Nová doporučení ESC pro myokarditidy a perikarditidy

ZOBRAZOVACÍ METODY A JEJICH ROLE V DIAGNOSTICE MYOKARDITID A PERIKARDITID

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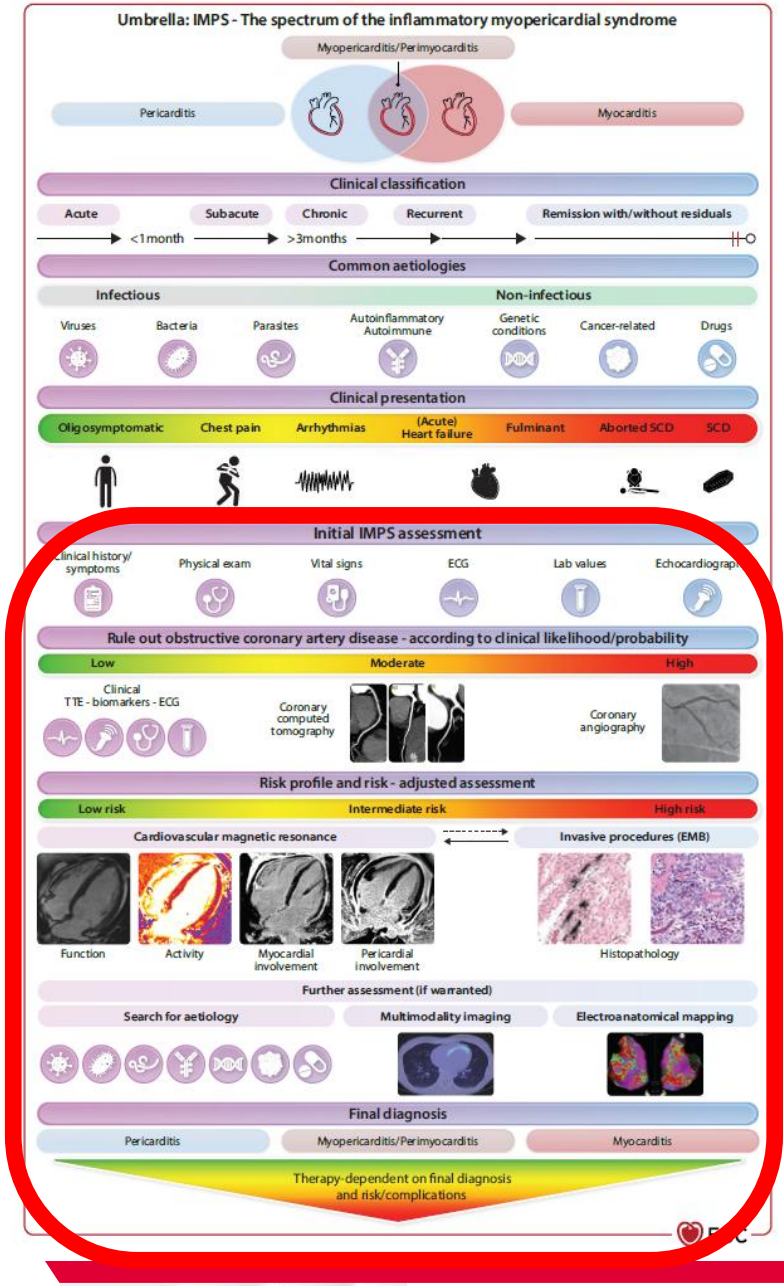
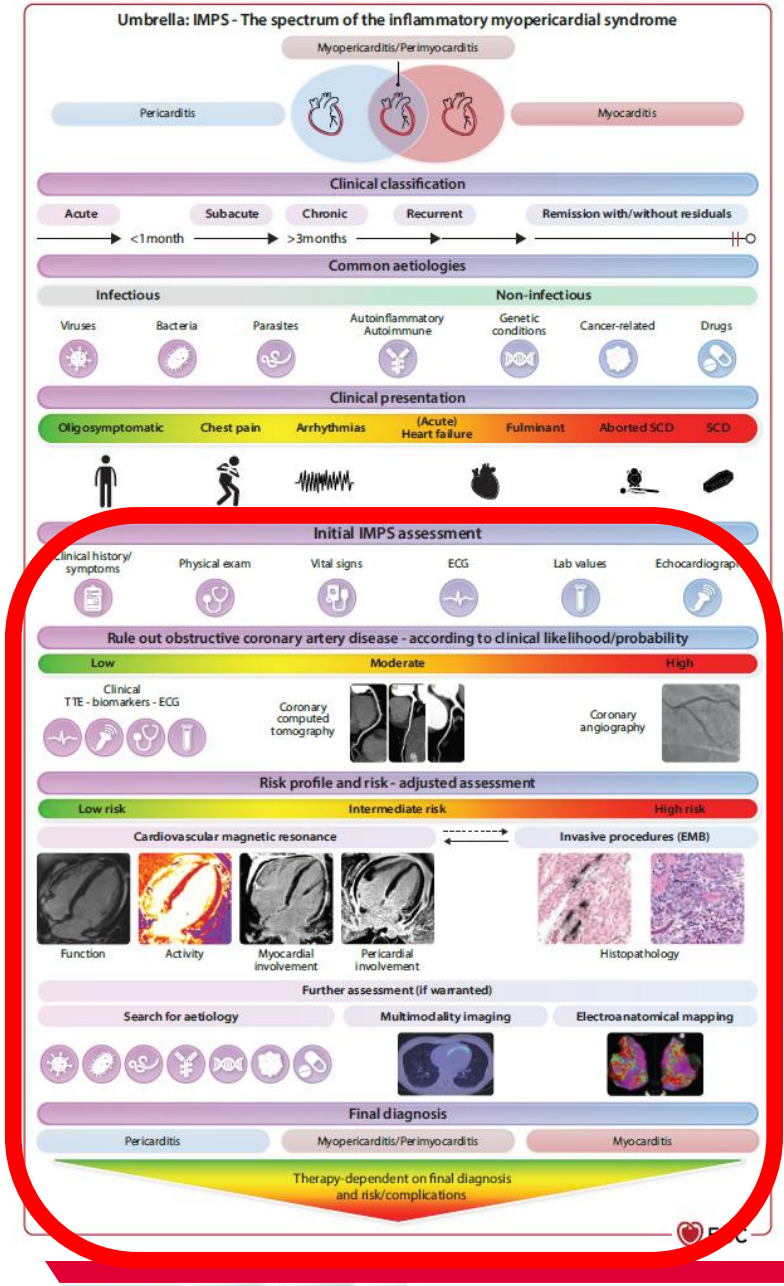

Umbrella: IMPS - The spectrum of the inflammatory myopericardial syndrome
Myopericarditis/Perimyocarditis
Pericarditis
Myocarditis
Clinical classification
Acute
Subacute
Chronic
Recurrent
Remission with/without residuals
<1 month
>3 months
Common aetiologies
Infectious
Non-infectious
Viruses
Bacteria
Parasites
Autoinflammatory Autoimmune
Genetic conditions
Cancer-related
Drugs
Clinical presentation
Oligosymptomatic
Chest pain
Arrhythmias
(Acute) Heart failure
Fulminant
Aborted SCD
SCD
Initial IMPS assessment
Clinical history/ symptoms
Physical exam
Vital signs
ECG
Lab values
Echocardiograp
Rule out obstructive coronary artery disease - according to clinical likelihood/probability
Low
Moderate
High
Clinical TTE - biomarkers - ECG
Coronary computed tomography
Coronary angiography
Risk profile and risk - adjusted assessment
Low risk
Intermediate risk
High risk
Cardiovascular magnetic resonance
Invasive procedures (EMB)
Function
Activity
Myocardial involvement
Pericardial involvement
Histopathology
Further assessment (if warranted)
Search for aetiology
Multimodality imaging
Electroanatomical mapping
Final diagnosis
Pericarditis
Myopericarditis/Perimyocarditis
Myocarditis
Therapy-dependent on final diagnosis and risk/complications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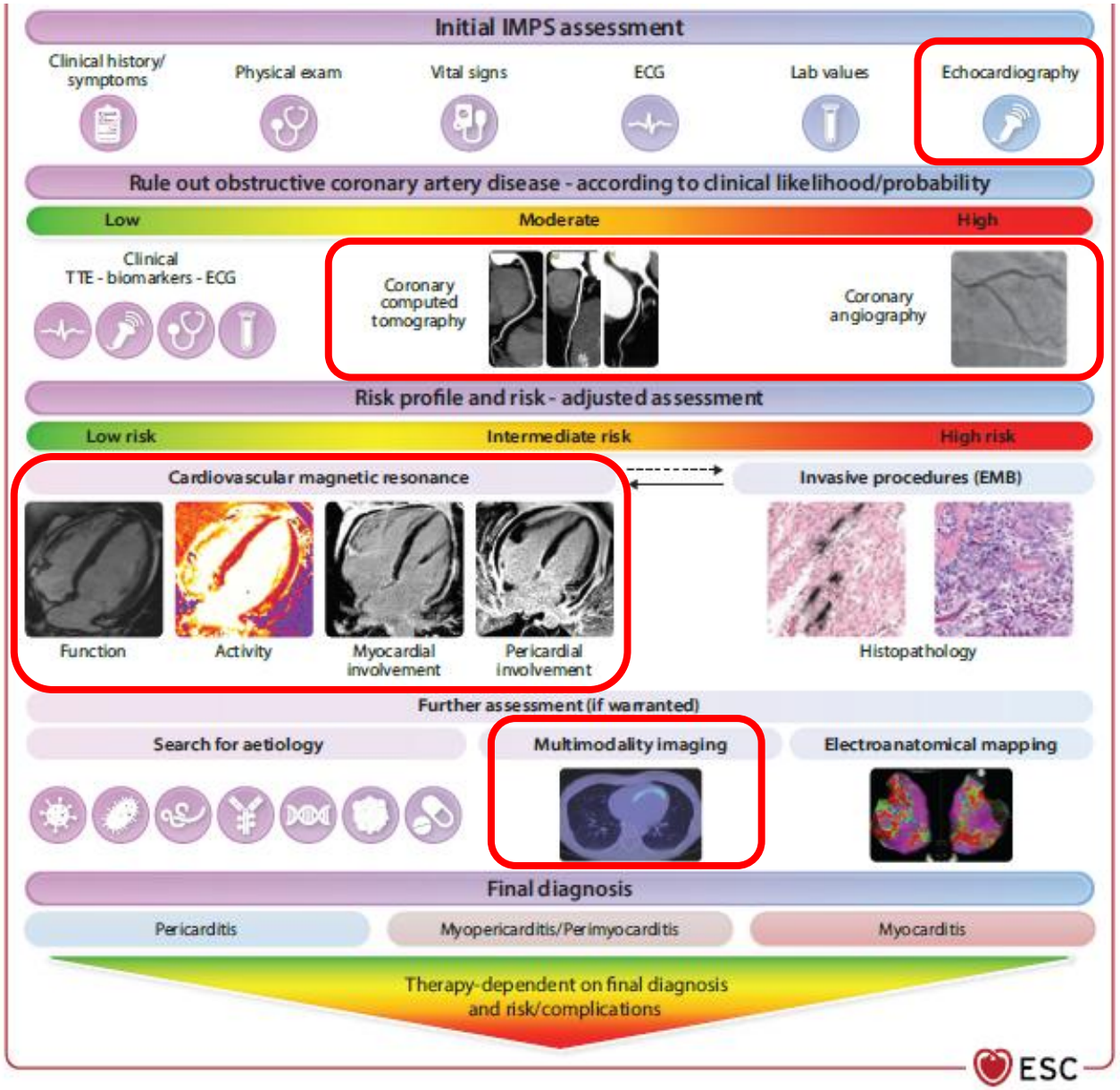
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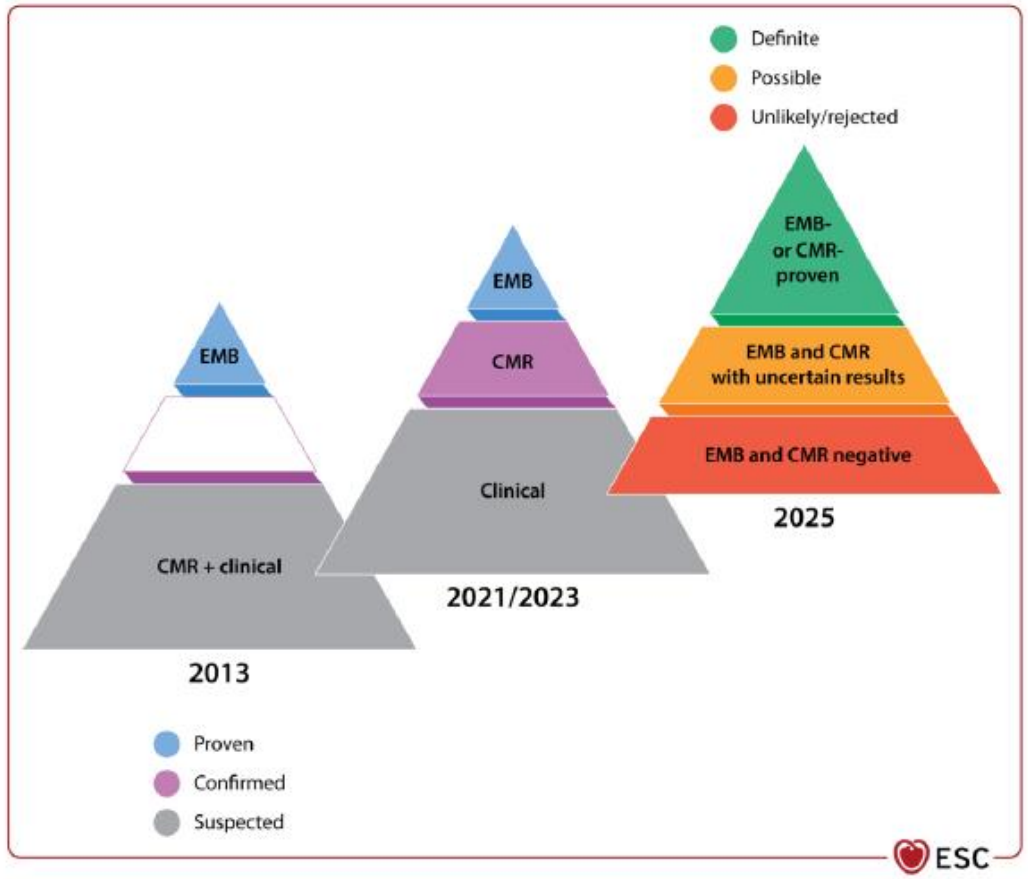
Figure 2

Paradigm change in the clinical diagnosis of myocarditis



2025 ESC Guidelines for the management of myocarditis and pericarditis
(European Heart Journal; 2025 – doi: 10.1093/eurheartj/ehaf192)

Diagnostic criteria and classification for inflammatory myopericardial syndrome

IMPS		
If diagnostic criteria for myocarditis and/or pericarditis are fulfilled		
	Myocarditis	**Pericarditis**
Definite	Clinical presentation and CMR- or EMB-proven	Clinical presentation with >1 additional criterion
Possible	Clinical presentation with at least 1 additional criterion CMR- or EMB-uncertain or not available	Clinical presentation with 1 additional criterion
Unlikely/ Rejected	Only clinical presentation without additional criteria	Only clinical presentation without additional criteria
Additional criteria beyond clinical presentations		
	Myocarditis	**Pericarditis**
Clinical	Non-specific findings	Pericardial rubs
ECG	ST-T changes	PR depression, widespread, ST-segment elevation
Biomarkers	Troponin elevation	CRP elevation
Imaging	Abnormal strain, wall motion, reduced EF Myocardial oedema and/or LGE (CMR findings)	New or worsening pericardial effusion Pericardial oedema and/or LGE (CMR findings)

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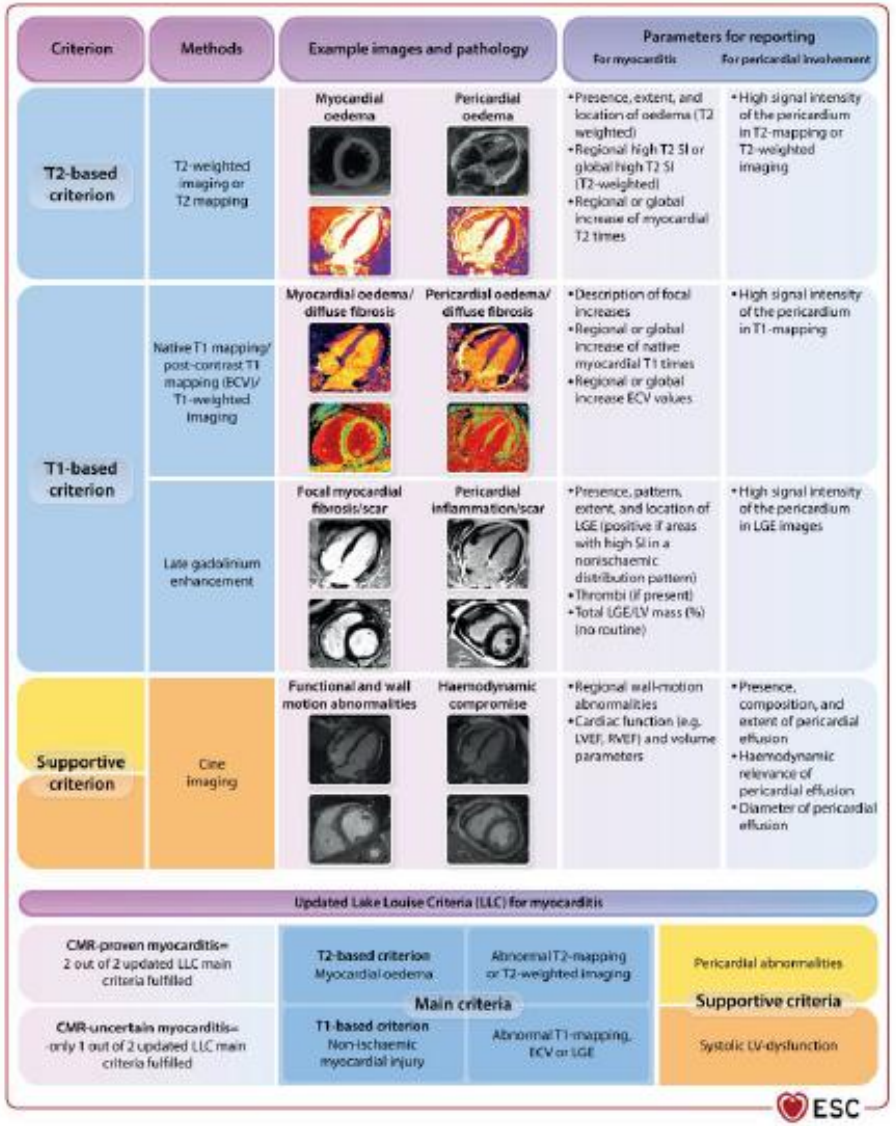
Figure 4

Diagnostic criteria by cardiovascular magnetic resonance based on the updated Lake Louise criteria



CMR categories:
proven = 2 out of 2 updated LLC fulfilled
uncertain = only 1 out of 2 updated LLC fulfilled
rejected = negative CMR

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Clinical risk stratification to guide work-up in inflammatory myopericardial syndrome

Risk	High risk	Intermediate risk	Low risk
Myocarditis	-Acute HF/cardiogenic shock -Dyspnoea NYHA III-IV refractory to medical therapy -Cardiac arrest/syncope -Ventricular fibrillation/sustained ventricular tachycardia -High-level AV block	-New/progressive dyspnoea -Non-sustained ventricular arrhythmias -Persistent release or relapsing troponin	-Stable symptoms or oligosymptomatic
	Imaging criteria: -Newly reduced LVEF (<40%) -Extensive LGE on CMR	**Imaging criteria:** -Newly mildly reduced LVEF (41%–49%) and/or WMA -Preserved LVEF (≥50%) and LGE ≥2 segments on CMR	**Imaging criteria:** -Preserved LVEF (≥50%) without LGE or limited LGE (<2 segments) on CMR
Pericarditis	-Signs and symptoms of cardiac tamponade -Fever (temperature >38°C) -Effusive–constrictive pericarditis -Failure of NSAID therapy -Incessant pericarditis	-Signs and symptoms of right heart failure	-Response to adequate therapy within 1–2 weeks
	Imaging criteria: -Large PEff (>20 mm end-diastole) -Cardiac tamponade -Extensive pericardial LGE on CMR	**Imaging criteria:** -Moderate–large PEff (10–20 mm end-diastole) -Constrictive physiology regardless of the size of the effusion	**Imaging criteria:** -Absence or mild PEff -Absence of pericardial LGE on CMR

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Figure 5

Diagnostic algorithm and triage for inpatient myocarditis

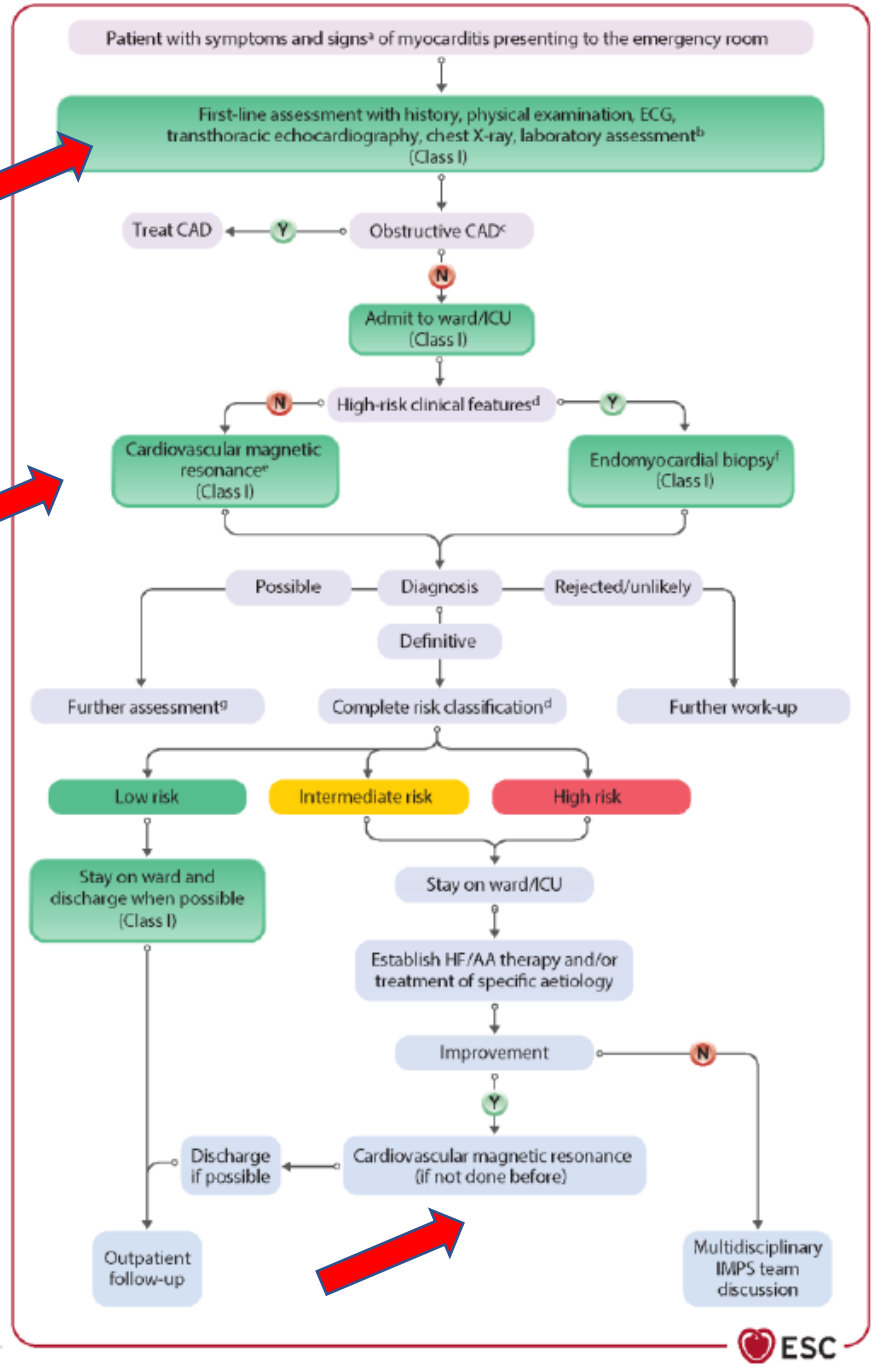

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Figure 6

Diagnostic algorithm and triage for outpatient myocarditis

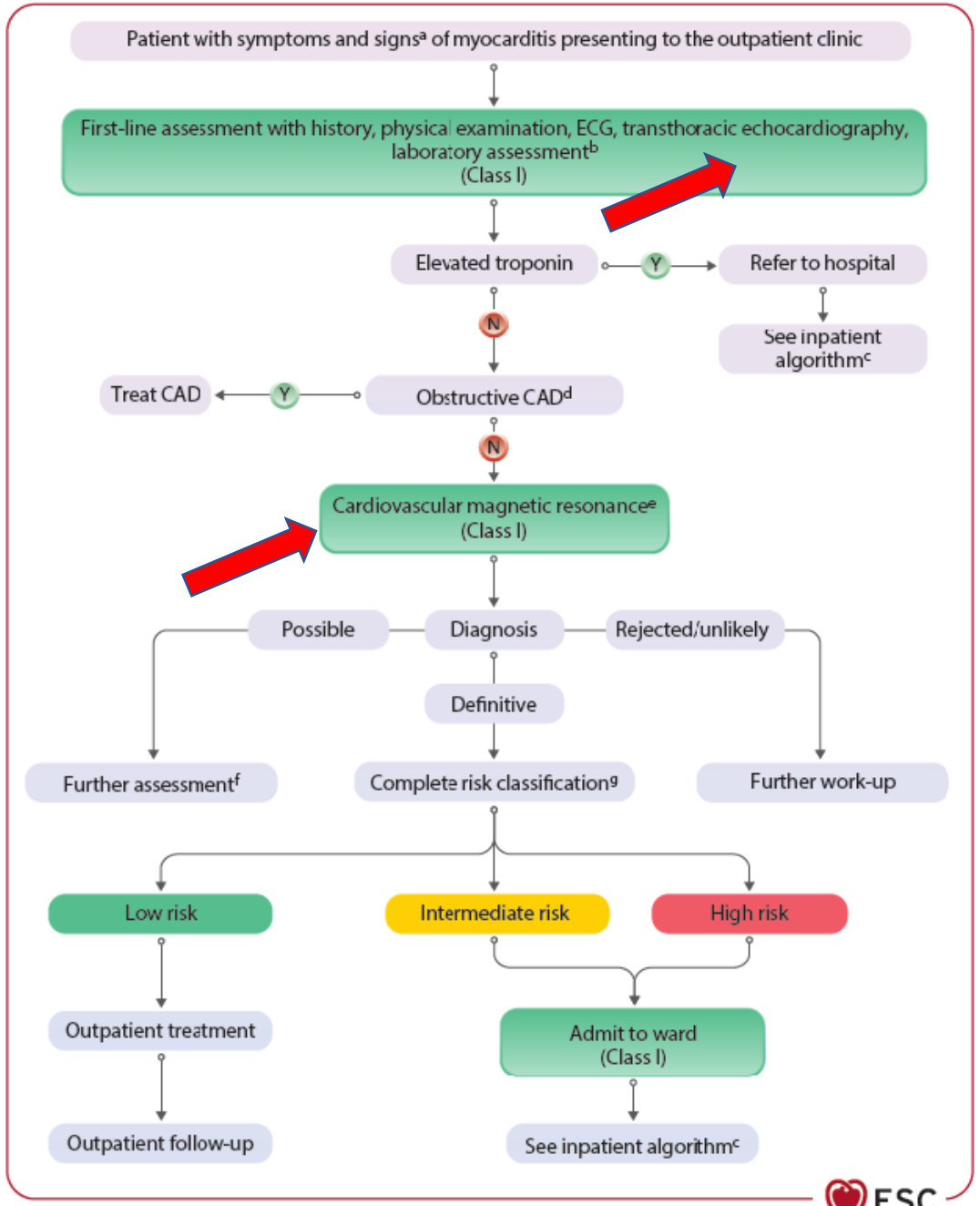

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Figure 9

Diagnostic algorithm for acute chest pain presentation

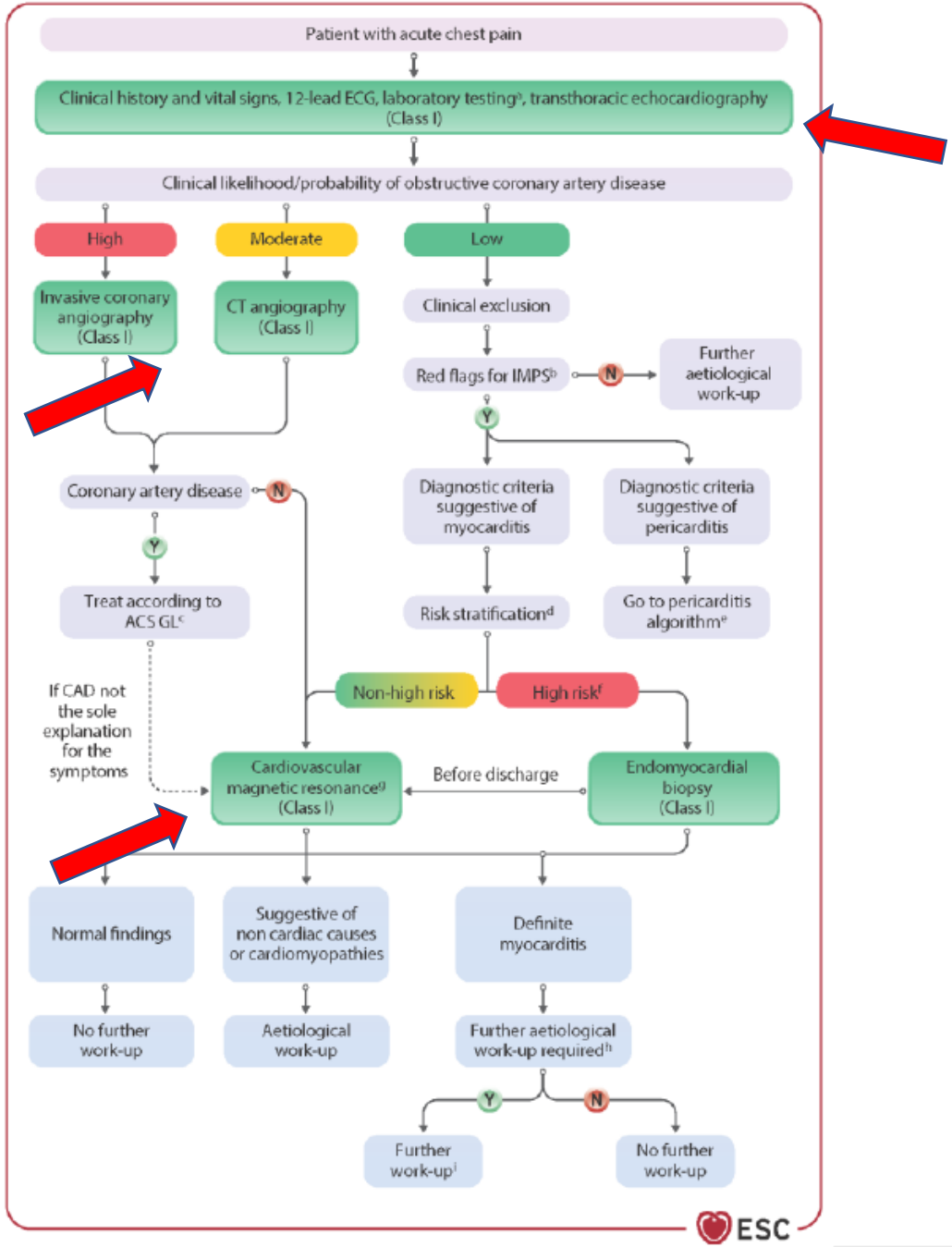

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Figure 10

Diagnostic algorithm for acute heart failure presentation

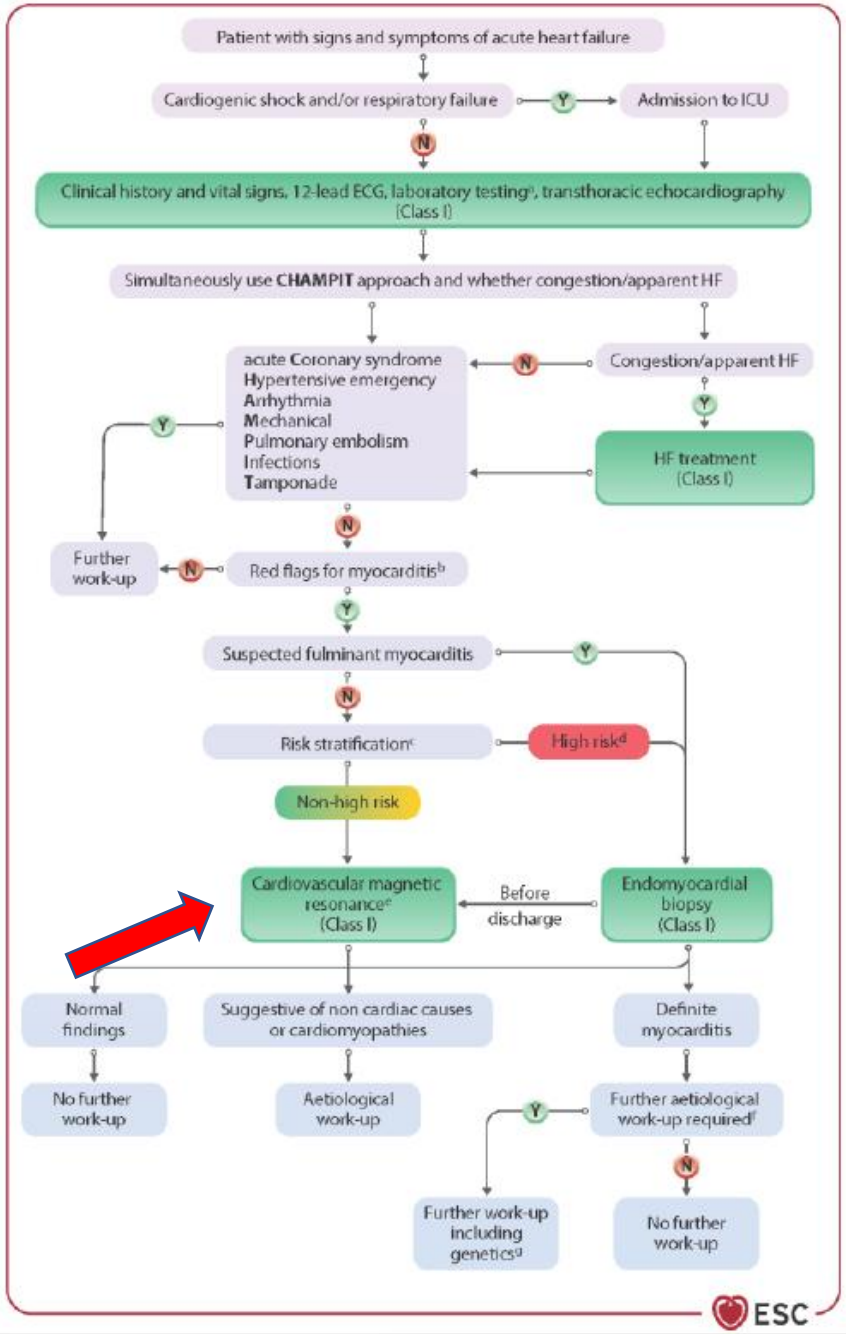

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Figure 11

Diagnostic algorithm for arrhythmia presentation

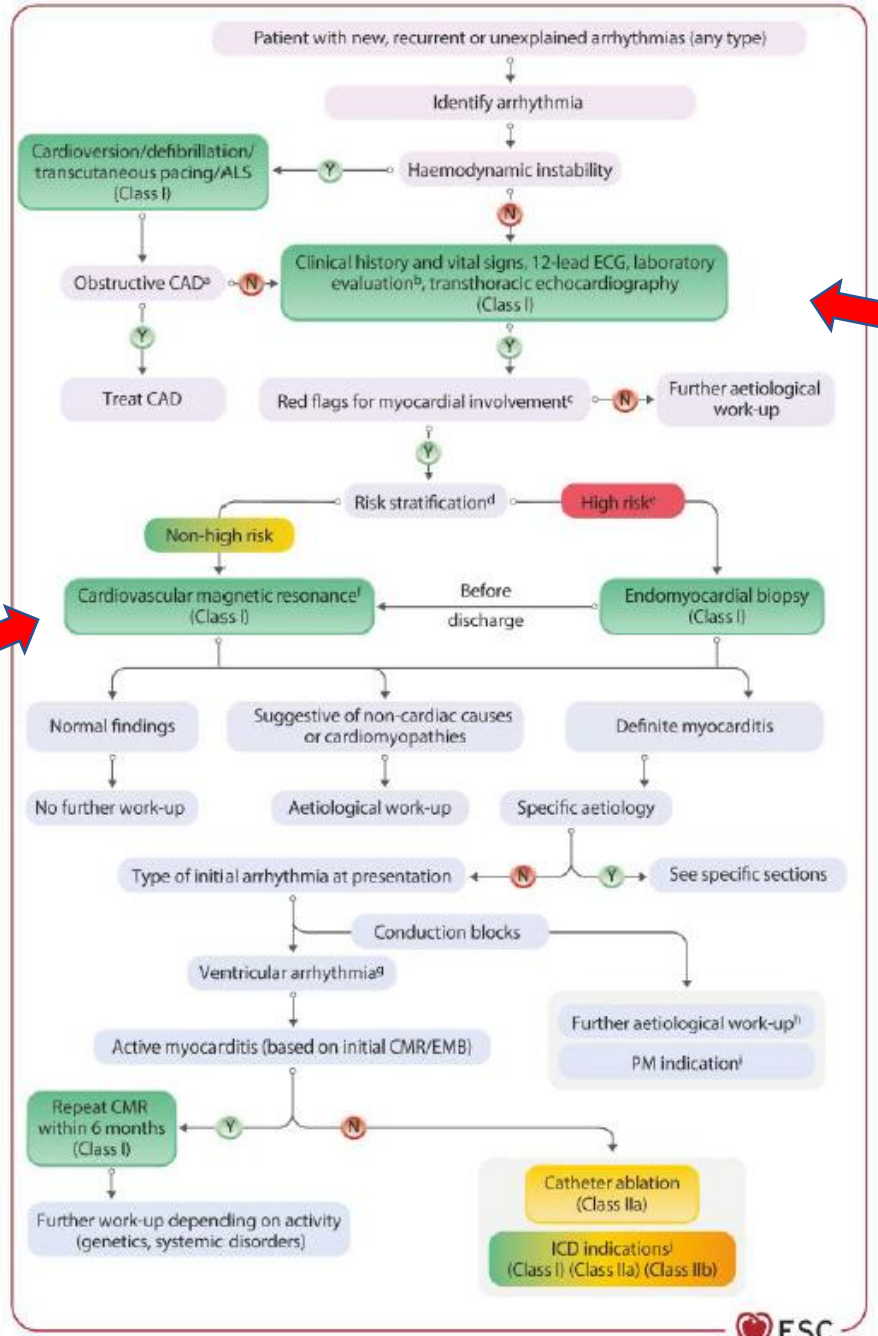

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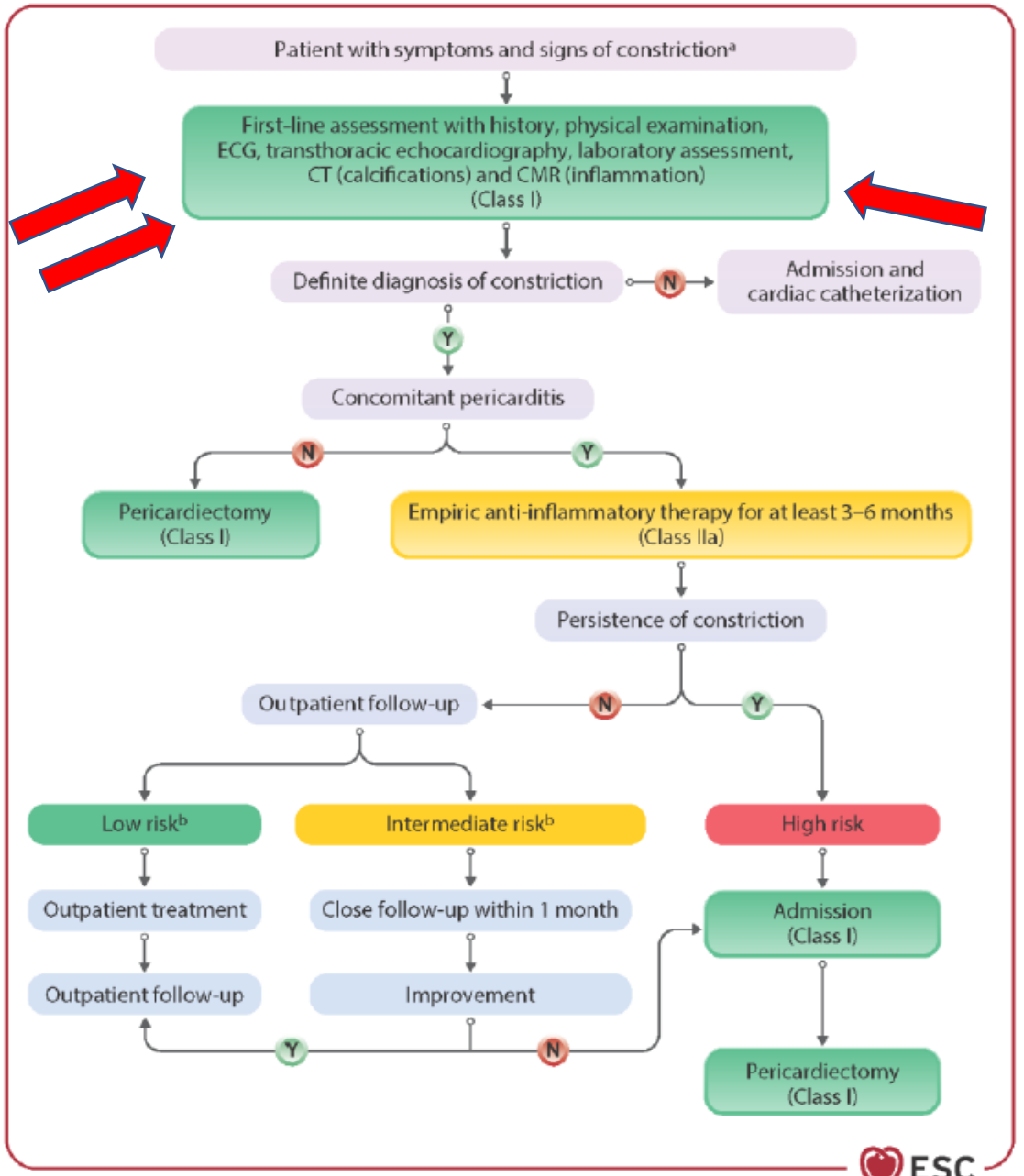
Figure 13

Management of constriction



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Basic and advanced level assessment (1)

Basic assessment:
History: potential causes and triggers (viral infection of upper respiratory or gastrointestinal tract, toxins, drug use, medications), recurrent symptoms, family history of IMPS/cardiomyopathy/SCD, and systemic inflammatory/autoimmune diseases
Physical examination: assess clinical stability, symptoms (chest pain, HF symptoms, palpitations, syncope), malaise, general weakness and fatigue, pericardial friction rub, clinical symptoms/signs of CTP
ECG: PR-segment depression, ST/T-wave changes, AVB, and ventricular arrhythmias
Chest X-ray
Basic laboratory data: Markers of myocardial lesion (e.g. hs-TnT/TnI) Markers of systemic inflammation (e.g. CRP, ESR, WBC count) Markers of heart failure (e.g. NT-proBNP) Complete blood count (including eosinophilic count) Renal function and electrolytes (e.g. sodium, potassium, creatinine) Thyroid function (e.g. TSH) Hepatic function and additional testing (e.g. lactate dehydrogenase, aspartate aminotransferase, alanine aminotransferase)
Echocardiography including strain imaging

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Basic and advanced level assessment (2)

Advanced assessment usually after admission:
Coronary anatomy evaluation (if needed for differential diagnosis by invasive coronary angiography or coronary CT depending on the clinical likelihood of ACS)
CMR to assess signs of myocardial and pericardial inflammation and/or fibrosis
Arrhythmia screening depending on risk stratification (e.g. Holter-ECG)
Additional laboratory parameters guided by clinical suspicion (e.g. if therapeutic consequences are expected)
Dedicated genetic testing if indicated
CT to assess concomitant pleuropulmonary diseases
Specific Myocarditis: EMB in high-risk cases and in intermediate-risk cases on a case-by-case decision to detect specific histology and some aetiologies if needed
Specific Pericarditis: diagnostic pericardiocentesis when indicated

Recommendations for clinical evaluation of myocarditis and pericarditis (1)

Recommendations	Class	Level
Complete clinical evaluation, including history, physical examination, chest X-ray, biomarkers, ECG, and echocardiography is recommended in all patients with a suspicion of myocarditis and/or pericarditis for the initial diagnostic assessment.	I	C
CMR is recommended in patients with the clinical suspicion of myocarditis (using updated LL criteria) and/or pericarditis for the non-invasive diagnosis of inflammatory reaction.	I	B
Hospital admission is recommended for patients with high-risk pericarditis for monitoring and treatment.	I	B
Hospital admission is recommended for patients with moderate- to high-risk myocarditis for monitoring and treatment.	I	C
EMB is recommended in patients with high-risk myocarditis and/or haemodynamic instability, and/or in patients with intermediate-risk myocarditis not responding to conventional therapy in order to detect a specific histologic subtype and to assess the presence of viral genome for treatment.	I	C

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Recommendations for clinical evaluation of myocarditis and pericarditis (2)

Recommendations	Class	Level
Invasive coronary angiography or coronary CT, depending on clinical likelihood, is recommended in patients with IMPS if an acute coronary syndrome is suspected to rule out obstructive coronary artery disease.	I	C
Hospital admission should be considered for patients with low-risk myocarditis for monitoring and treatment.	IIa	C
Pericardial or epicardial biopsy may be considered in relapsing pericardial effusion as part of the diagnostic work-up when the diagnosis cannot be reached with multimodality imaging and laboratory examinations.	IIb	C
Routine serology is not recommended in patients with myocarditis and/or pericarditis for the evaluation of viral aetiology except for hepatitis C, HIV, and Lyme disease.	III	C

Recommendations for genetic testing

Recommendations	Class	Level
It is recommended to obtain family history including pedigrees in cases of recurrent IMPS to provide clues to the underlying aetiology, determine inheritance pattern, and identify relatives at risk.	I	C
Genetic testing should be considered in patients with definite myocarditis/pericarditis in cases of: -family history of IMPS, inherited or suspected cardiomyopathy -severe ventricular arrhythmia -significant left/right LGE (e.g. ring-like pattern or septal LGE) or persistent LVEF systolic dysfunction -recurrent myocarditis or persistent troponin elevation -recurrent pericarditis with an inflammatory phenotype, refractory to conventional treatment, with the aim to detect an underlying genetic cause.	IIa	B

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Recommendations for the use of cardiovascular magnetic resonance imaging

Recommendations	Class	Level
Myocarditis		
CMR is recommended in patients with suspected myocarditis to reach a clinical diagnosis and to determine the cause of acute myocardial injury, including assessment of oedema, ischaemia, and necrosis/fibrosis/scarring.	I	B
CMR is recommended for follow-up at least within the first 6 months in patients with myocarditis to identify a healed or ongoing process, for risk stratification and personalized therapy, and to enable a return to exercise.	I	C
Pericarditis		
CMR is recommended in patients with suspected pericarditis when a diagnosis cannot be made using clinical criteria to assess evidence of pericardial thickening, oedema, LGE, and to assess the persistence of disease during follow-up in selected cases.	I	B

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Recommendations for computed tomography

Recommendations	Class	Level
CT is recommended to evaluate pericardial thickness, calcifications, masses, and loculated pericardial effusions, as well as concomitant pleuropulmonary diseases and chest abnormalities.	I	C

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Recommendations for nuclear medicine

Recommendations	Class	Level
Carb-free ^{18}F-FDG-PET or ^{18}F-FDG-PET/CT should be considered for the diagnostic work-up in patients with suspected myocarditis and/or pericarditis in whom echocardiography and CMR are inconclusive for the clinical diagnosis.	IIa	C

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Recommendations for risk stratification, complications, and outcomes of inflammatory myopericardial syndromes

Recommendations	Class	Level
Follow-up with clinical assessment, biomarkers, ECG, exercise test, Holter-ECG monitoring, echocardiography, and CMR at least within 6 months after the index hospitalization is recommended in all patients with myocarditis to identify a potential progression or new risk factors.	I	C
Long-term follow-up is recommended for patients with complicated myocarditis to identify a potential progression or new complications.	I	C
Long-term follow-up is recommended for patients with incessant or recurrent pericarditis to identify a potential progression and new complications.	I	C

Normal CMR = good prognosis

Negative prognostic markers:
- Initial LGE
- Mid-wall anteroseptal LGE
- LGE in ≥2 segments

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Table 15 **Follow-up in inflammatory myopericardial syndrome after discharge**

		Within 1 month	Within 3–6 months	12 months	>1 year and long-term FU[a]
Clinical evaluation and ECG	Myocarditis	X	X	X	X
	Pericarditis	X	X	X	X
Biomarkers (TnI, C-reactive protein)	Myocarditis	X	X	(X)	(X)
	Pericarditis	X	X	(X)	(X)
Rhythm (stress and/or Holter-ECG)	Myocarditis	–	X	(X)	(X)
	Pericarditis	–	–	–	–
Imaging myocarditis	TTE	X[b]		X[c]	X[c]
	CMR	X[b]		X[c]	X[c]
Imaging pericarditis	TTE	X[b]		X[c]	X
	CMR	(X)[b]		(X)[d]	(X)[d]

All follow-ups should be adapted to the clinical situation and severity. In round brackets, optional testing according to clinical presentation [(X), case-by-case decision].

[a]A long-term FU, e.g. after 2 years, is suggested only for complicated cases of IMPS, usually myocarditis.

[b]In complicated cases or if abnormal at 1 month, imaging should be repeated between 3 and 6 months.

[c]If abnormal at 6 months, imaging should be repeated within the next 6 months and/or in the next 12 months.

[d]Follow-up proposed for uncomplicated cases of acute pericarditis. Long-term follow-up, tailored to the single patient, is recommended for high-risk cases.

Recommendations for myocarditis in sarcoidosis

Recommendations	Class	Level
Diagnosis		
CMR, using tissue characterization techniques, is recommended in patients with suspected CS to assess cardiac inflammation and myocardial involvement.	I	B
^{18}F-FDG-PET is recommended for the diagnostic work-up, including detection of inflammation, as well as for follow-up and assessment of therapeutic response in patients with CS.	I	B
Therapy		
ICD implantation is recommended in patients with CS and sustained ventricular arrhythmia (VT/VF) or aborted CA to prevent SCD.	I	B
ICD implantation is recommended in patients with CS and LVEF ≤35% to prevent SCD.	I	C
ICD implantation should be considered in patients with CS and LVEF >35% after resolution of the active phase with significant LGE, a history of arrhythmias, unexplained syncope, inducible sustained VA at PVS, or with persistent high-degree AVB to prevent SCD.	IIa	C

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Echocardiographic signs of cardiac tamponade

Echocardiographic feature	Sensitivity	Specificity
Large pericardial effusion with swinging heart	n.a.	n.a
Diastolic collapse of the RA	50%–100%	33%–100%
Duration of diastolic collapse of the RA as a ratio of the cardiac cycle length >0.34	>90%	100%
Diastolic collapse of the RV	48%–100%	72%–100%
Respiratory changes of the mitral E velocity >25%–30%, tricuspid E velocity >40%–60%	n.a.	n.a.
Inferior vena cava plethora (dilatation >20 mm and <50% reduction of diameter with respiratory phases) as well as hepatic vein dilatation	97%	40%

Recommendations for constrictive pericarditis

Recommendations	Class	Level
Diagnosis		
Multimodality imaging is recommended in all patients with suspected constrictive pericarditis to make the diagnosis and assess pericardial thickening, calcifications, and active inflammation.	I	C
Cardiac catheterization for haemodynamic assessment should be considered in patients with suspected constrictive pericarditis when multimodality imaging is inconclusive.	IIa	C
Therapy		
Anti-inflammatory therapy is recommended in haemodynamically stable patients with a transient or new diagnosis of constriction with concomitant evidence of pericardial inflammation to prevent progression to constriction and avoid pericardiectomy.	I	C
Pericardiectomy is recommended in patients with permanent constriction if there is no active inflammation or anti-inflammatory treatment is not successful after 3–6 months.	I	C

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Table S5 Capabilities of multimodality imaging in inflammatory myopericardial syndrome

Modality		Echocardiography			CMR					^{18}F-FDG-PET	CT
technique		2D/3D	Strain	Doppler	Cine	LGE	T1 mapping	T2 mapping/ T2 weighted	Overview images (coverage thorax)	^{18}F-FDG-PET	
Myocardium	**Morphology/function**										
	LV function (global/segmental)	+++/+++	+++/++	++/++	+++/+++					+/+	+/+
	RV function (global/segmental)	+++/+++	++/++	+/+	+++/+++						+/-
	Tissue characteristics										
	Scar		+	+	+	+++	++			+++	++
	Oedema	+			+	+	++	+++			
	Inflammatory reaction					+	+++	+++		+++	
Pericardium	Inflammation					+++	++	+++		+	
	Calcification	+			+	+	+	+	+		+++
	Effusion	+++			+++	+++	++	++	+		++
	Diastolic dynamics	++		+++	++						
	Thickness/adhesions	+/++			+++/+++	+++	+	+	+/–		+++/+
	Masses	+++			+++	+++	+	+	+	+	++
Extracardiac findings		+			+	+	+	+	+++	+++	+++

2D, two-dimensional; 3D, three-dimensional; CMR, cardiovascular magnetic resonance; CT, computed tomography; [18F]-fluorodeoxyglucose positron emission tomography; LGE, late gadolinium enhancement; LV, left ventricle; RV, right ventricle; +++=excellent; ++=good; +=sufficient.

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