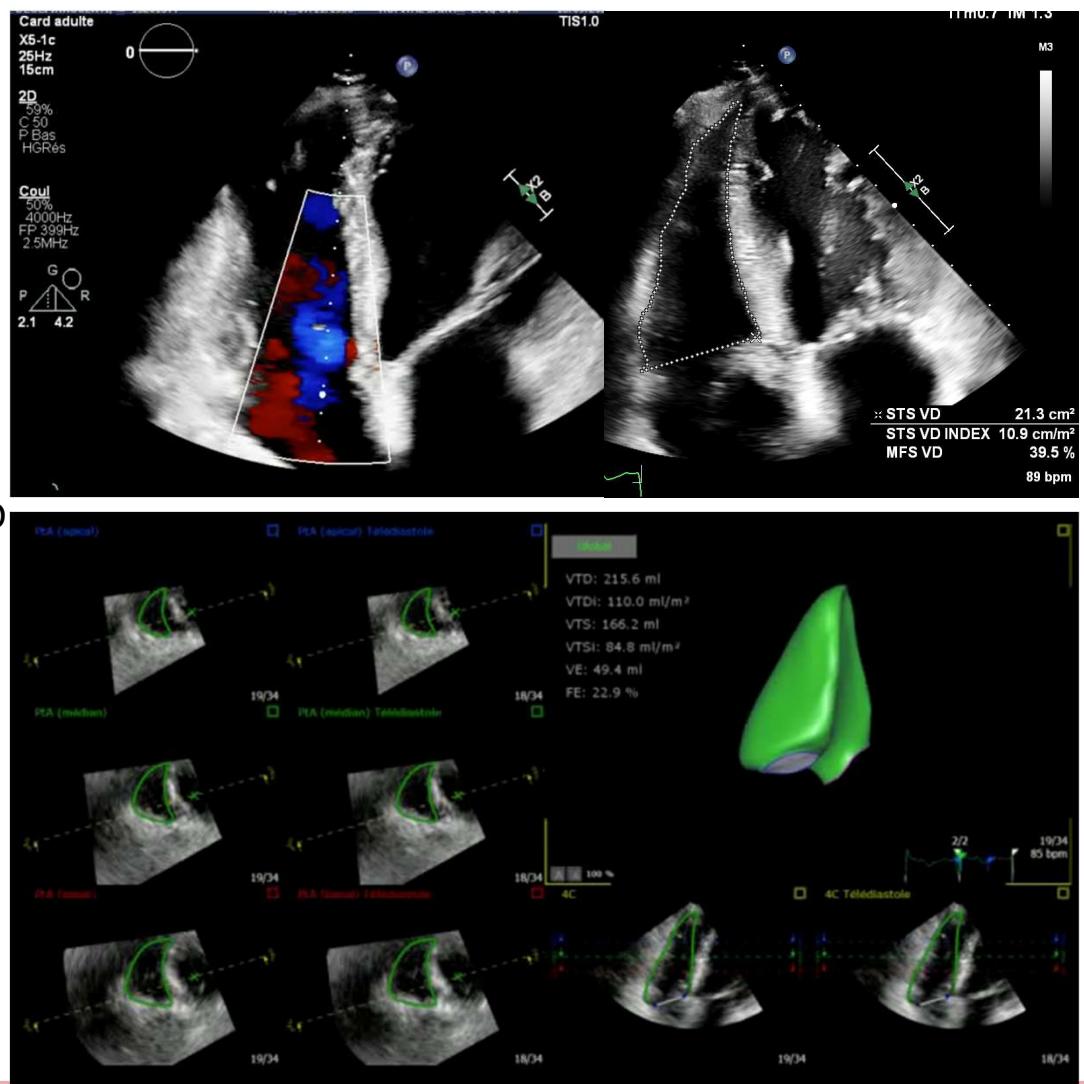
Calculation

(Disk method, direct reconstruction...)

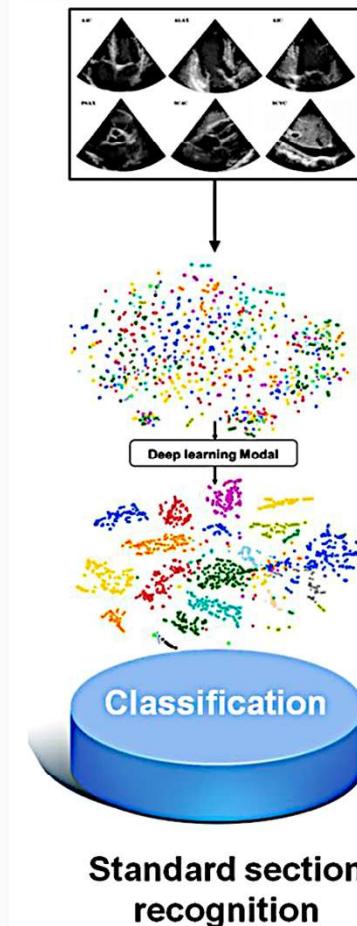
- Independent of geometric assumptions
- Extensively validated against CMR
- Established prognostic value, superior to other RV parameters

In echocardiographic laboratories with good expertise in 3Dechocardiography, 3D-derived RV EF should be used routinely for assessment of RV systolic function in patients with good acoustic window

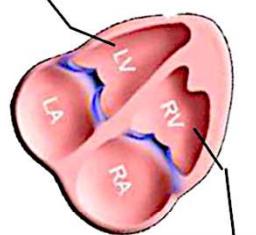
RVFAC
39 %
RVEF 3D
22,9 %



From Machine Learning to Deep Learning

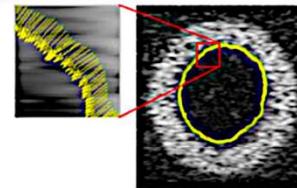


- Endocardial boundary refinement
 - Segment the ventricle from the short-axis view
 - Add the MCC values
- Detect both endocardium and epicardium
• Priori information

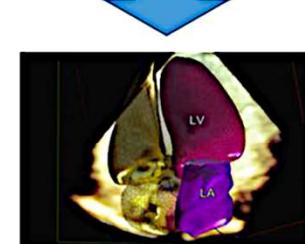


Optimization

Standard section recognition



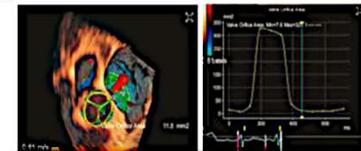
Endocardium detection



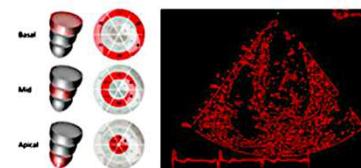
Auto-generated volume

Volume calculation

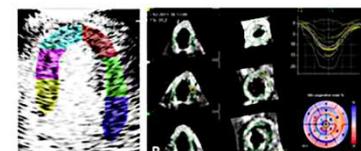
Functional left ventricle assessment



Valve automatic analysis



Cardiomyopathy diagnosis



Myocardial strain analysis

Identification

Cardiac disease diagnosis

Suivi de la fonction cardiaque selon les stades d'insuffisance cardiaque

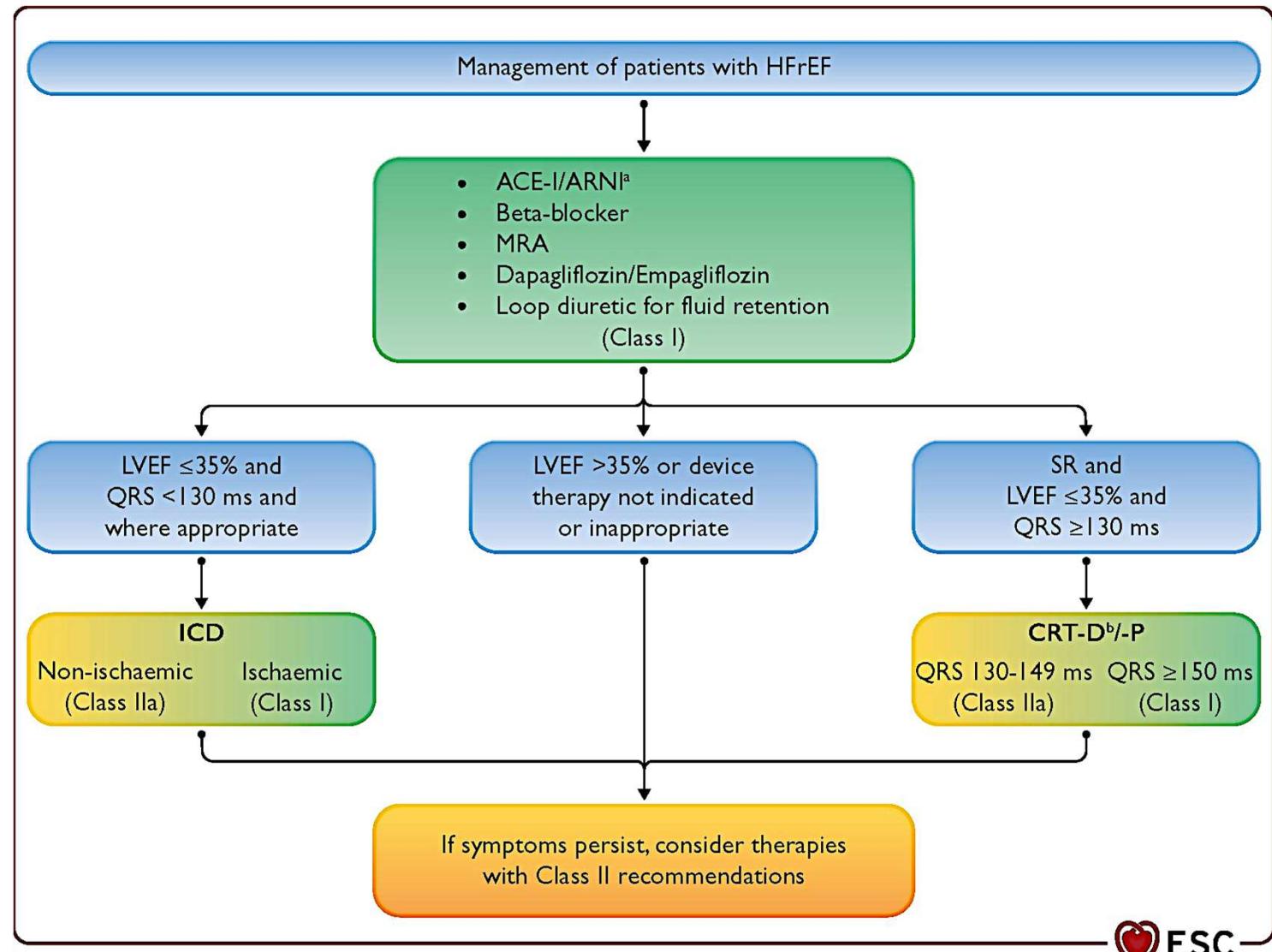
La répétition des échocardiographies n'est généralement pas nécessaire,

Une échocardiographie doit être répété en cas de détérioration de l'état clinique

Une échocardiographie est également conseillée à 3 et 6 mois après l'optimisation des traitements standard en cas d'insuffisance cardiaque à FEVG réduite pour déterminer les adaptations de traitements pharmacologiques et discuter l'indication de CRT, DAI et thérapies valvulaires

McDonagh 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368.

McDonagh 2021 ESC
Guidelines for the diagnosis
and treatment of acute and
chronic heart failure. Eur
Heart J. 2021 Sep
21;42(36):3599-3726. doi:
10.1093/euroheartj/ehab368



Cardiac rhythm management for heart failure with reduced ejection fraction

CRT;
FEVG < 35 %
QRS > 150 msec

*McDonagh 2021 ESC Guidelines for the diagnosis
and treatment of acute and chronic heart failure.
Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi:
10.1093/eurheartj/ehab368.*

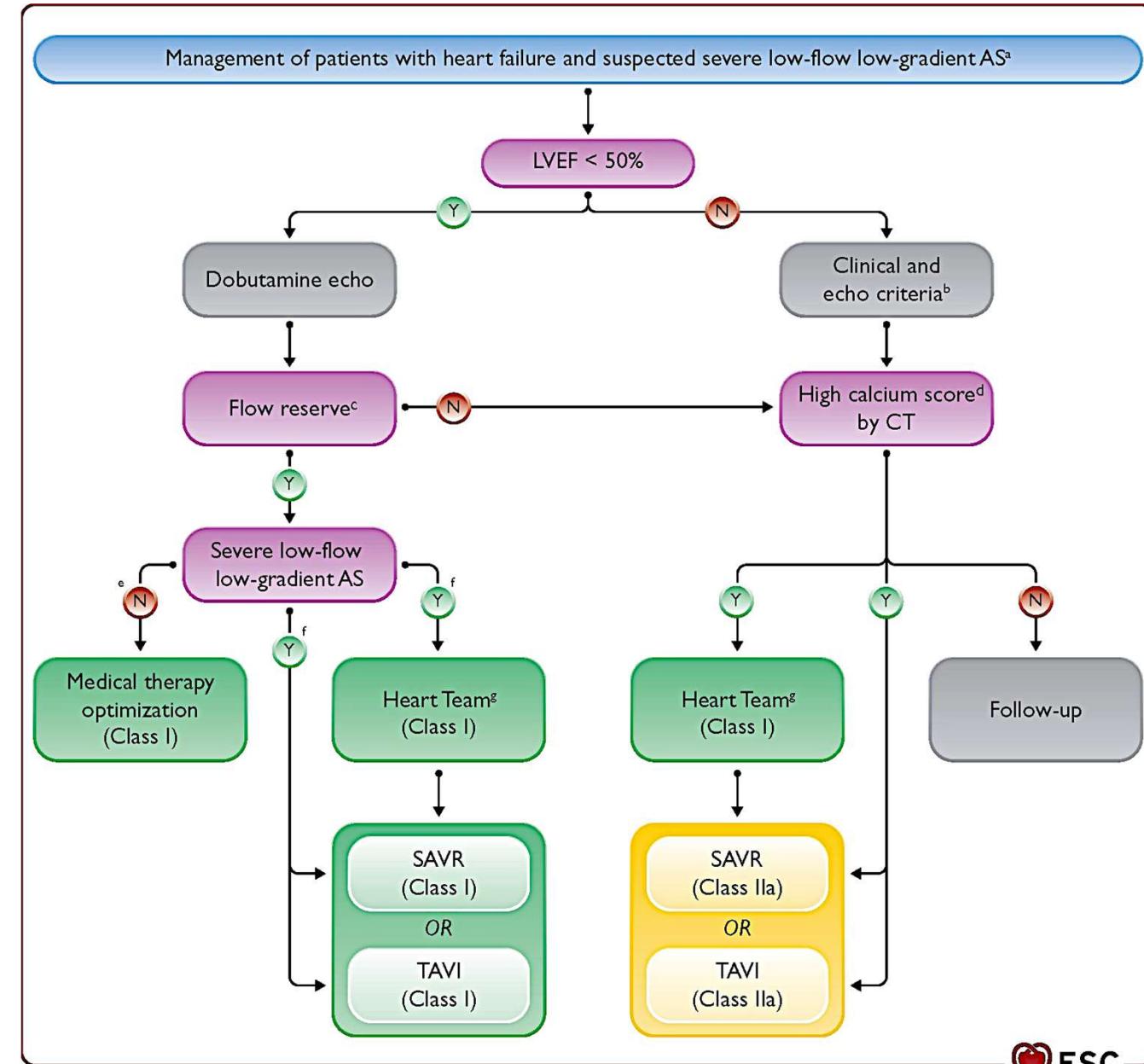
An ICD is recommended to reduce the risk of sudden death and all-cause mortality in patients with symptomatic HF (NYHA class II–III) of an ischaemic aetiology (unless they have had a MI in the prior 40 days—see below), and an LVEF $\leq 35\%$ despite ≥ 3 months of OMT, provided they are expected to survive substantially longer than 1 year with good functional status.^{161,165}

An ICD should be considered to reduce the risk of sudden death and all-cause mortality in patients with symptomatic HF (NYHA class II–III) of a non-ischaemic aetiology, and an LVEF $\leq 35\%$ despite ≥ 3 months of OMT, provided they are expected to survive substantially longer than 1 year with good functional status.^{161,166,167}

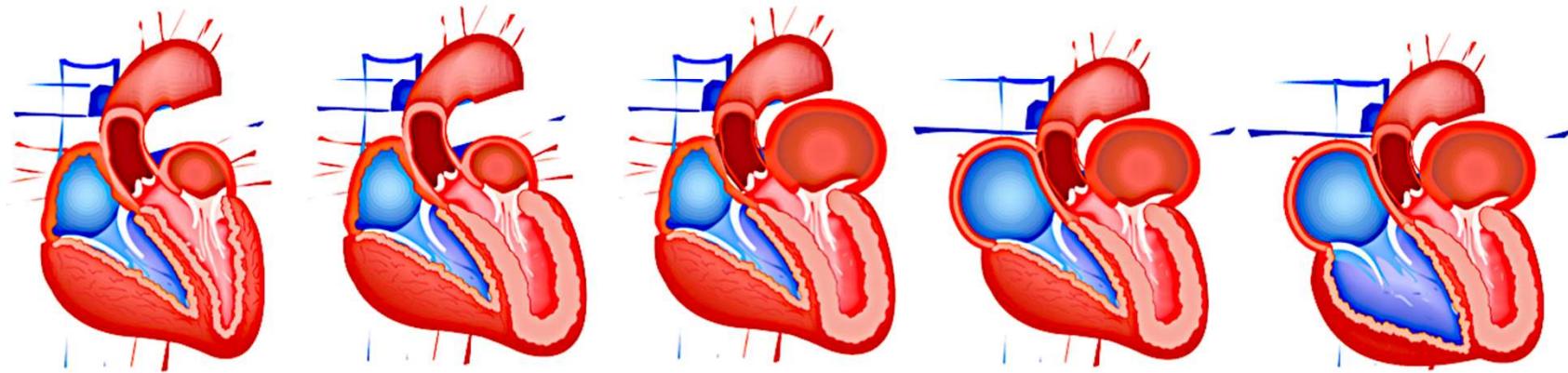
I	A
IIa	A

Management of patients with severe low-flow low-gradient aortic stenosis and heart failure

McDonagh 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368.



Asymptomatic AS Staging and Disease Severity



Stage 0 No damage	Stage 1 LV damage	Stage 2 LA/Mitral damage	Stage 3 PA/Tricuspid damage	Stage 4 RV damage
	Increased LV Mass Index $>115 \text{ g/m}^2$ Male $>95 \text{ g/m}^2$ Female	Indexed left atrial volume $>34 \text{ mL/m}^2$	PAS $\geq 60 \text{ mmhg}$	Moderate-Severe RV dysfunction
	Diastolic Dysfunction Grade ≥ 2	Moderate-Severe MR	Moderate-Severe TR	$SVi < 30 \text{ mL/m}^2$
	EF $<60\%$	Atrial Fibrillation		
	GLS $<15\%$			

Tastet... Lancellotti et al. JACC; 2019: 74: 550-563

Management of secondary mitral regurgitation

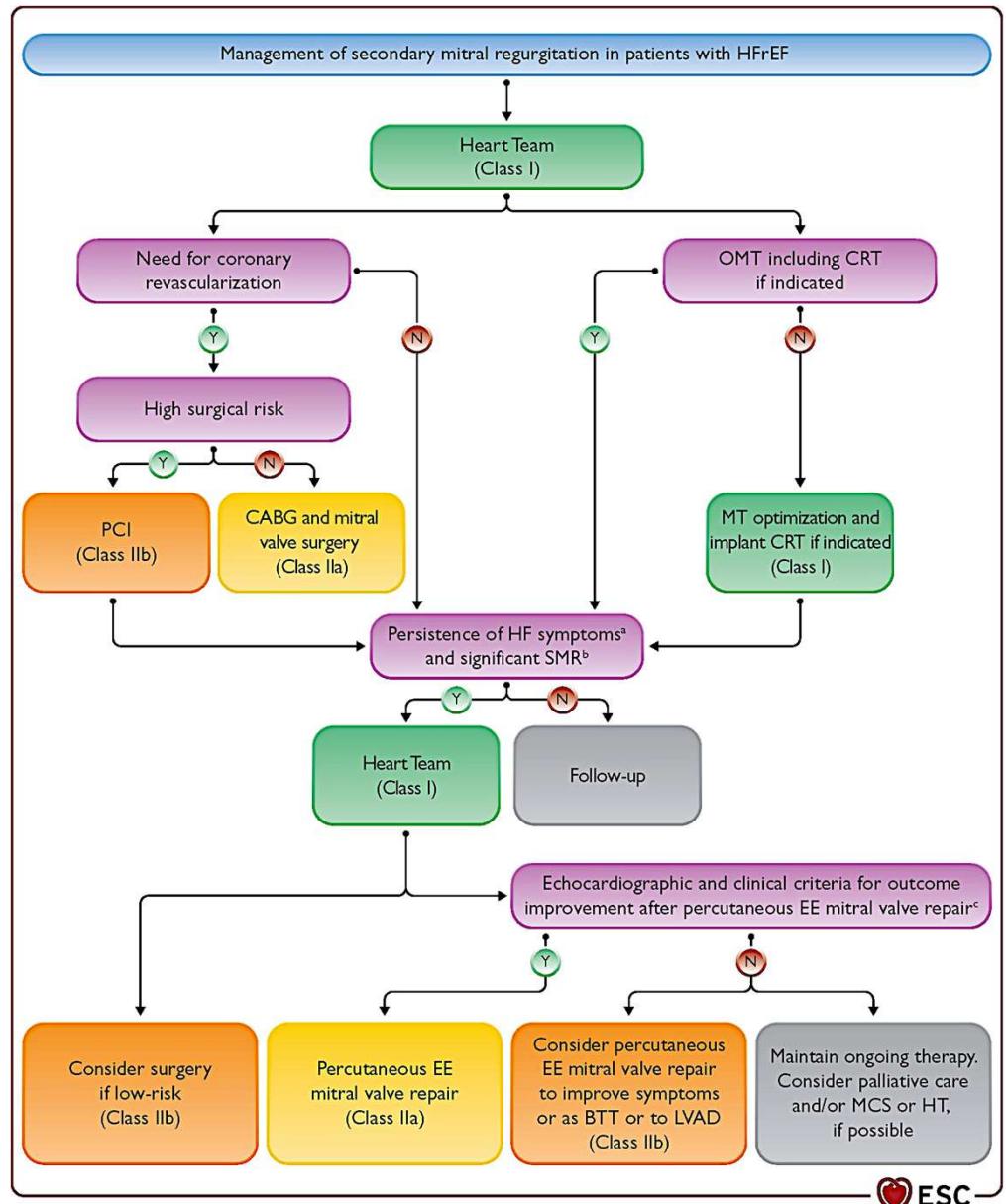
LVEF 20-50 %

LVESD < 70 mm

PAPS < 70 mm Hg

McDonagh 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368

Heidenreich PA., 2022 AHA/ACC/HFSA guideline for the management of heart failure: J Am Coll Cardiol. 2022;79:e263–e421



Hypertrophic cardiomyopathy: specific aspects of diagnosis and treatment

- Wall thickness >14 mm in one or more LV myocardial segments not sufficiently explained solely by abnormal loading conditions.
- LVOTO ≥ 30 mmHg at rest or exercise, asymmetric hypertrophy, or increased LGE in a patchy mid-wall pattern in the most hypertrophied segment, further suggest the presence of HCM.
- It can be considered familial when two or more first- or second-degree relatives with HCM or a first-degree relative with autopsy proven HCM and sudden death at <50 years of age are detected.

*McDonagh 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure.
Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368.*

Cardiac imaging in cardio-oncology

- Cardiac imaging is indicated at baseline and should be performed at any time if patients receiving cardiotoxic therapies present with new cardiac symptoms.
- The frequency of cardiac imaging monitoring during therapy should be adapted according to the estimated baseline risk and the expected CTR-CVT manifestation
- The cardiac imaging technique used should be based on local expertise and availability, and the same imaging modality (i.e. 3D-TTE, 2D-TTE, CMR) is recommended throughout the entire treatment to decrease inter-technique variability
 - including 3D-LVEF and GLS assessment (threshold -15 %)

Alexander R Lyon, 2022 ESC Guidelines on cardio-oncology (ESC), European Heart Journal, Volume 43, Issue 41, 1 November 2022, Pages 4229–4361, <https://doi.org/10.1093/eurheartj/ehac244>

Criteria for definition of advanced heart failure

HAEMODYNAMIC CONSIDERATION

1. SBP<90mmHg or meanBP<60mmHg
2. Cardiac index <2.2 L/min/m²
3. Pulmonary capillary wedge pressure >15 mm Hg
4. Other hemodynamic considerations
 - a. Cardiac power output ([CO x MAP]/451) <0.6 W
 - b. Shock index (HR/systolic BP) >1.0
 - c. RV shock
 - i. Pulmonary artery pulse index [(PASP-PADP)/CVP] <1.0
 - ii. CVP >15 mm Hg
 - iii. CVP-PCW >0.6

All the following criteria must be present despite optimal medical treatment:

1. Severe and persistent symptoms of heart failure [NYHA class III (advanced) or IV].

2. Severe cardiac dysfunction defined by at least one of the following:

LVEF ≤30%

Isolated RV failure (e.g., ARVC)

Non-operable severe valve abnormalities

Non-operable severe congenital abnormalities

Persistently high (or increasing) BNP or NT-proBNP values and severe LV diastolic dysfunction or structural abnormalities (according to the definitions of HFpEF).

3. Episodes of pulmonary or systemic congestion requiring high-dose i.v. diuretics (or diuretic combinations) or episodes of low output requiring inotropes or vasoactive drugs or malignant arrhythmias causing >1 unplanned visit or hospitalization in the last 12 months.

4. Severe impairment of exercise capacity with inability to exercise or low 6MWT distance (<300m) or pVO₂ <12 mL/kg/min or <50% predicted value, estimated to be of cardiac origin.

Interagency Registry for Mechanically Assisted Circulatory Support profile descriptions of patients with advanced heart failure

Profile	Time frame for intervention
Profile 1. Critical cardiogenic shock Patient with life-threatening hypotension despite rapidly escalating inotropic support, critical organ hypoperfusion, often confirmed by worsening acidosis and/or lactate levels. "Crash and burn."	Definitive intervention needed within hours.
Profile 2. Progressive decline Patient with declining function despite i.v. inotropic support, may be manifest by worsening renal function, nutritional depletion, inability to restore volume balance. "Sliding on inotropes." Also describes declining status in patients unable to tolerate inotropic therapy.	Definitive intervention needed within few days.
Profile 3. Stable on inotope or inotope-dependent Patient with stable blood pressure, organ function, nutrition, and symptoms on continuous i.v. inotropic support (or a temporary circulatory support device or both) but demonstrating repeated failure to wean from support due to recurrent symptomatic hypotension or renal dysfunction. "Dependent stability."	Definitive intervention elective over a period of weeks to few months.
Profile 4. Frequent Flyer Patient can be stabilized close to normal volume status but experiences daily symptoms of congestion at rest or during activities of daily living. Doses of diuretics generally fluctuate at very high levels. More intensive management and surveillance strategies should be considered, which may in some cases reveal poor compliance that would compromise outcomes with any therapy. Some patients may shuttle between 4 and 5.	Definitive intervention elective over a period of weeks to few months.
Profile 5. Housebound Comfortable at rest and with activities of daily living but unable to engage in any other activity, living predominantly within the house. Patients are comfortable at rest without congestive symptoms, but may have underlying refractory elevated volume status, often with renal dysfunction. If underlying nutritional status and organ function are marginal, patients may be more at risk than INTERMACS 4, and require definitive intervention.	Variable urgency, depends upon maintenance of nutrition, organ function, and activity.
Profile 6. Exertion limited Patient without evidence of fluid overload, comfortable at rest and with activities of daily living and minor activities outside the home but fatigues after the first few minutes of any meaningful activity. Attribution to cardiac limitation requires careful measurement of peak oxygen consumption, in some cases with haemodynamic monitoring, to confirm severity of cardiac impairment. "Walking wounded."	Variable, depends upon maintenance of nutrition, organ function, and activity level.
Profile 7. Advanced NYHA class III symptoms Patient without current or recent episodes of unstable fluid balance, living comfortably with meaningful activity limited to mild physical exertion.	Heart transplantation or MCS may not be currently indicated.

McDonagh Eur Heart J. 2021 Sep 21;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368.

Résumé; suivi échographique de l'insuffisant cardiaque

- Clinique, biologique, infirmier
- Premier examen l'échographie 45 jours
- Compte rendu type
- Analyse VG, VD couplages ventriculo-artériels
- Penser aux valvulopathies
- De nombreux outils nouveaux, GLS, fonction VD 3 D
- Cardiopathie à caractériser; autre modalités d'imagerie, effort