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em Medicina
Cardiovascular

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The Village Praia
D'El Rey - Óbidos



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Role of imaging in acute cardiovascular care

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Imaging techniques in acute cardiovascular care

- **Chest X-ray**
- **Ultrasound**
 - Echocardiography (TT/TE)
 - Thoracic
 - Vascular
- **Computed tomography angiography**
 - Coronary
 - Pulmonary
 - Aorta
- **Cardiac magnetic resonance**

- ✓ Diagnosis
- ✓ Treatment decisions
- ✓ Follow up
- ✓ Prognostic stratification

Imaging techniques in acute cardiovascular care

	Main applications	Limitations
Chest X-ray	Diagnosis of HF Diagnosis of concurrent extracardiac disease (pneumothorax, pleural effusion, consolidation, etc.)	Low specificity Limited correlation with hemodynamic parameters
Focused TTE	Global assessment of cardiac structure and function in acute situations Qualitative assessment of: • Pericardial effusion • Intravascular volume • Ventricular size and function Pulmonary ultrasound	Equipment technically inferior Specific training Stressful situations Risk of missing important abnormalities Window
Comprehensive TTE	Syndromic diagnosis (preserved vs reduced LVEF) Etiological diagnosis (ischemia, valvular heart disease, cardiomyopathies, etc.) Noninvasive hemodynamic assessment	Specific training Window
TEE	As with TTE Endocarditis, intracardiac thrombus, aortic dissection Valvular heart disease (severity and mechanism) Monitoring of therapeutic procedures Possibility of continuous monitoring (miniaturized probes)	Adequate training Esophageal probing
CT	Triple rule out: noninvasive coronary angiography, pulmonary thromboembolism, acute aortic syndrome Diagnosis of concurrent pulmonary and chest disease	Radiation Iodinated contrast (hypersensitivity, nephrotoxicity)
MRI	Characterization of myocardium Quantification of severity of valvular heart disease Aortography	Hemodynamic instability Metallic implants, devices, etc. Availability Gadolinium contrast

CT, computed tomography; HF, heart failure; LVEF, left ventricular ejection fraction; MRI, magnetic resonance imaging; TEE, transesophageal echocardiography; TTE, transthoracic echocardiography.

Imaging techniques in acute cardiovascular care

■ Chest X-ray

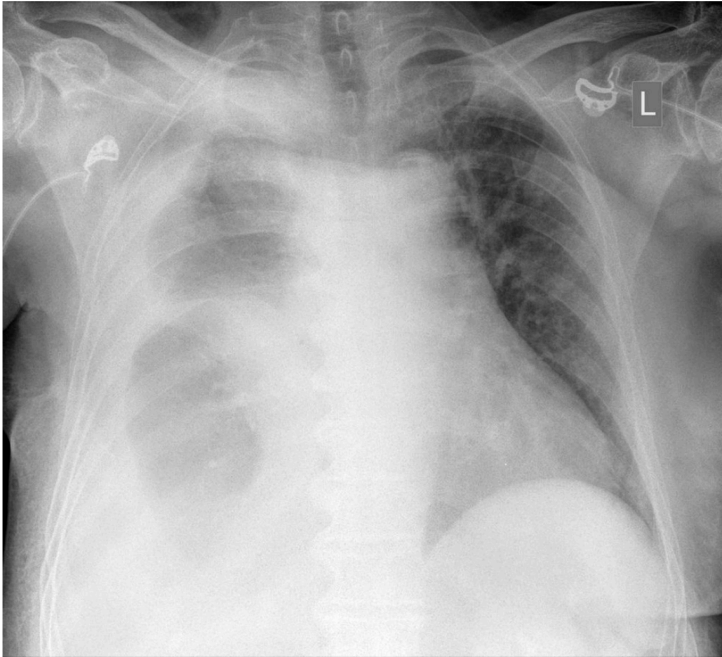
- Diagnosis and follow up
- Device placements

- ✗ Radiation exposure
- ✗ Low specificity
- ✗ Limited correlation with hemodynamic parameters

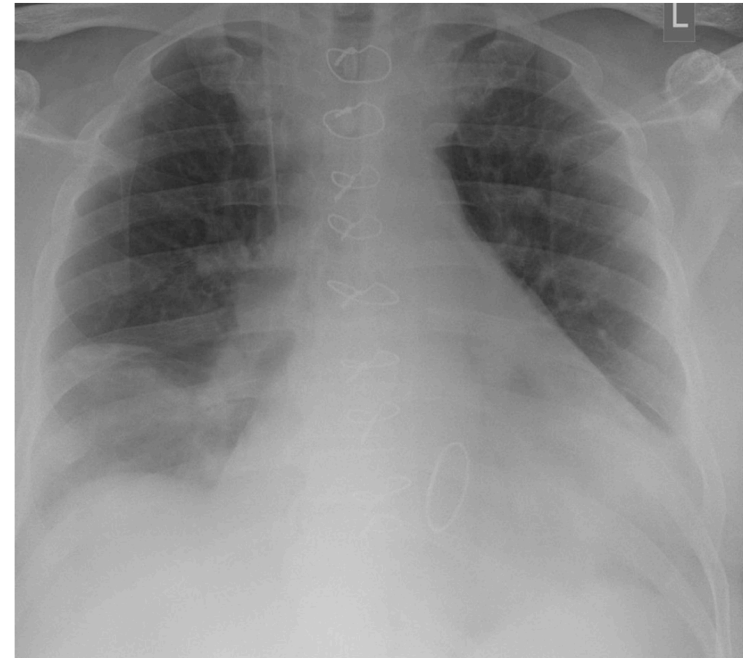
Imaging techniques in acute cardiovascular care

- **Chest X-ray**
 - Diagnosis and follow up

Water retention-related problems



Right-sided pleural effusion

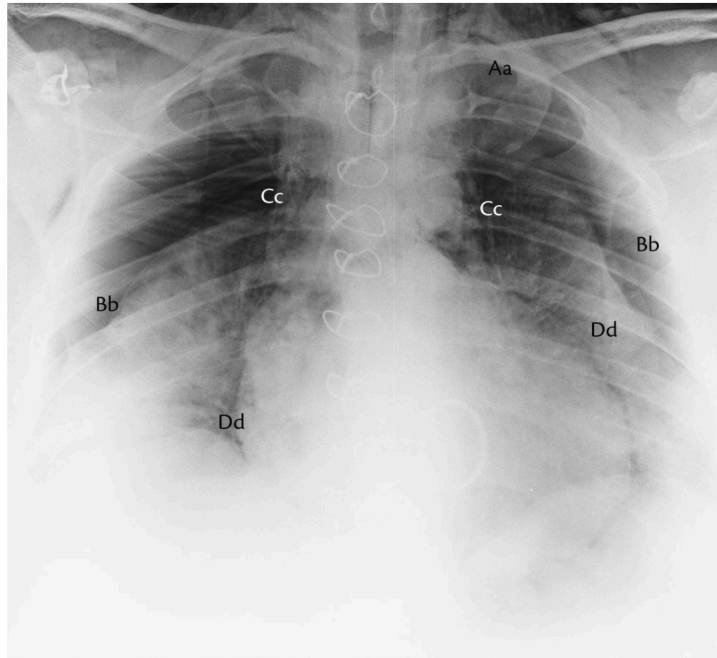


Pericardial effusion

Imaging techniques in acute cardiovascular care

- **Chest X-ray**
 - Diagnosis and follow up

Air-related problems

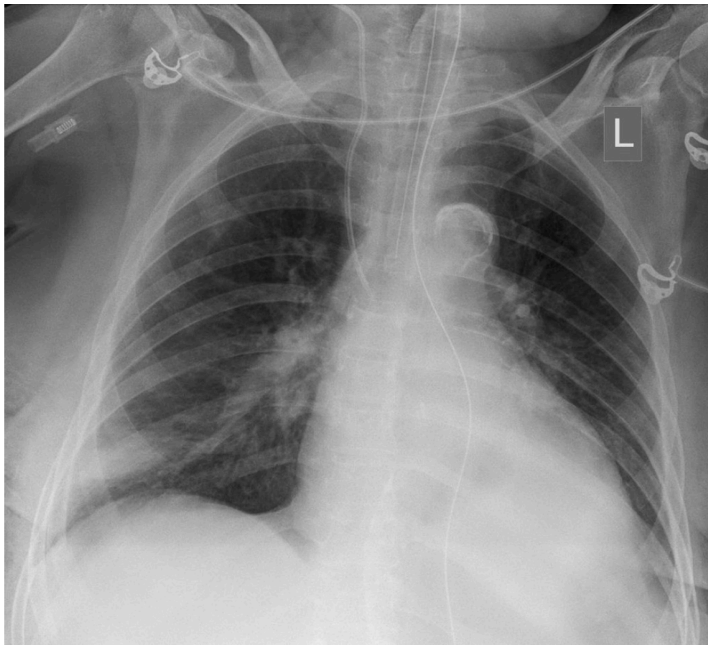


(A) Subcutaneous emphysema. (B) Large bilateral tension pneumothorax.
(C) Pneumomediastinum. (D) Pneumopericardium.

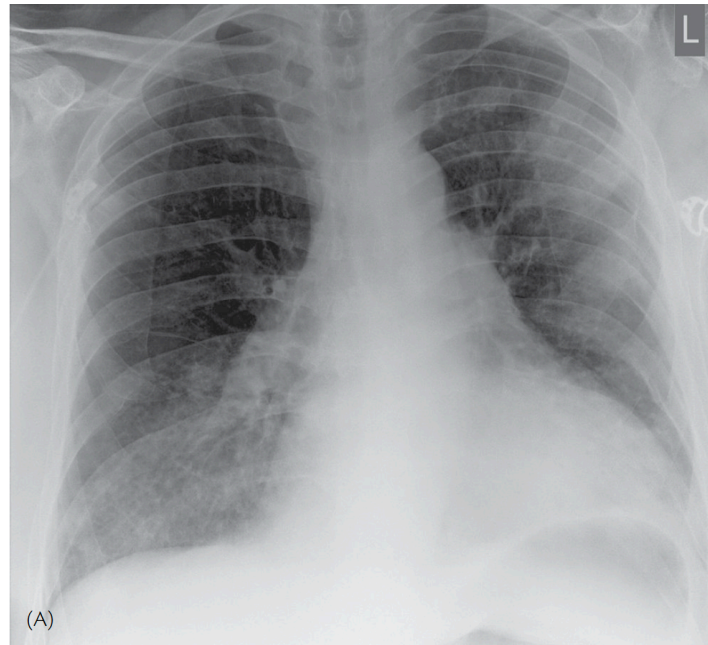
Imaging techniques in acute cardiovascular care

- **Chest X-ray**
 - Diagnosis and follow up

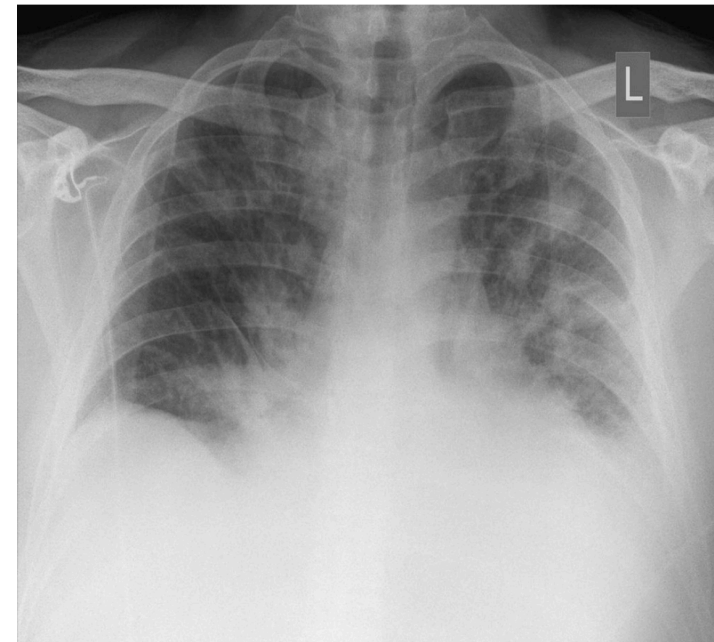
Lung-related problems



Pneumonia (opacity in right lower lobe)



Massive PE (enlargement of the right pulmonary artery-*Palla's* sign), oligemia of pulmonary vessels (*Westmark's* sign)



Pulmonary oedema (*bat wing* opacities, *Kerley A* lines running to the periphery)

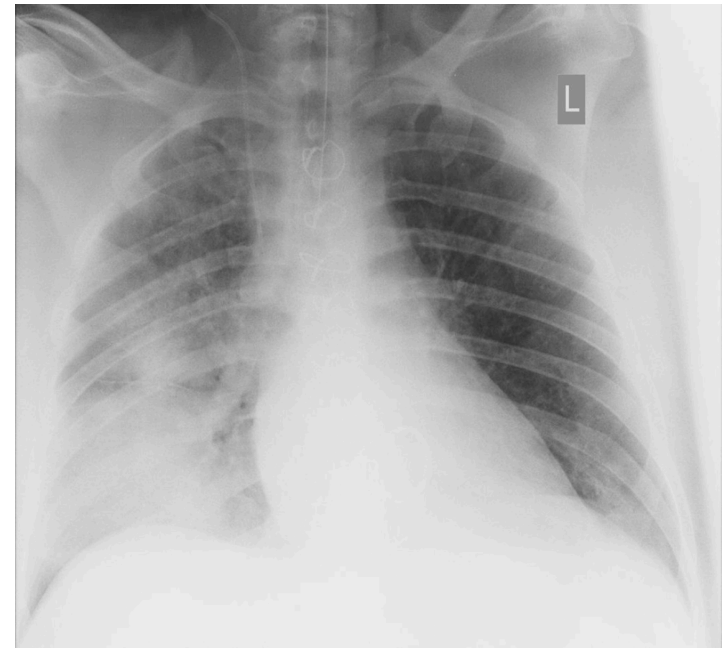
Imaging techniques in acute cardiovascular care

- **Chest X-ray**
 - Diagnosis and follow up

Lung-related problems



ARDS (bilateral airspace opacities and increased interstitial markings in a patient with acute respiratory failure)



Aspiration pneumonia (right lower lobe consolidation, right-sided pulmonary oedema)

Imaging techniques in acute cardiovascular care

■ Chest X-ray

- Device placements

- **Endotracheal tubes**
- Central venous catheters
- IABPs
- Pacemakers leads
- Chest Tubes and drains



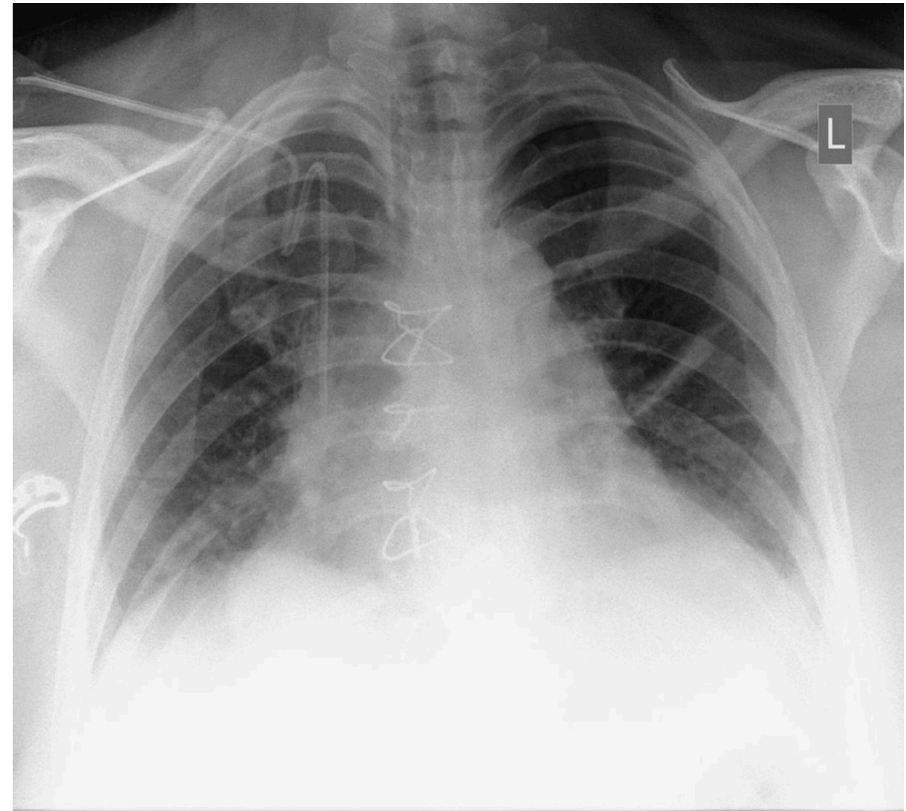
Correctly placed ETT

Imaging techniques in acute cardiovascular care

■ Chest X-ray

- Device placements

- Endotracheal tubes
- **Central venous catheters**
- IABP
- Pacemakers leads
- Chest Tubes and drains



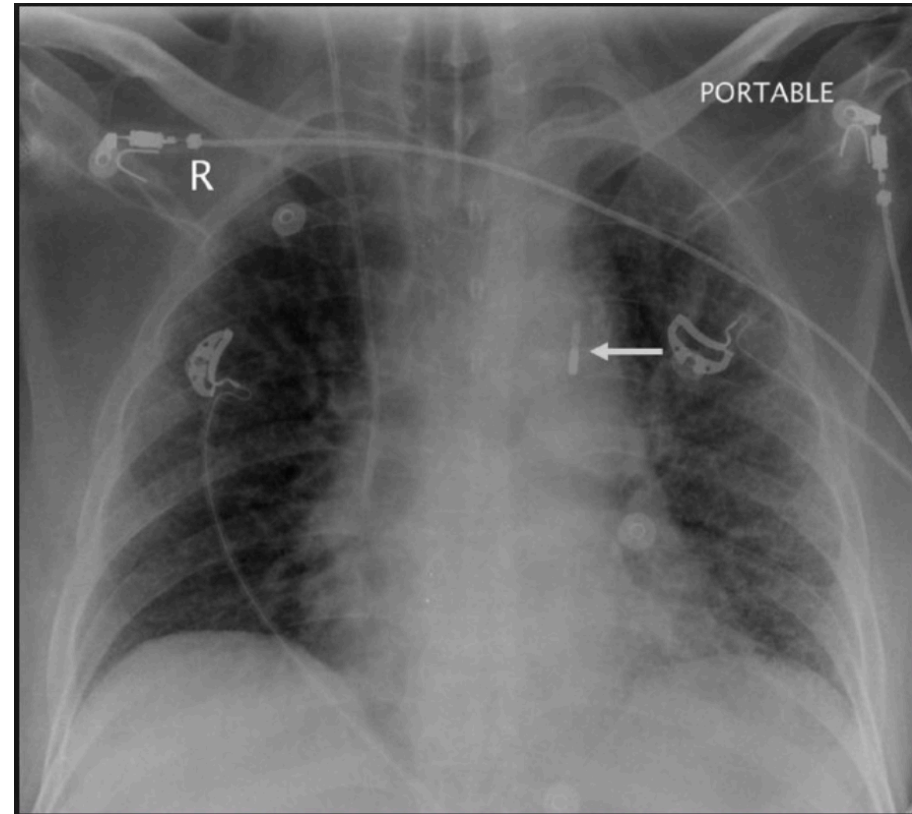
Coiled CVC

Imaging techniques in acute cardiovascular care

■ Chest X-ray

- Device placements

- Endotracheal tubes
- Central venous catheters
- **IABP**
- Pacemakers leads
- Chest Tubes and drains



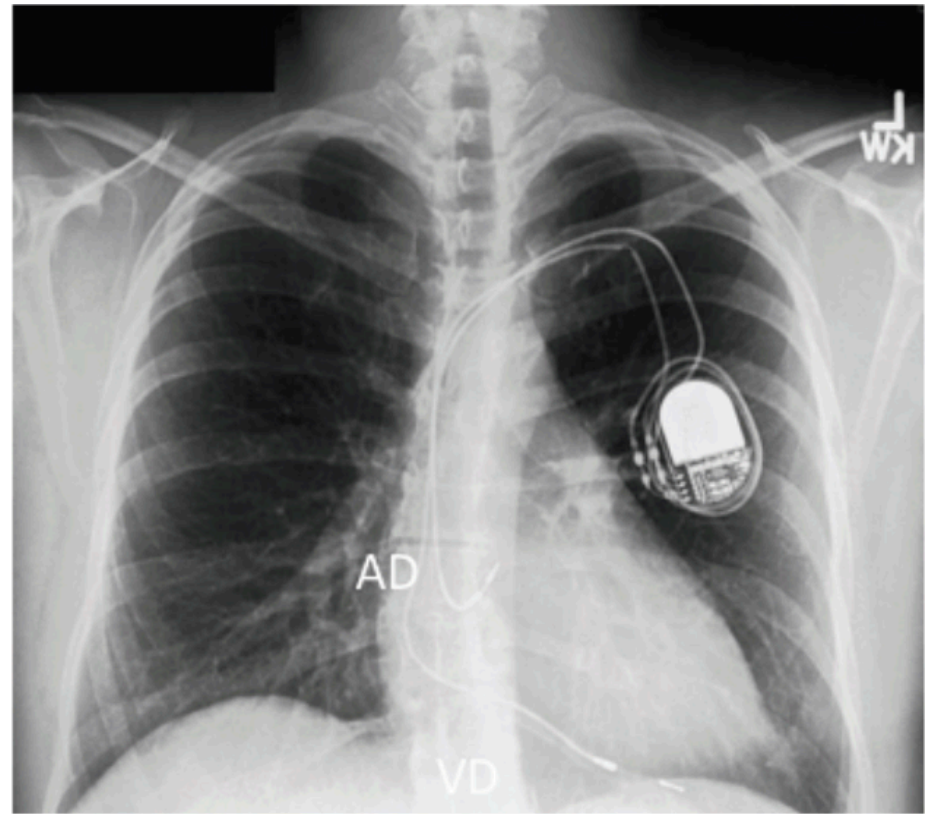
IABP

Imaging techniques in acute cardiovascular care

■ Chest X-ray

- Device placements

- Endotracheal tubes
- Central venous catheters
- IABP
- **Pacemakers leads**
- Chest Tubes and drains



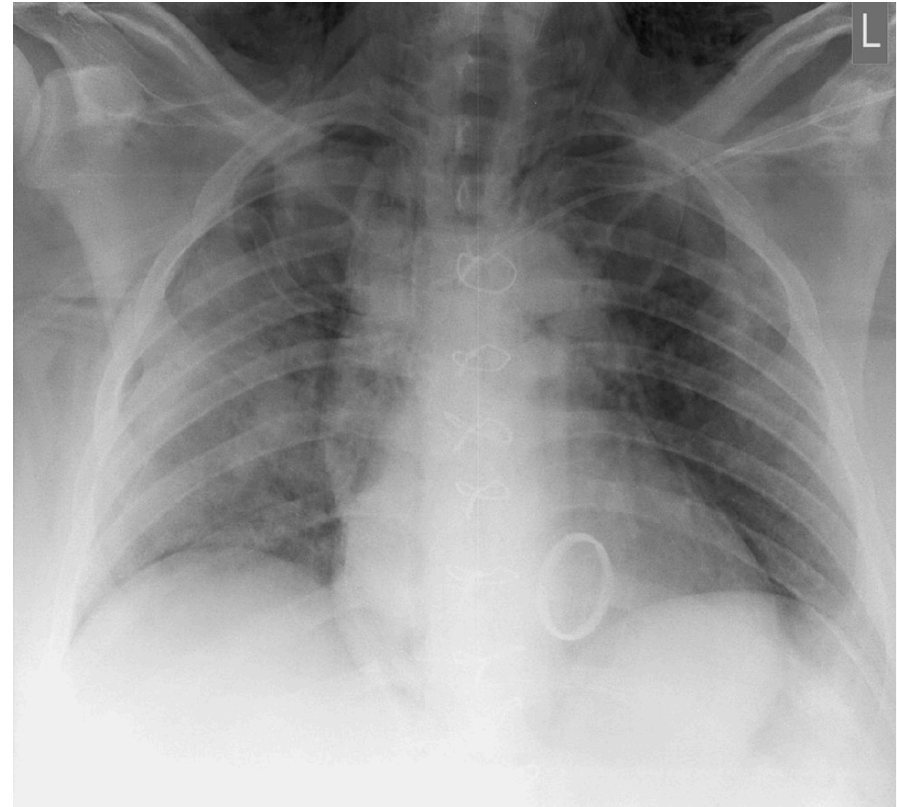
Pacemaker leads

Imaging techniques in acute cardiovascular care

■ Chest X-ray

- Device placements

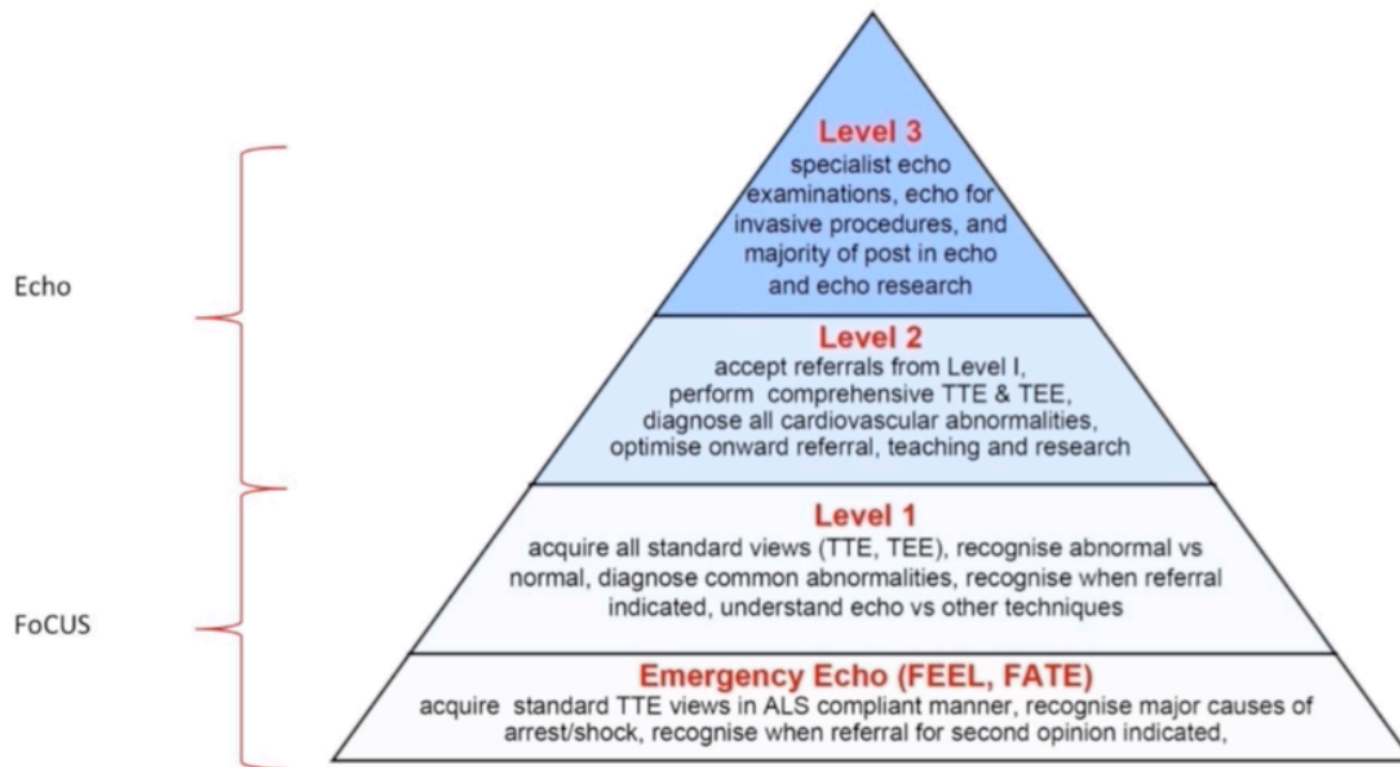
- Endotracheal tubes
- Central venous catheters
- IABP
- Pacemakers leads
- **Chest Tubes and drains**



Partial resolution of right-sided pneumothorax after chest tube placement

Imaging techniques in acute cardiovascular care

■ Ultrasound Echocardiography vs FoCUS



Cholley et al. 2006; Price et al., 2008

Imaging techniques in acute cardiovascular care

■ Ultrasound FoCUS

- Standardized and restricted, scanning protocol
- Extension of the clinical examination
- To detect a limited number of critical cardiac conditions
- Immediate decisions



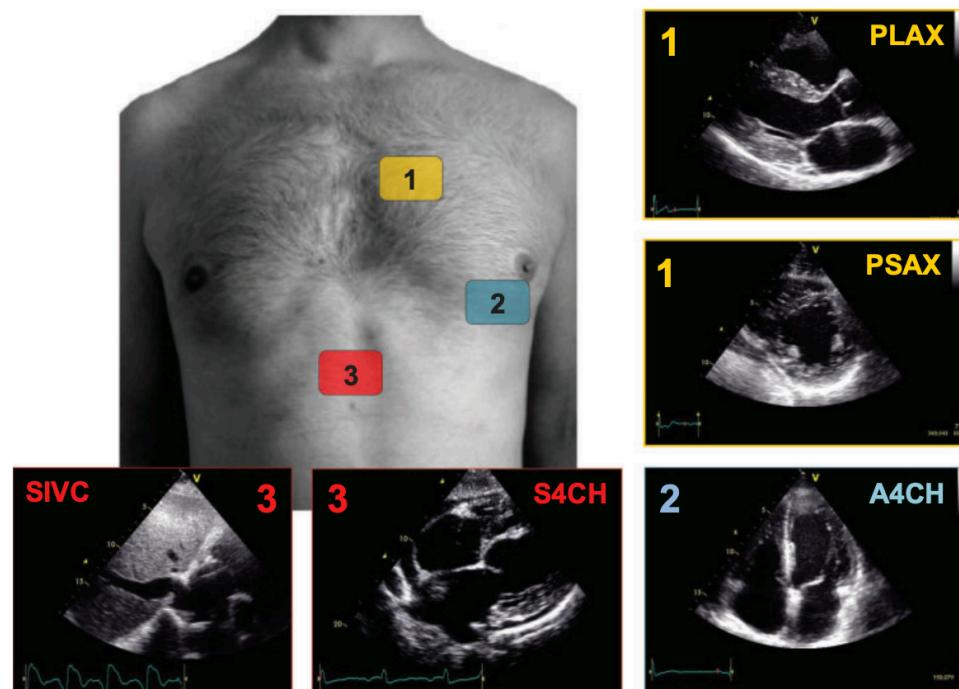
ESC

European Society
of Cardiology

European Heart Journal - Cardiovascular Imaging (2018) 19, 475–481
doi:10.1093/ehjci/jeu006

**EACVI CONSENSUS
DOCUMENT**

Focus cardiac ultrasound core curriculum and core syllabus of the European Association of Cardiovascular Imaging[†]



Nescovik et al., EHJ. 2018

Imaging techniques in acute cardiovascular care

■ Ultrasound FoCUS

Aetiology	Key echocardiographic signs	Remarks
LV pump failure	Enlarged hypokinetic, spheroid LV, functional mitral regurgitation	
Pulmonary embolism (PE)	Enlarged RV apex reaching cardiac apex, hypokinetic RV, tricuspid regurgitation, elevated pulmonary pressure (degree varies with pre-existing pulmonary hypertension (PH), RV function, and extent of embolism)	
Pericardial tamponade	Pericardial fluid compressing the RV and/or right atrium; exaggerated respiratory variation in LV and RV inflow	Look for signs of aortic dissection, MI, trauma, or other thoracic disease, e.g. tumours
Acute left-sided valvular regurgitation	Structural damage of aortic or mitral valve, e.g. papillary muscle rupture; Doppler signs of severe aortic or mitral regurgitation; hyperkinetic LV, often of normal size	Look for signs of inferior MI in papillary muscle rupture and for signs of aortic dissection in aortic regurgitation
Acute right heart failure	Enlarged hypokinetic RV, may occur with PE, chronic PH, or as RV infarction complicating inferior myocardial infarction (MI)	
Aortic dissection or rupture	Aortic enlargement, aortic valvular regurgitation, dissection flap in the aorta, pericardial tamponade	The typical site of aortic rupture, e.g. after deceleration trauma, is the proximal descending aorta, which is visualizable by TOE
Sepsis	Endocarditic vegetation on valve or pacemaker electrode, abscess, or destruction of valves	In sepsis due to non-cardiac causes, the discrepancy between systemic hypotension in the presence of an often hyperkinetic heart is typical
Prosthetic valve obstruction	'Frozen' occluder position in mitral prostheses, often with clear thrombus; in the aortic position, difficult to see, even by TOE. Massive transvalvular gradient elevation by Doppler	Always use TOE; compare to earlier transprosthetic gradients, if possible
Prosthetic valve regurgitation or dehiscence	Abnormal mobility ('rocking') of prosthesis, (colour) Doppler signs of severe regurgitation, premature mitral valve closure in aortic regurgitation	
AS	Severe AS, typically with a severely depressed LV	Continuity equation must be used to evaluate stenosis severity; gradients may be deceptively low

Imaging techniques in acute cardiovascular care

■ **Ultrasound FoCUS**

✗ Time-constraints

✗ Restricted image acquisition protocol

✗ Risk of missing important abnormalities

✗ Operator experience

✗ Technician equipment technically inferior

✗ Stressful situations



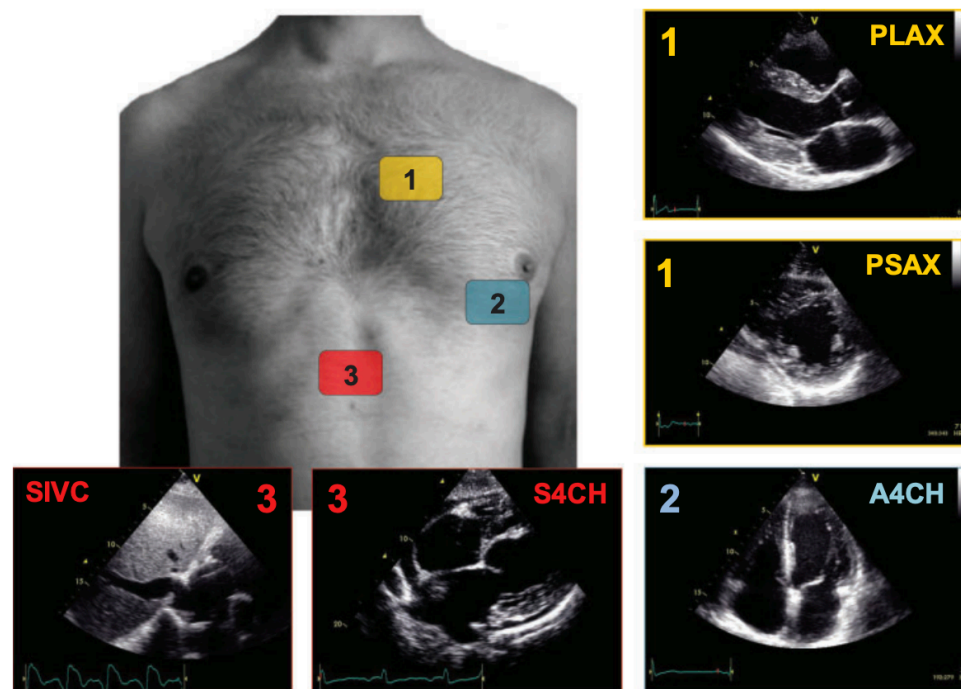
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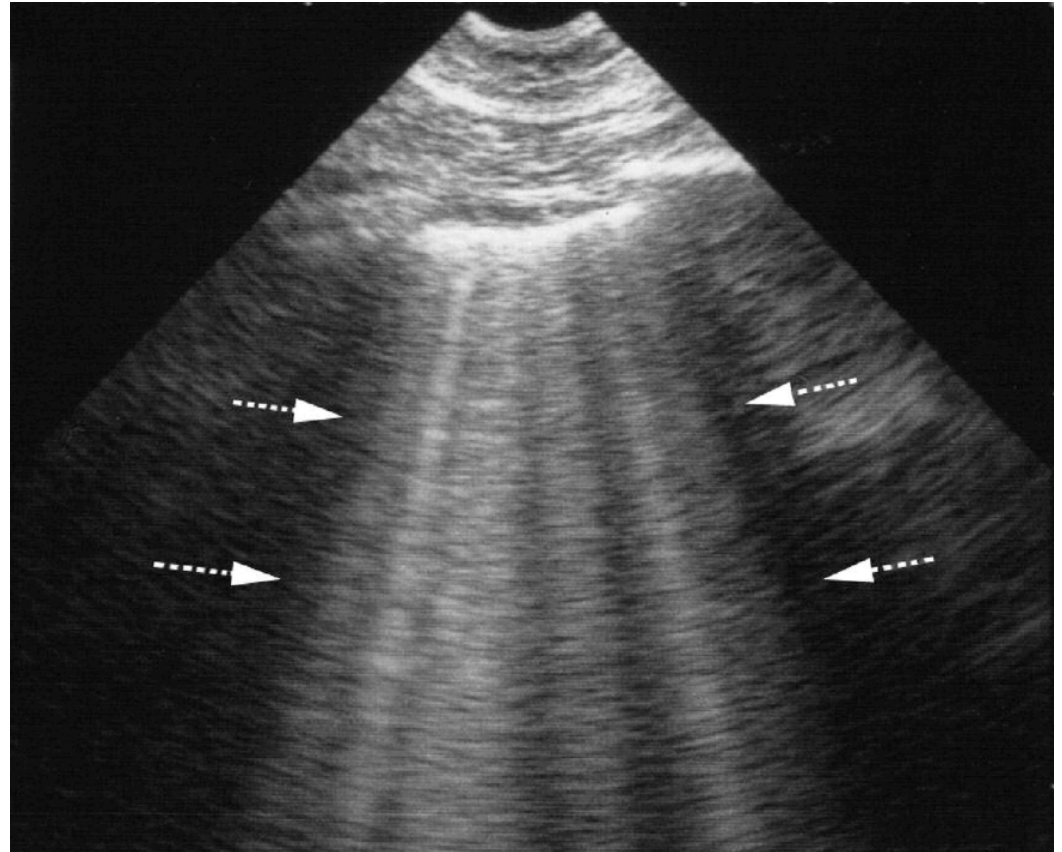
Focus cardiac ultrasound core curriculum and core syllabus of the European Association of Cardiovascular Imaging[†]



Nescovik et al., EHJ. 2018

Imaging techniques in acute cardiovascular care

- **Ultrasound FoCUS**
 - Lung ultrasound
 - **pulmonar edema**
 - pleural effusion
 - pneumothorax

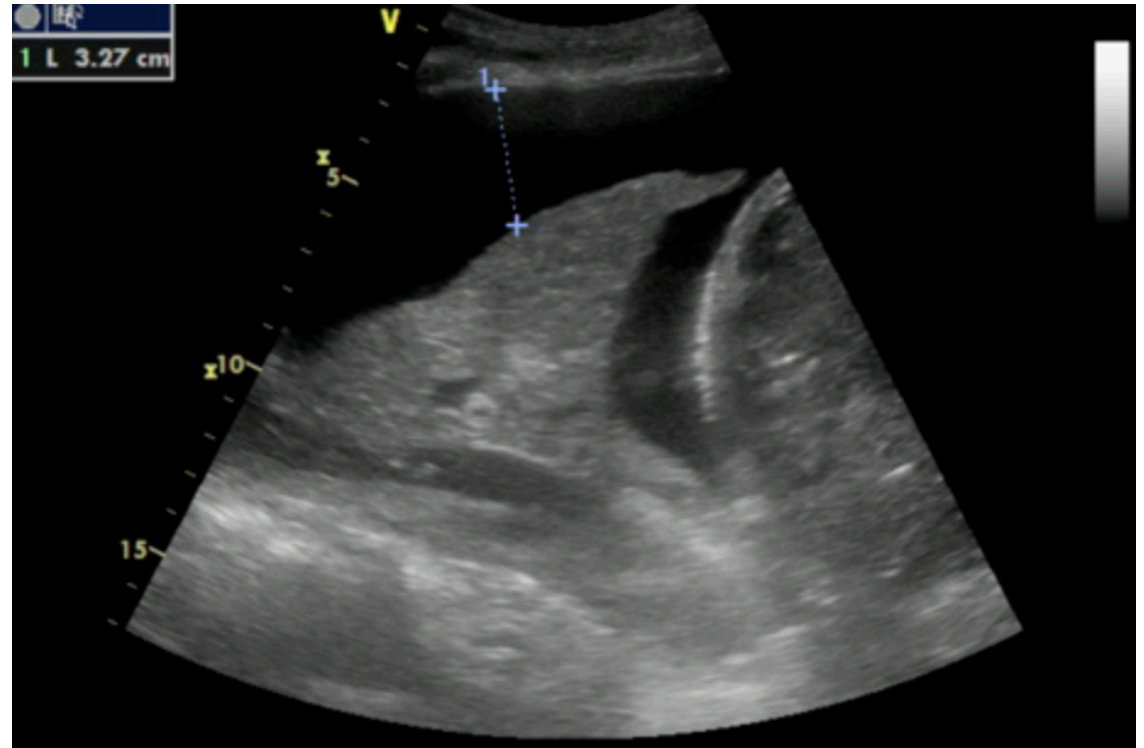


Interstitial pulmonary edema (B lines)

Imaging techniques in acute cardiovascular care

■ Ultrasound FoCUS

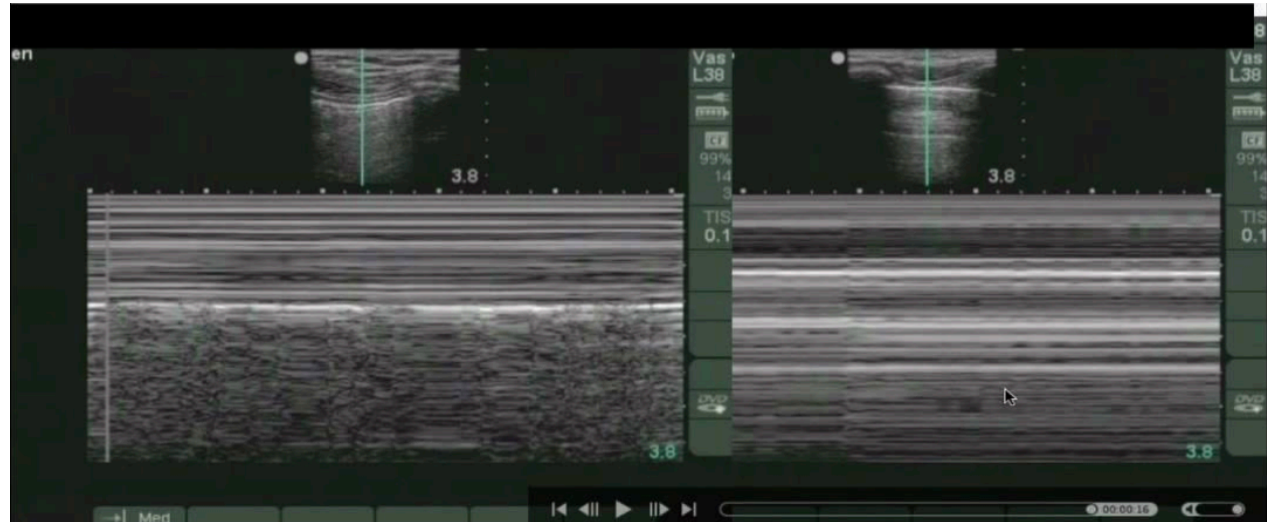
- Lung ultrasound
 - pulmonar edema
 - **pleural effusion**
 - pneumothorax



Pleural effusion

Imaging techniques in acute cardiovascular care

- **Ultrasound FoCUS**
 - Lung ultrasound
 - pulmonar edema
 - pleural effusion
 - **pneumothorax**

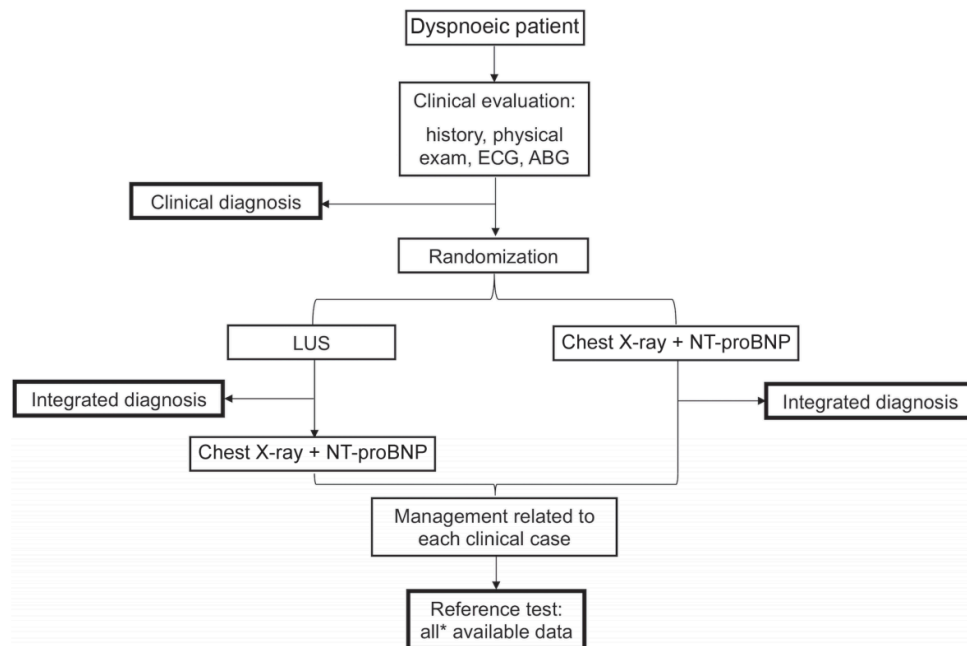


Normal lung will show a "seashore sign" with transition of lines differentiating movement at the pleural lines, whereas pneumothorax prevents detection of motion creating a single "barcode" pattern

Imaging techniques in acute cardiovascular care

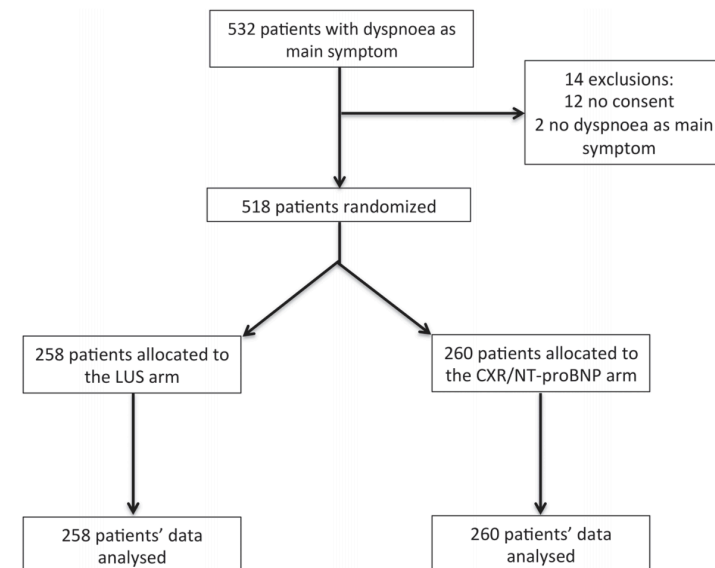
■ Ultrasound FoCUS

- Lung ultrasound



Lung ultrasound integrated with clinical assessment for the diagnosis of acute decompensated heart failure in the emergency department: a randomized controlled trial

Pivetta et al., EHJ. 2019



Imaging techniques in acute cardiovascular care

■ Ultrasound FoCUS

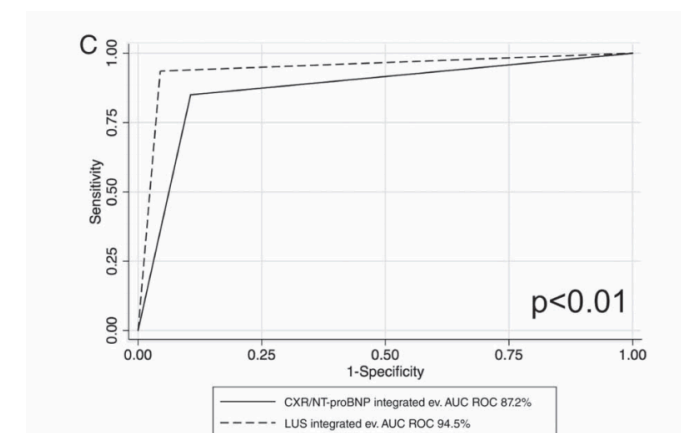
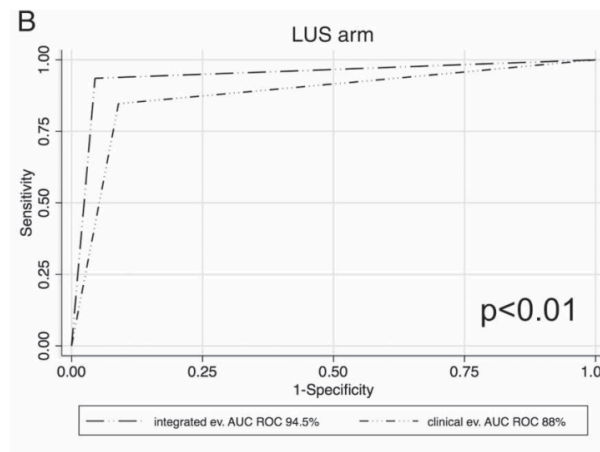
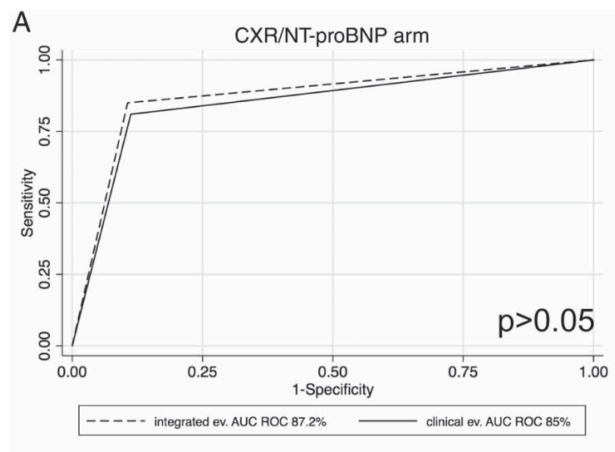
- Lung ultrasound



European Journal of Heart Failure (2019)
doi:10.1002/ehf.1379

RESEARCH ARTICLE

Lung ultrasound integrated with clinical assessment for the diagnosis of acute decompensated heart failure in the emergency department: a randomized controlled trial

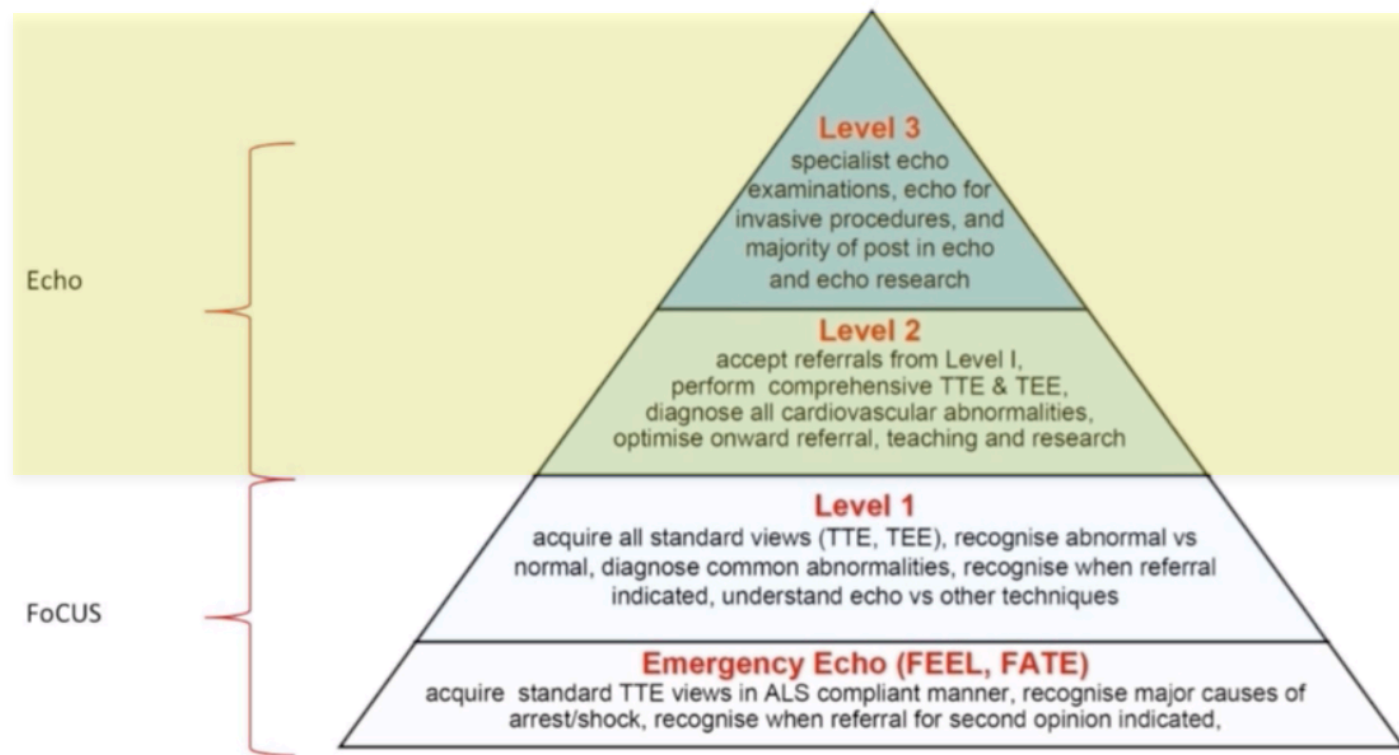


Conclusion

Integration of LUS with clinical assessment for the diagnosis of ADHF in the emergency department seems to be more accurate than the current diagnostic approach based on CXR and NT-proBNP.

Imaging techniques in acute cardiovascular care

- **Ultrasound**
Echocardiography vs FoCUS



Cholley et al. 2006; Price et al., 2008

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – diagnosis

Universal definitions of myocardial injury and myocardial infarction
Criteria for myocardial injury
The term myocardial injury should be used when there is evidence of elevated cardiac troponin values (cTn) with at least one value above the 99th percentile upper reference limit (URL). The myocardial injury is considered acute if there is a rise and/or fall of cTn values.
Criteria for acute myocardial infarction (types 1, 2 and 3 MI)
The term acute myocardial infarction should be used when there is acute myocardial injury with clinical evidence of acute myocardial ischaemia and with detection of a rise and/or fall of cTn values with at least one value above the 99th percentile URL and at least one of the following: • Symptoms of myocardial ischaemia; • New ischaemic ECG changes; • Development of pathological Q waves; • Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischaemic aetiology; • Identification of a coronary thrombus by angiography or autopsy (not for types 2 or 3 MIs). Post-mortem demonstration of acute athero-thrombosis in the artery supplying the infarcted myocardium meets criteria for <i>type 1 MI</i>. Evidence of an imbalance between myocardial oxygen supply and demand unrelated to acute athero-thrombosis meets criteria for <i>type 2 MI</i>. Cardiac death in patients with symptoms suggestive of myocardial ischaemia and presumed new ischaemic ECG changes before cTn values become available or abnormal meets criteria for <i>type 3 MI</i>.

Thygesen et al., EHJ. 2018

Imaging techniques in acute cardiovascular care

- **Echocardiography in specific scenarios**

Acute coronary syndromes – complications and prognosis

EMERGENTE	Choque cardiogénico Instabilidade hemodinâmica Suspeita de complicações mecânicas
ROTINA	Avaliação da função ventricular Prognóstico Terapêutica

Roffi et al., EHJ. 2016
Ibanez et al., EHJ. 2018

Imaging techniques in acute cardiovascular care

■ **Echocardiography in specific scenarios**

Acute coronary syndromes – complications and prognosis

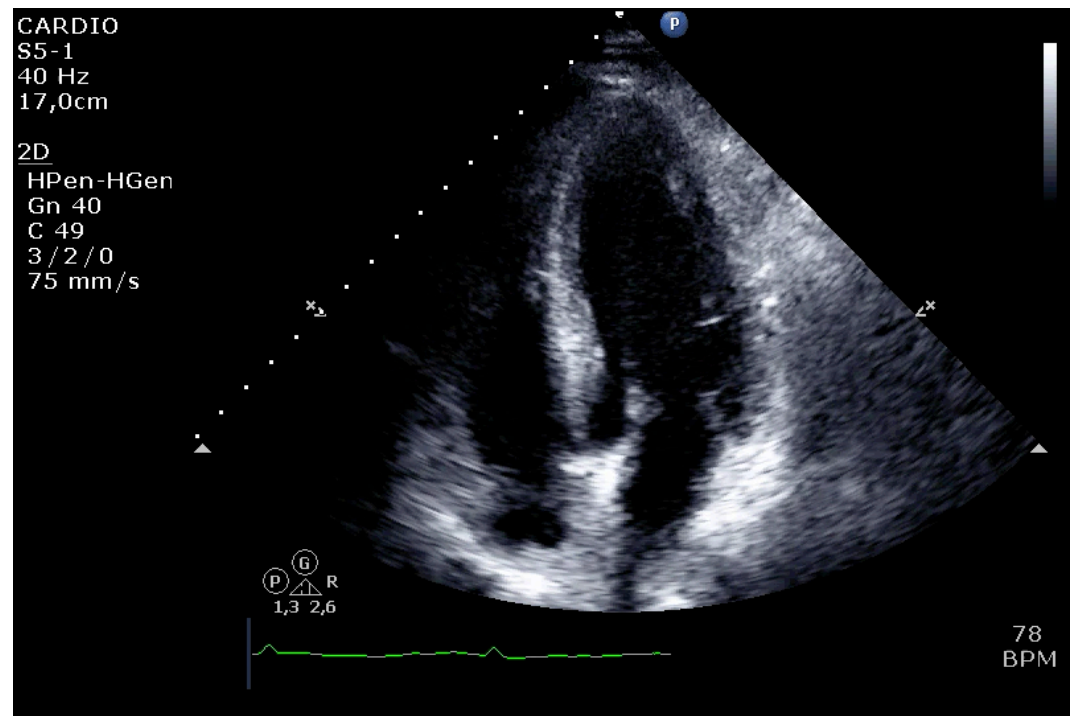
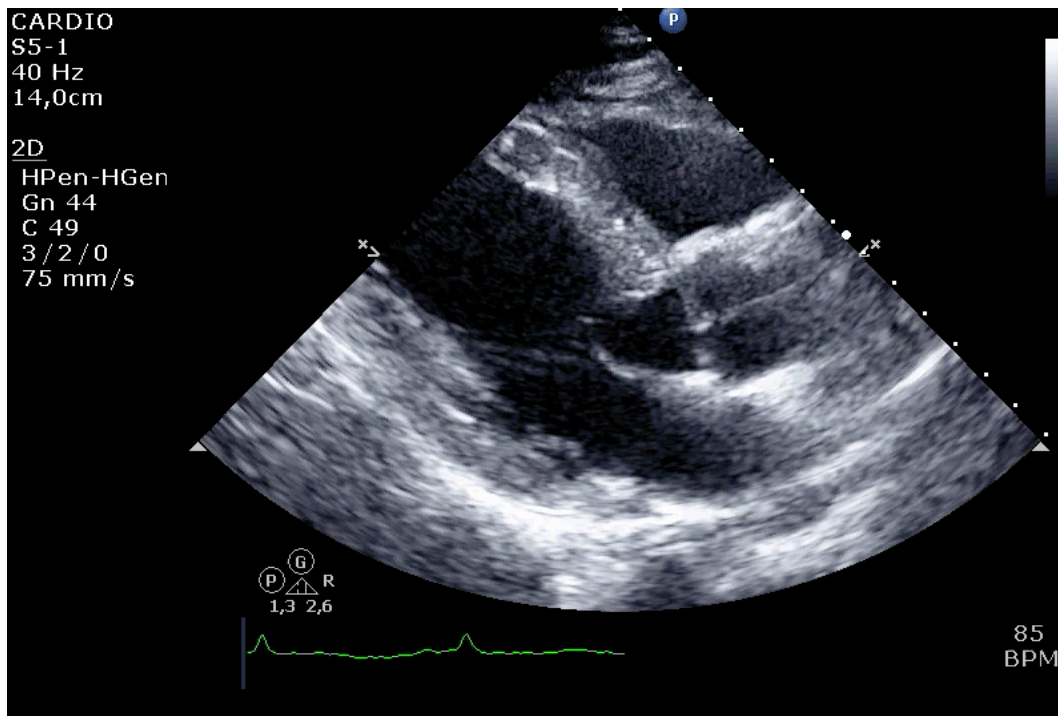
- **Left ventricular dysfunction**
- **Right ventricle infarctation**
- **Trombus**
- **Aneurysms**
- **Mitral regurgitation**
 - tethering
 - chordal rupture
 - papillary muscle rupture
- **Ventricular septum defect**
- **Ventricular free wall rupture**

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

- Left ventricular dysfunction

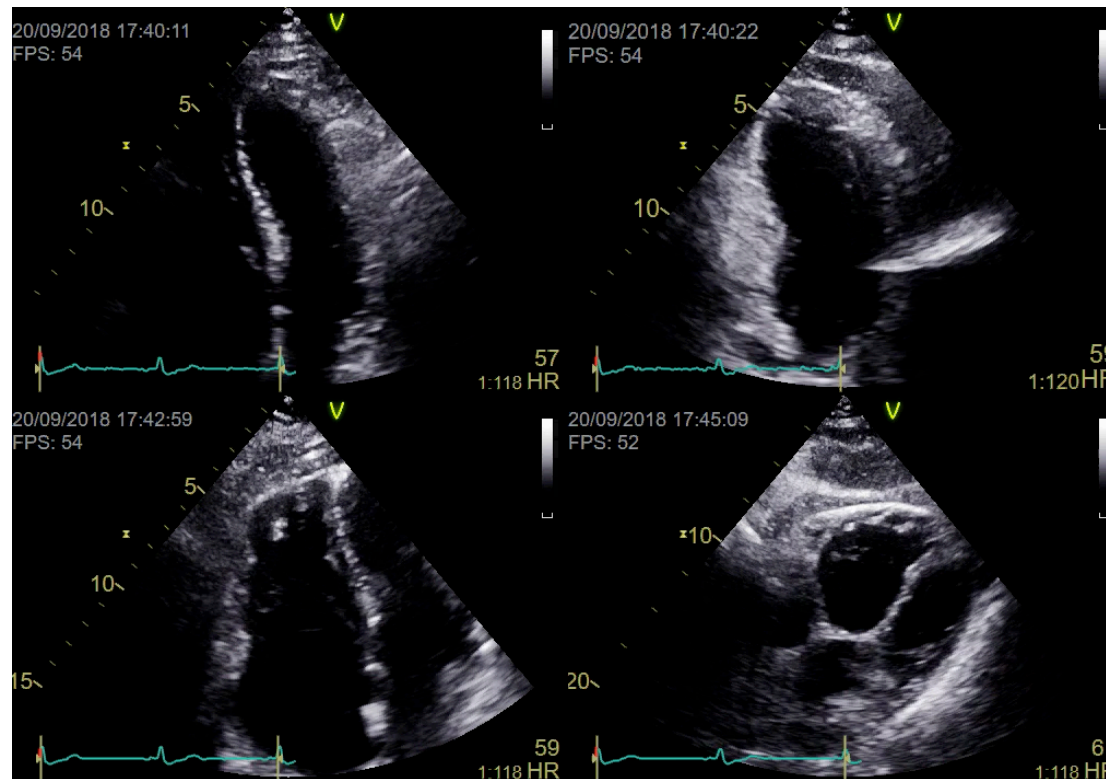


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

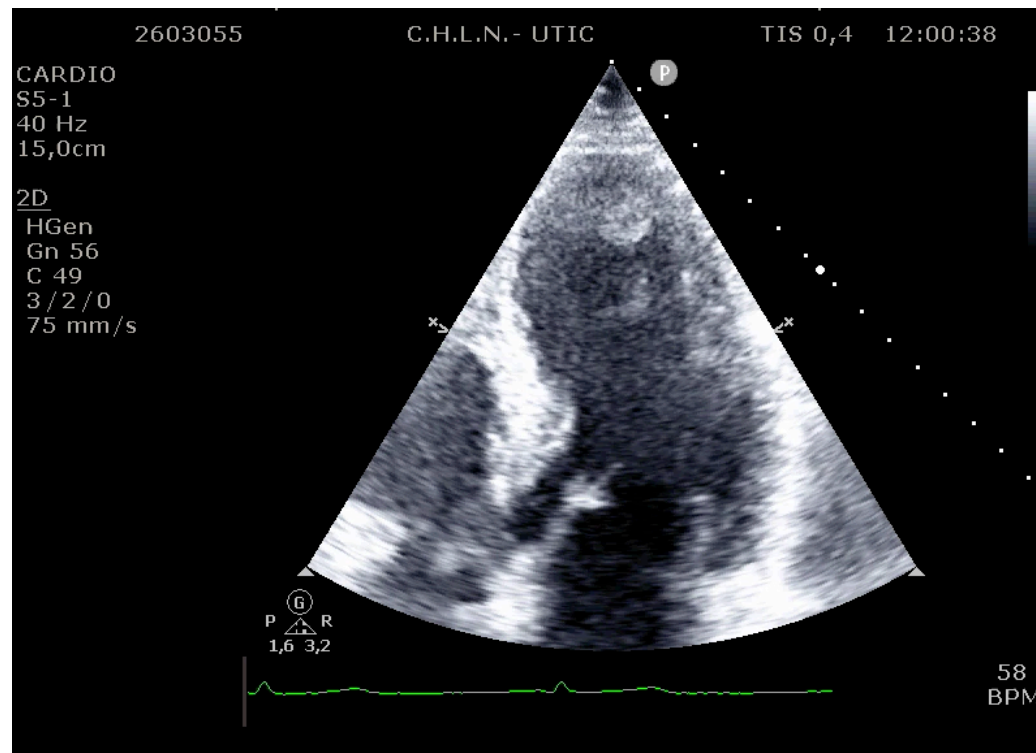
- RV infarctation



- **Echocardiography in specific scenarios**

Acute coronary syndromes – complications and prognosis

- Trombus

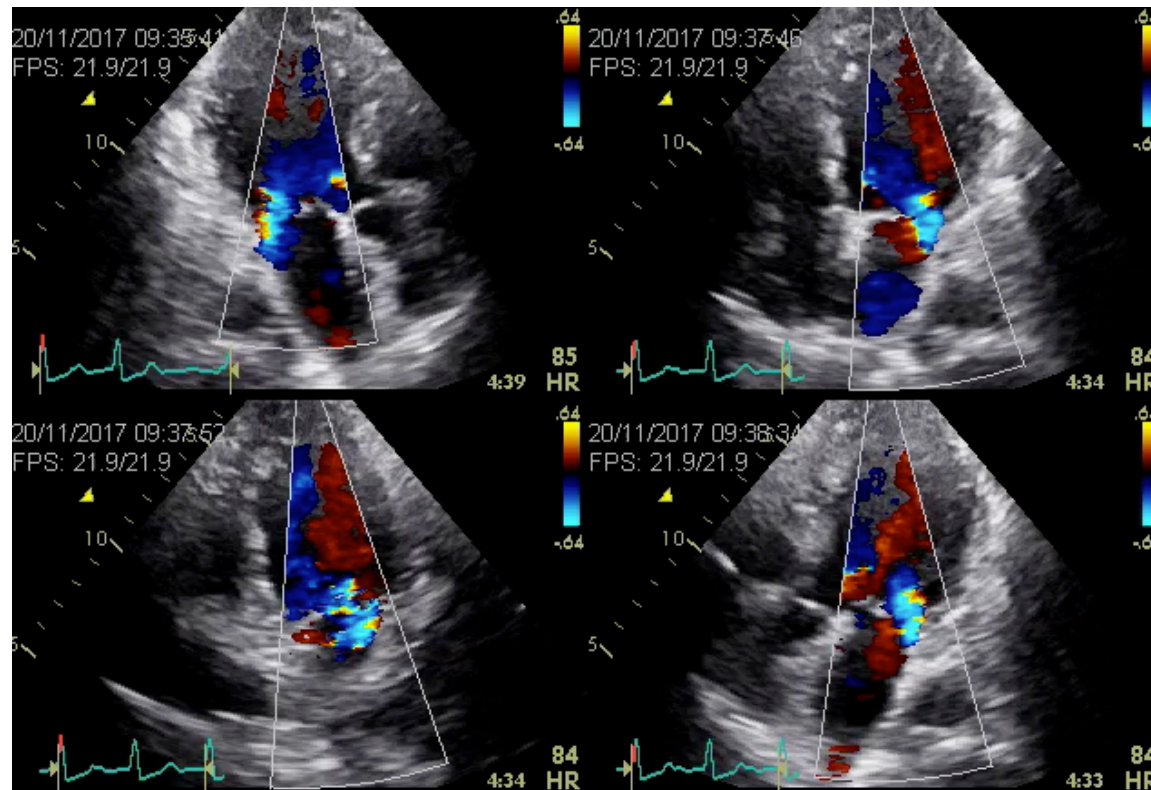


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

- Mitral regurgitation (papillary muscle rupture)

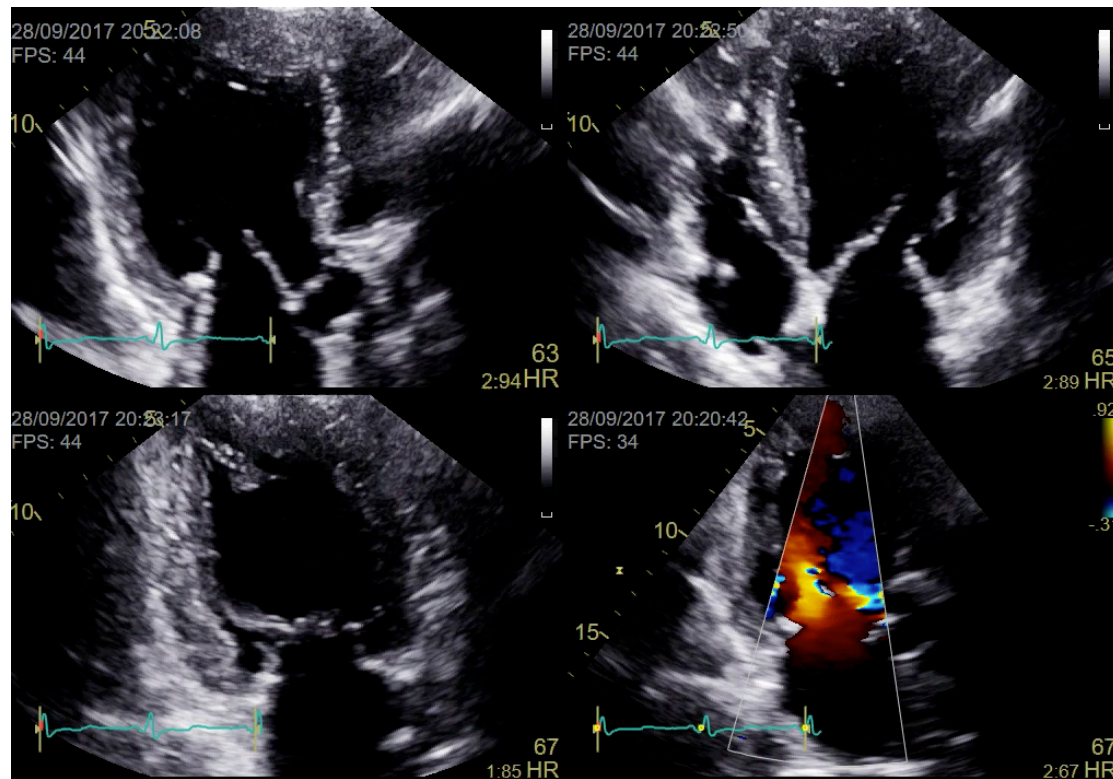


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

- Mitral regurgitation (leaflets tethering)

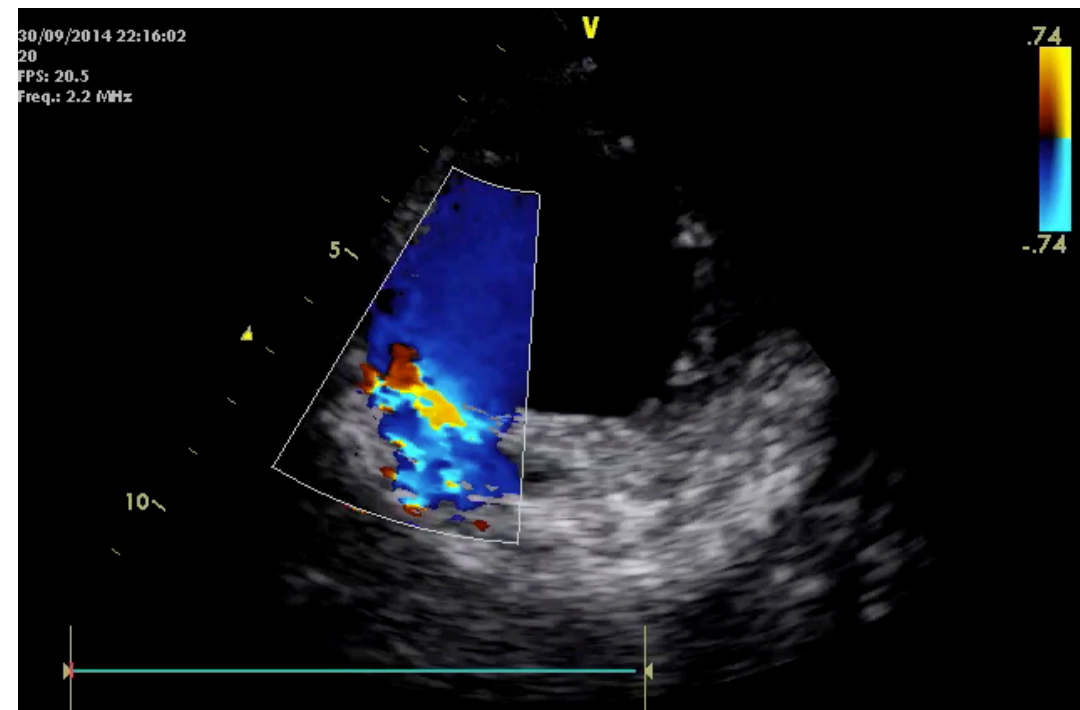
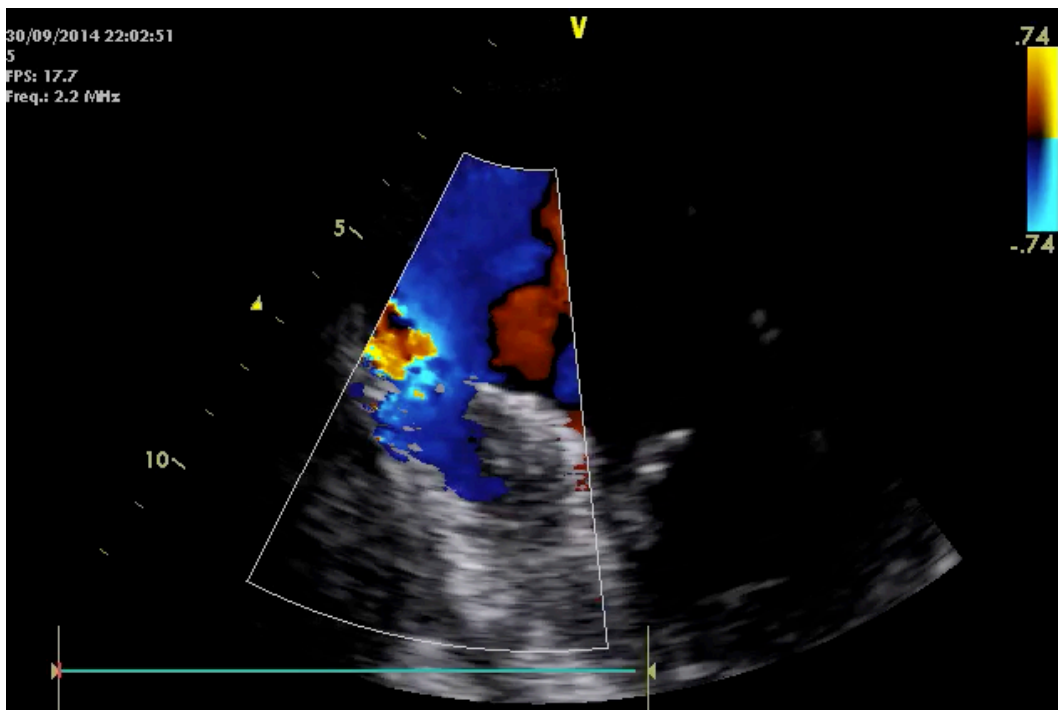


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

- Ventricular septum defect

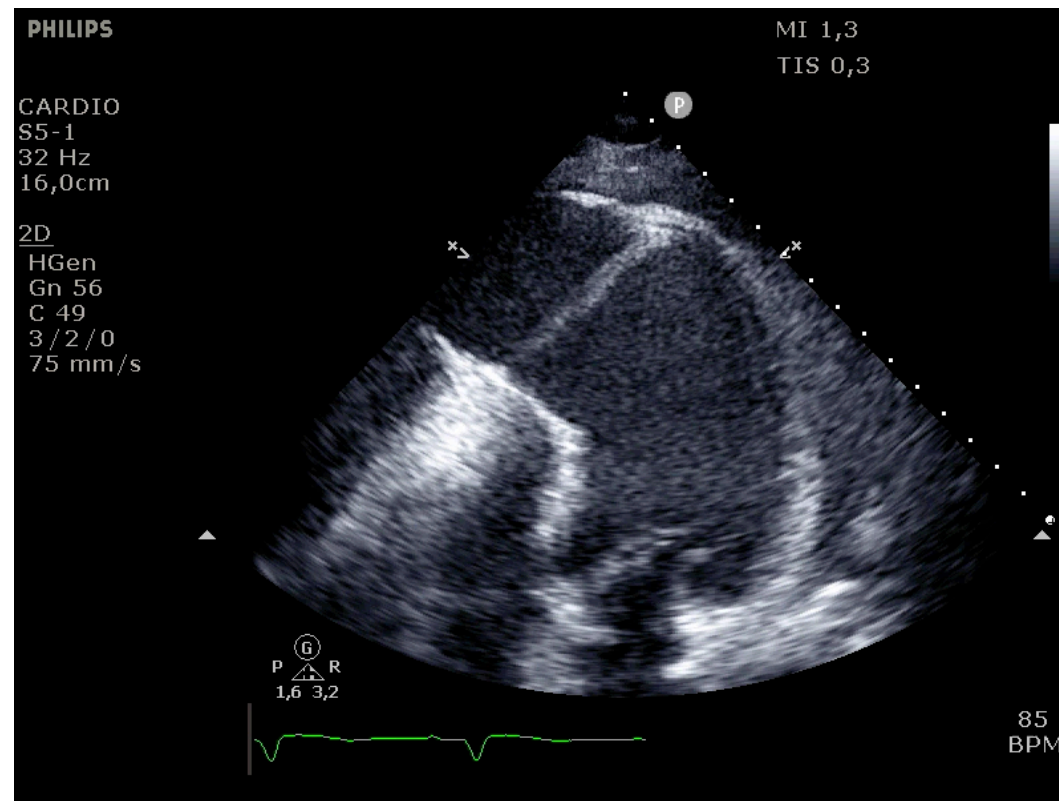


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Acute coronary syndromes – complications and prognosis

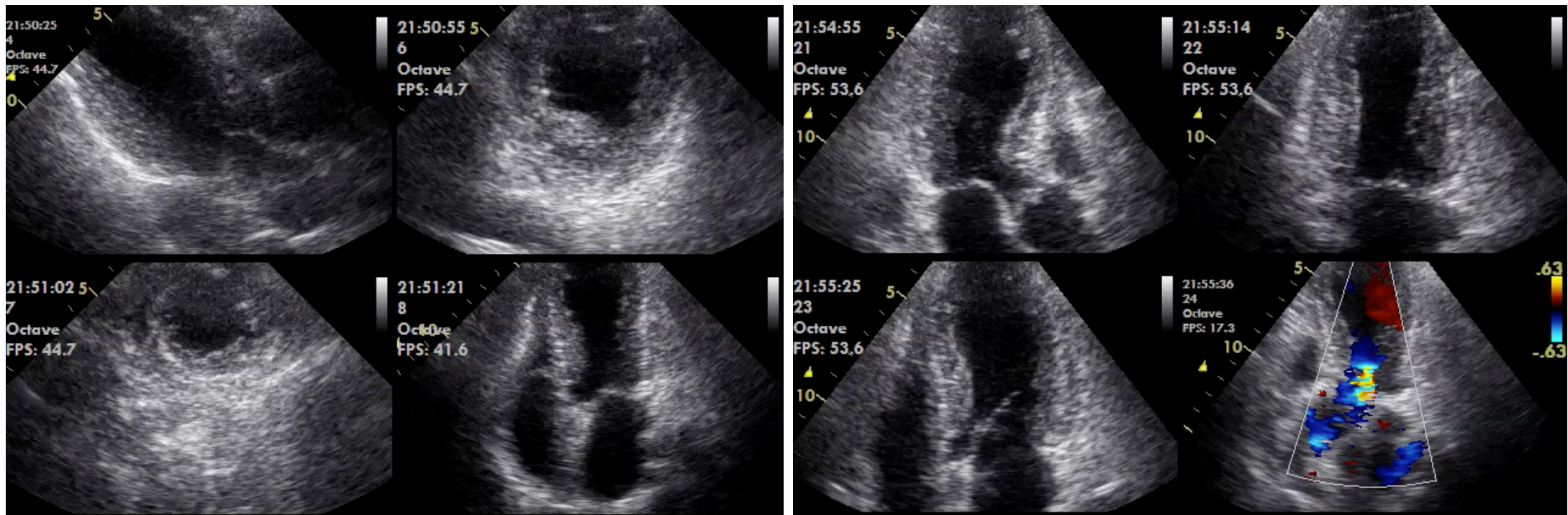
- Pseudoaneurysm



Imaging techniques in acute cardiovascular care

- **Echocardiography in specific scenarios**

Takotsubo syndrome



Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Heart Failure

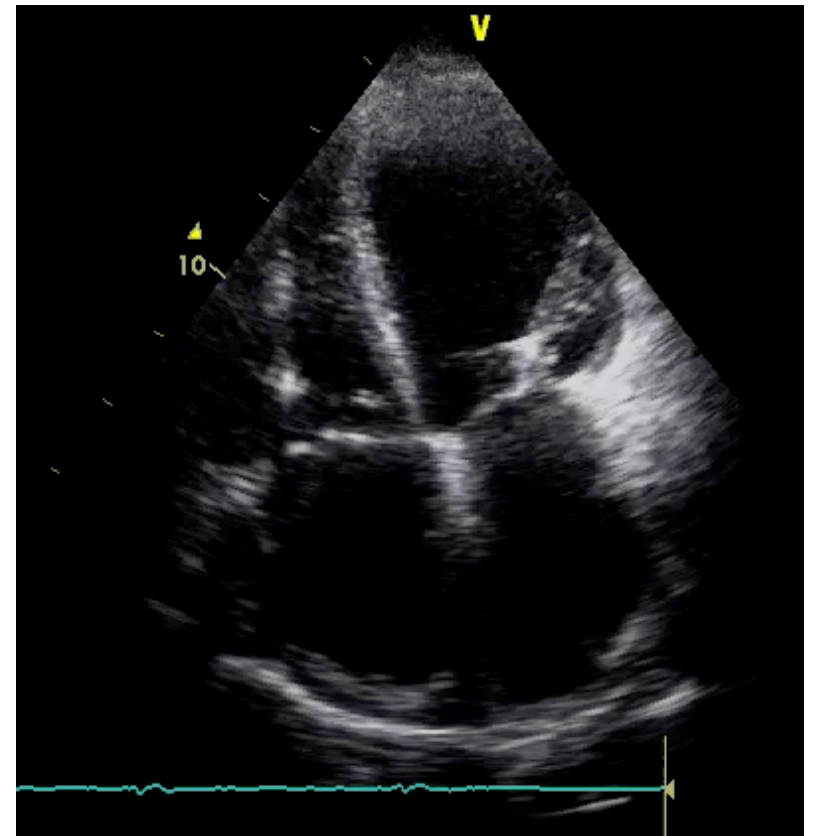
- Systolic left ventricular function

Ejection fraction:

Simpson biplane
3D

Contrast

Myocardial deformation



Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Journal of the American College of Cardiology

Volume 71, Issue 18, May 2018

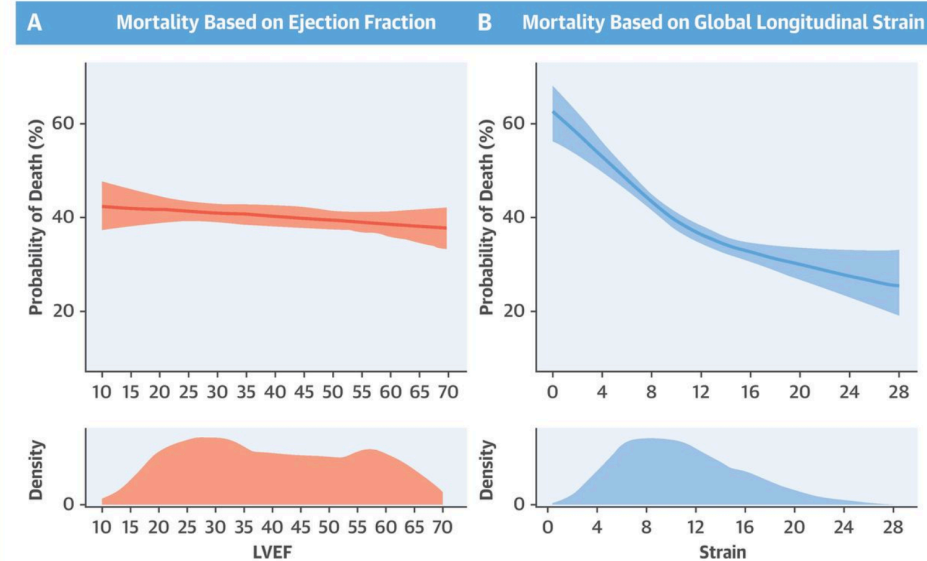
DOI: 10.1016/j.jacc.2018.02.064



Global Longitudinal Strain to Predict Mortality in Patients With Acute Heart Failure

Jin Joo Park, Jun-Bean Park, Jae-Hyeong Park and Goo-Young Cho

CENTRAL ILLUSTRATION: Prognostic Value of Strain in Acute Heart Failure: Probability Plot for 5-Year All-Cause Mortality



Park, J.J. et al. J Am Coll Cardiol. 2018;71(18):1947-57.

GLS has greater prognostic value than LVEF

Imaging techniques in acute cardiovascular care

■ **Echocardiography in specific scenarios**

Heart Failure

- Diastolic left ventricular function
- Etiology
- Mitral regurgitation
- RV dysfunction
- Prognosis
- Treatment

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Heart Failure

TTE is recommended for the assessment of myocardial structure and function in subjects with suspected HF in order to establish a diagnosis of either HFrEF, HFmrEF or HFpEF.	I	C
TTE is recommended to assess LVEF in order to identify patients with HF who would be suitable for evidence-based pharmacological and device (ICD, CRT) treatment recommended for HFrEF.	I	C
TTE is recommended for the assessment of valve disease, right ventricular function and pulmonary arterial pressure in patients with an already established diagnosis of either HFrEF, HFmrEF or HFpEF in order to identify those suitable for correction of valve disease.	I	C
TTE is recommended for the assessment of myocardial structure and function in subjects to be exposed to treatment which potentially can damage myocardium (e.g. chemotherapy).	I	C
Other techniques (including systolic tissue Doppler velocities and deformation indices, i.e. strain and strain rate), should be considered in a TTE protocol in subjects at risk of developing HF in order to identify myocardial dysfunction at the preclinical stage.	IIa	C

Ponikowski et al., EHJ. 2018

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Heart Failure

- Non-invasive hemodynamic assessment

Cardiac output

Volume status

- Central venous pressure (IVC and respiratory variation)
- LV filling pressures (E/e')

Pulmonary pressures

- PSAP

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Circulatory support therapies

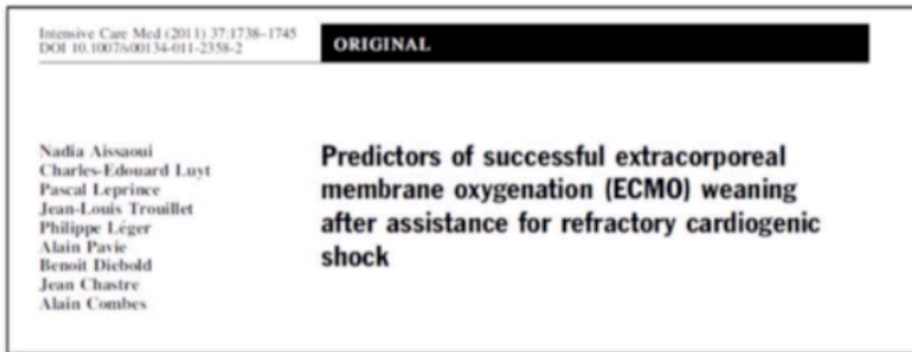
- Candidate patients
- Type of support
- Optimization
- Withdrawal or weaning

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Circulatory support therapies

- ECMO V-A



Step 1 : The etiology of cardiac failure must be compatible with myocardial recovery

Step 2 : Hemodynamic stability :

- The patient should have recovered from major metabolic disturbances
- The patient should have recovered a pulsatile arterial waveform for at least 24 hours
- Baseline MAP > 60 mmHg in the absence or with low doses of catecholamine

Step 3 : Pulmonary function should not be severely impaired

If PaO₂/FiO₂ <100 mmHg when FiO₂ of the ECMO gas flow is set at 21%, consider bridging the patient from VA- to VV-ECMO

Step 4 : The patient must tolerate a full weaning trial

** Hemodynamic and Doppler-echocardiographic assessment whereas ECMO flow is gradually decreased to 66%, and to 33% of its baseline value and then to a minimum of 1–1.5 L/min*

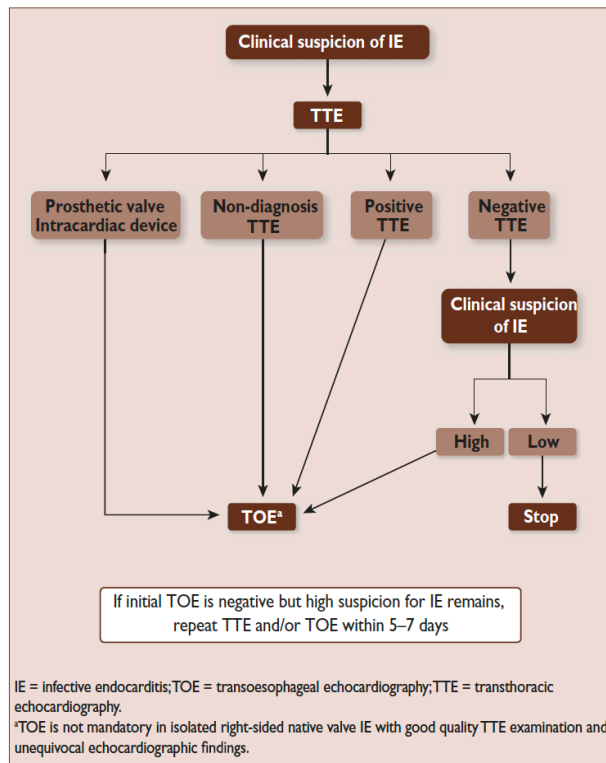
If steps 1, 2, 3 and 4 are validated and the patient has under minimal ECMO support LVEF of ≥ 20–25%, an aortic VTI of ≥ 12 cm and a TDSa ≥ 6 cm/s,

ECMO removal should be considered

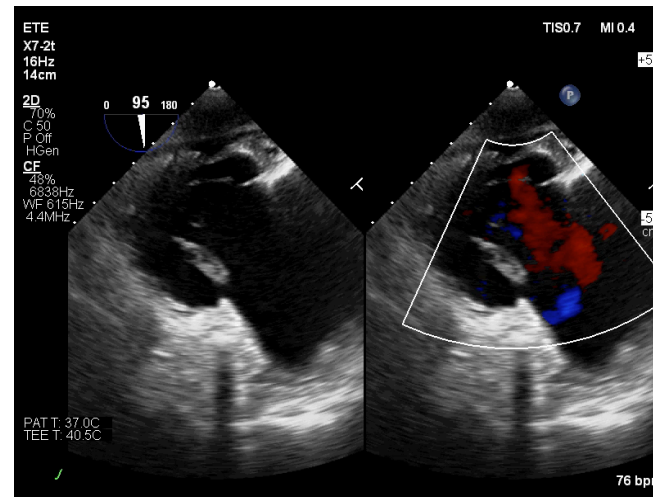
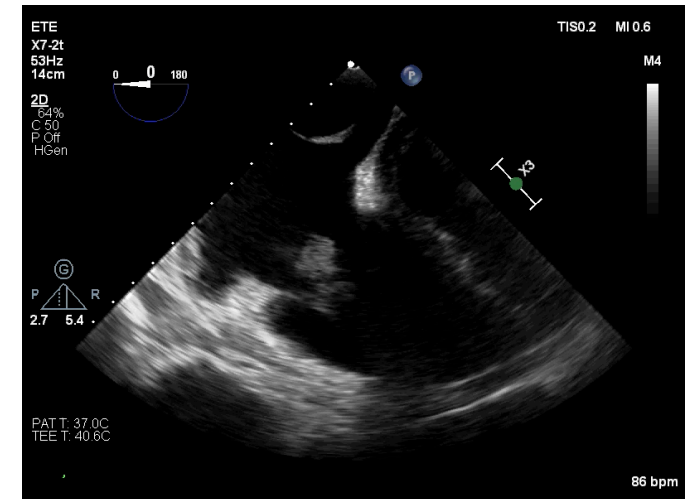
Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Endocarditis



Habib et al., EHJ. 2015



Imaging techniques in acute cardiovascular care

■ **Echocardiography in specific scenarios**

Valvular disease

- Regurgitation
 - - Acute vs chronic
- Stenosis
- Hemodynamic consequences

Imaging techniques in acute cardiovascular care

■ **Echocardiography in specific scenarios**

Prosthetic valve dysfunction

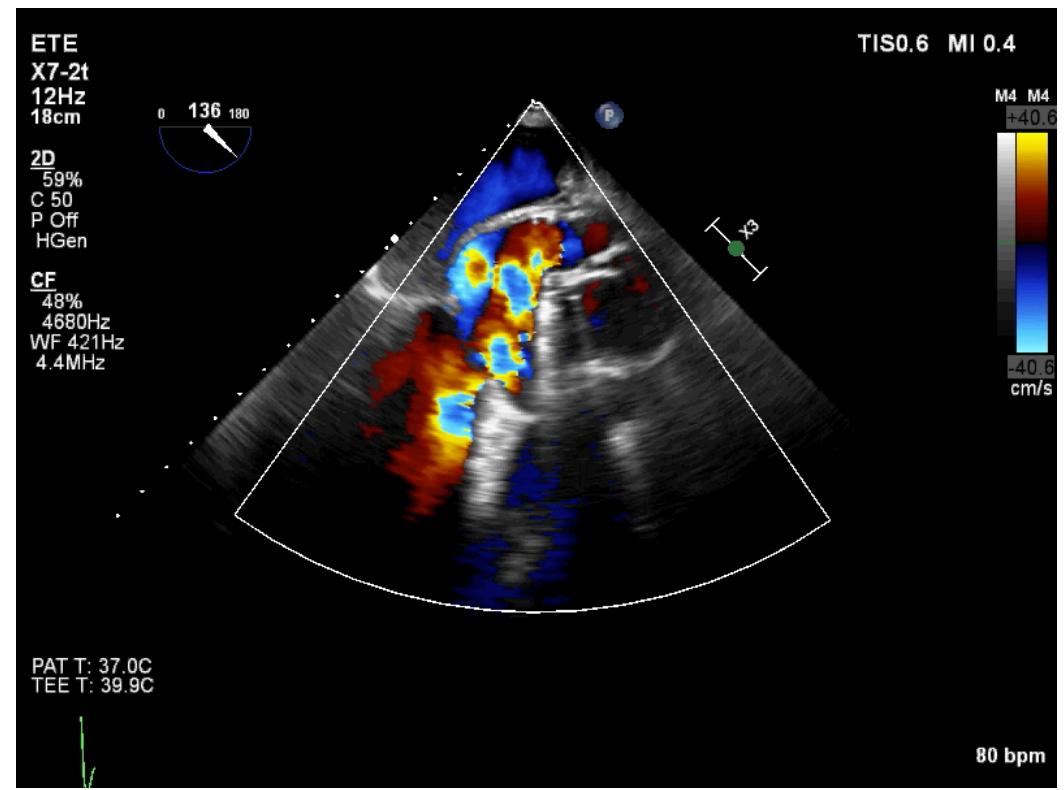
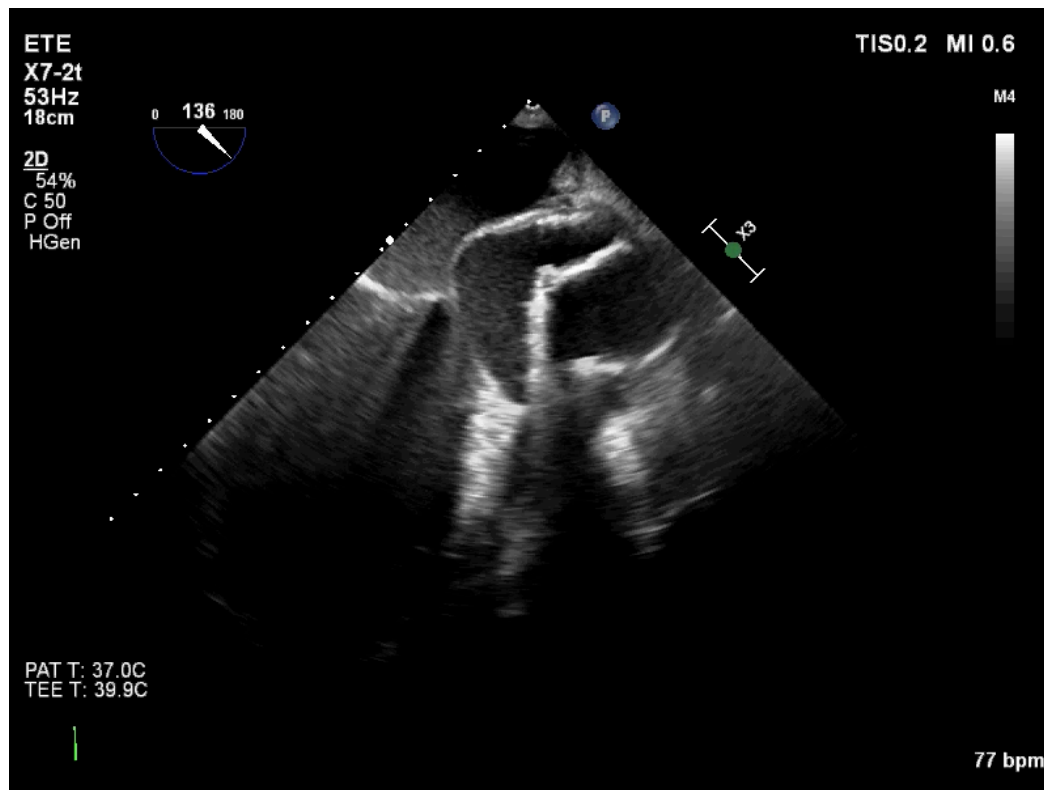
- Ring dehiscence
- Thrombosis

Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Prosthetic valve dysfunction

- Ring dehiscence

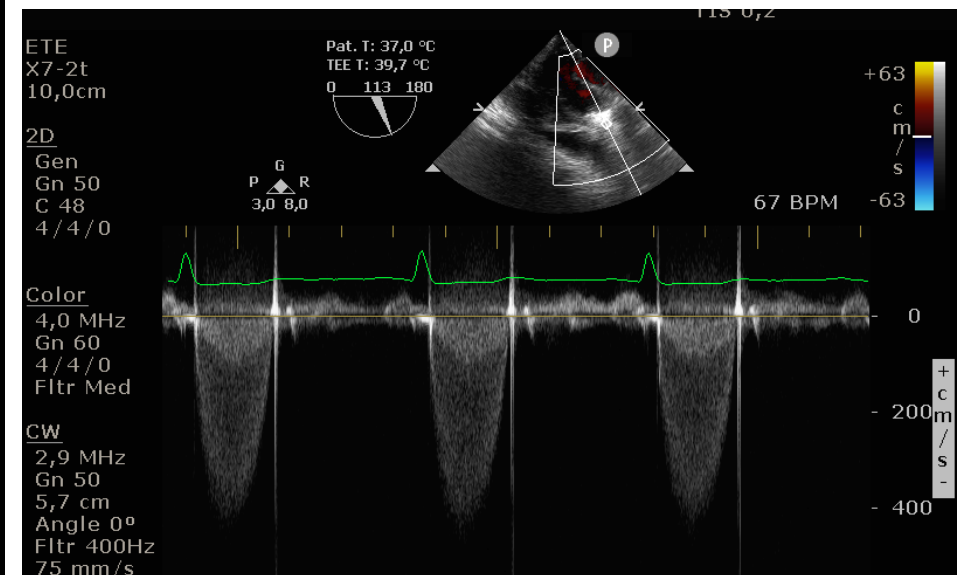
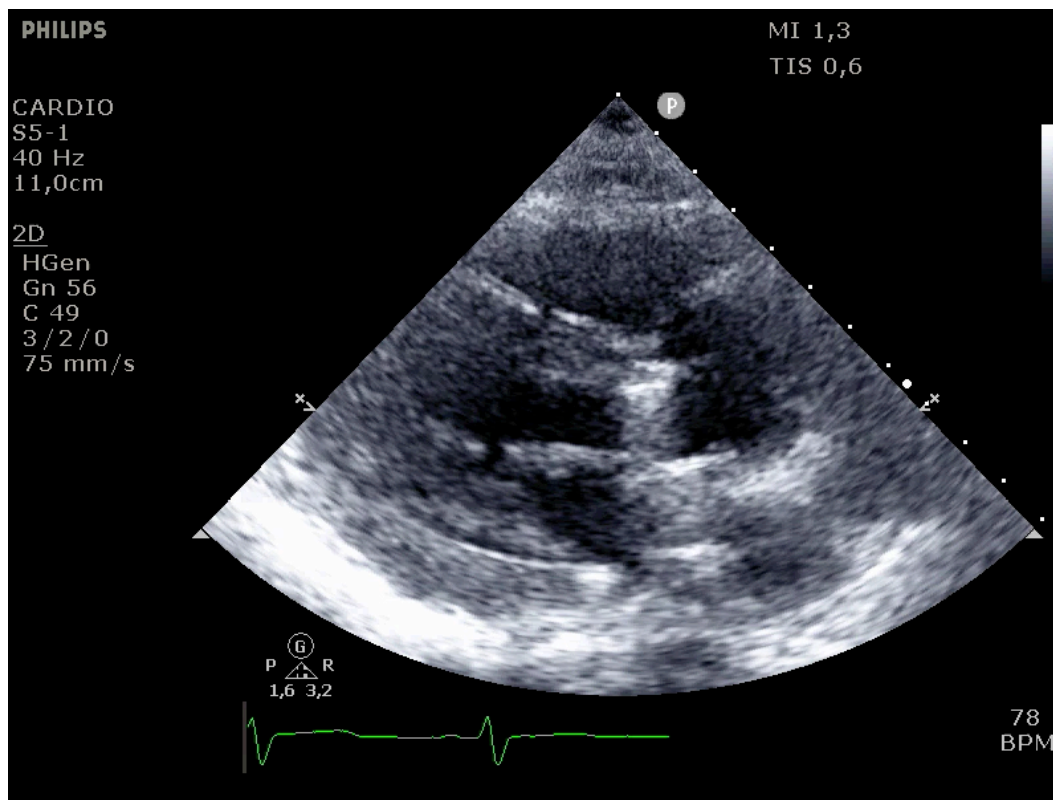


Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Prosthetic valve dysfunction

- Thrombosis



Imaging techniques in acute cardiovascular care

■ Echocardiography in specific scenarios

Pericardial disease

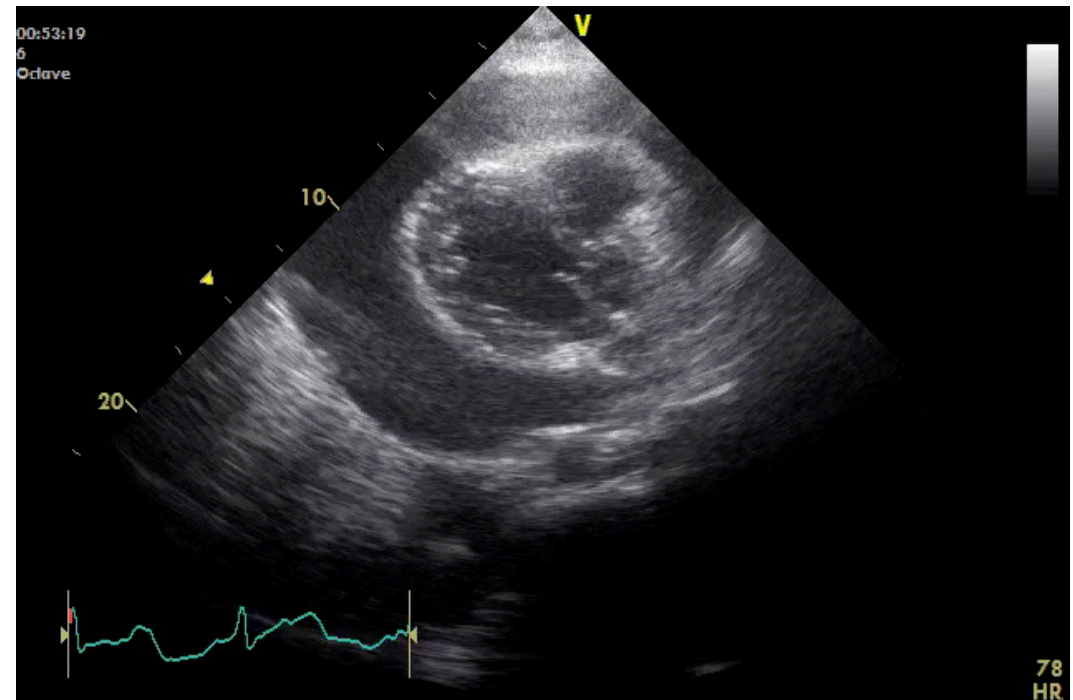
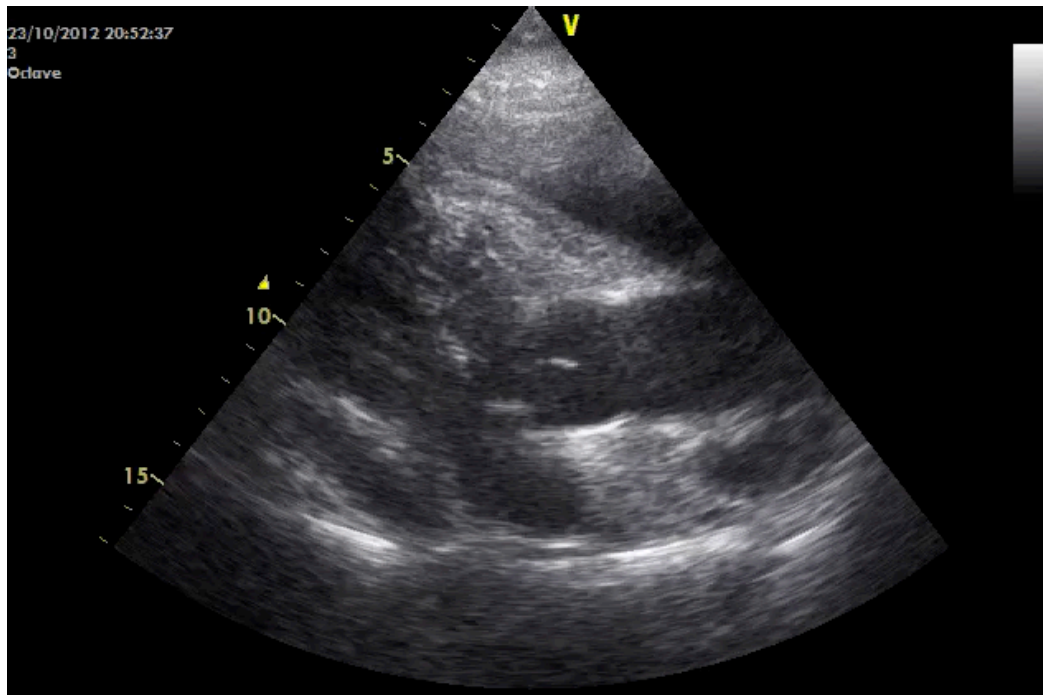
- Pericardial effusion
 - Tamponade
- Constrictive pericarditis

Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Pericardial disease

- Pericardial effusion
 - Tamponade

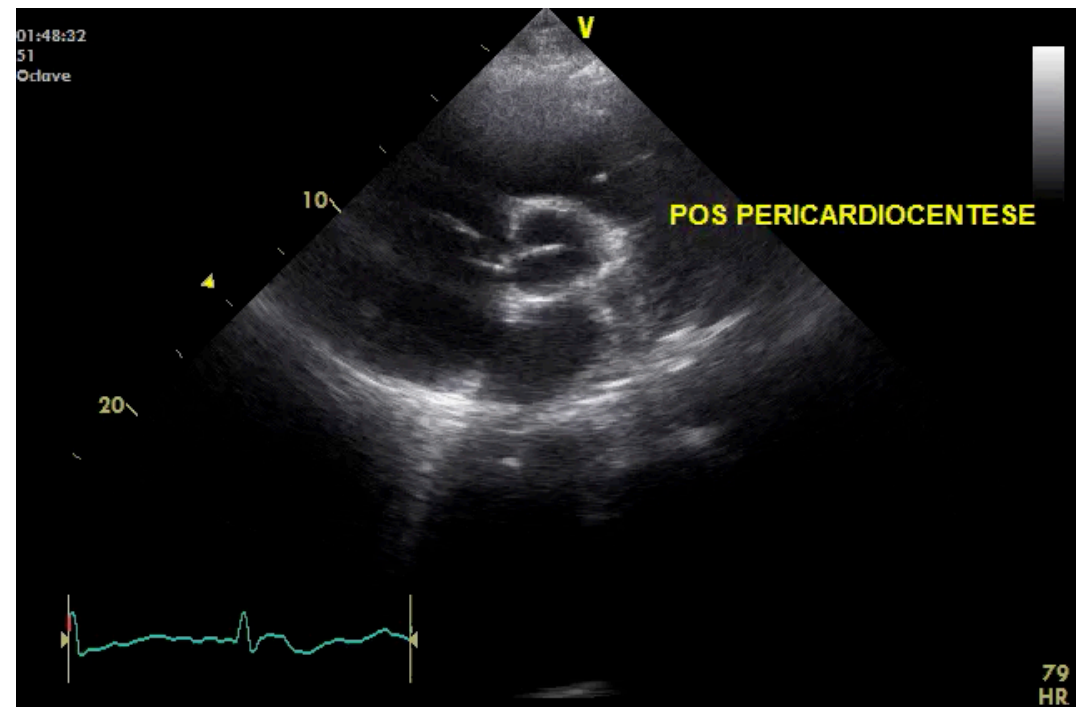
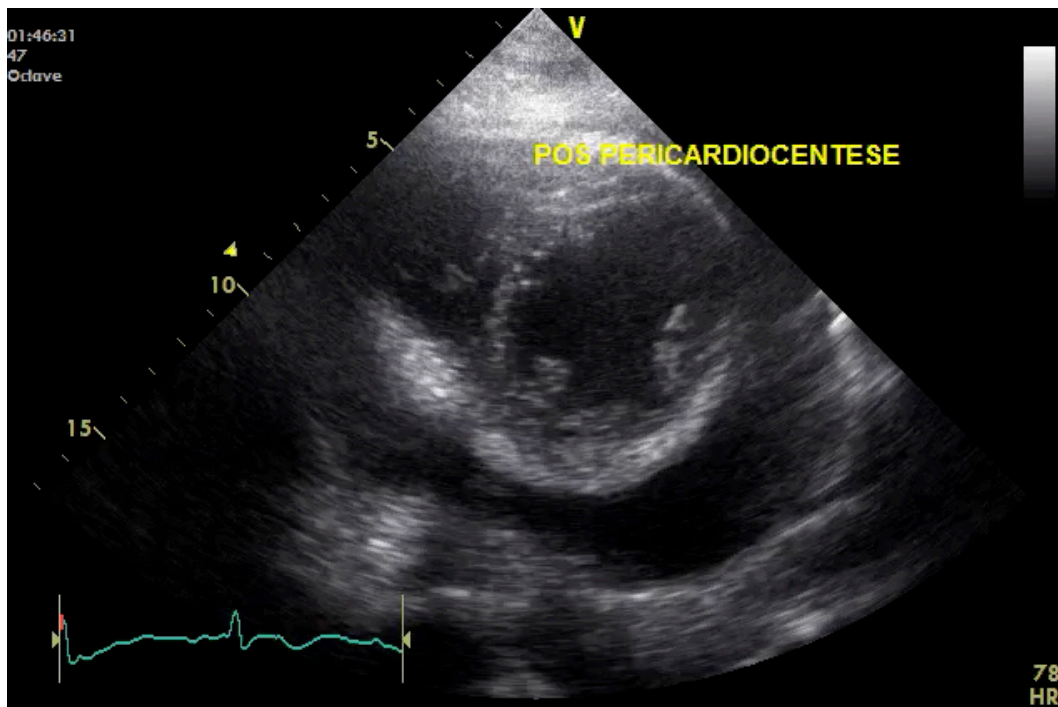


Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Pericardial disease

- Pericardial effusion
 - Tamponade

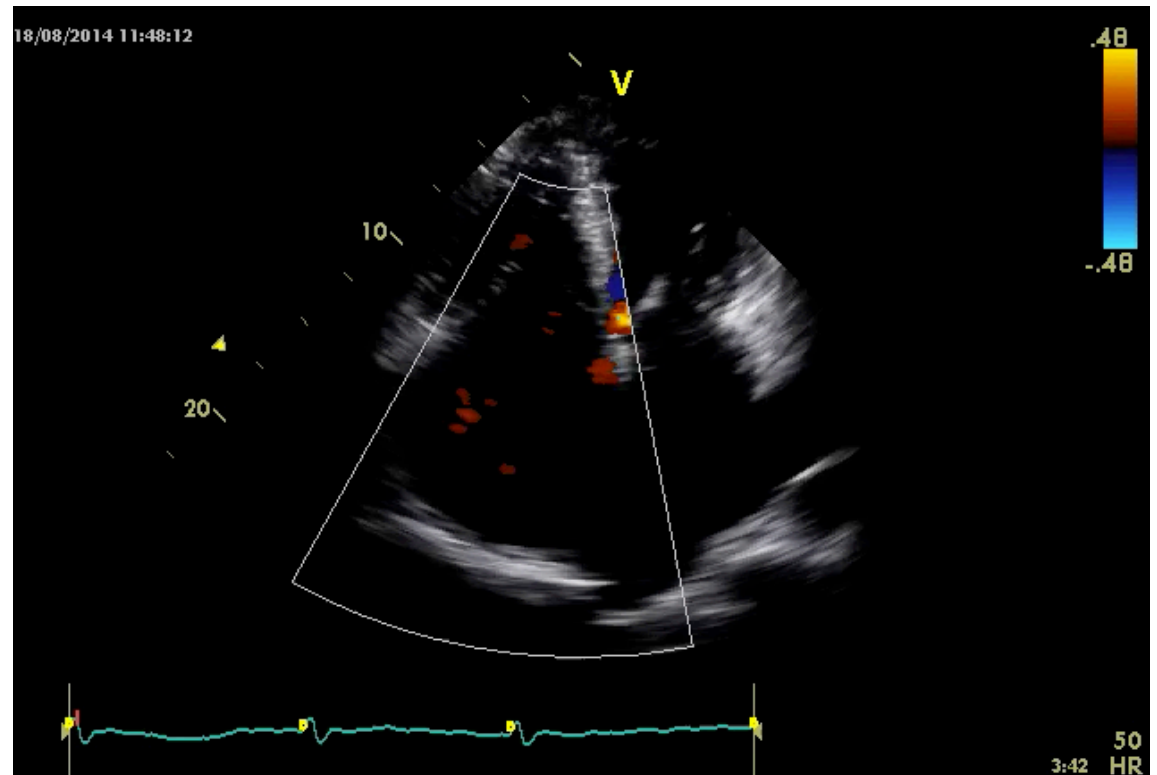
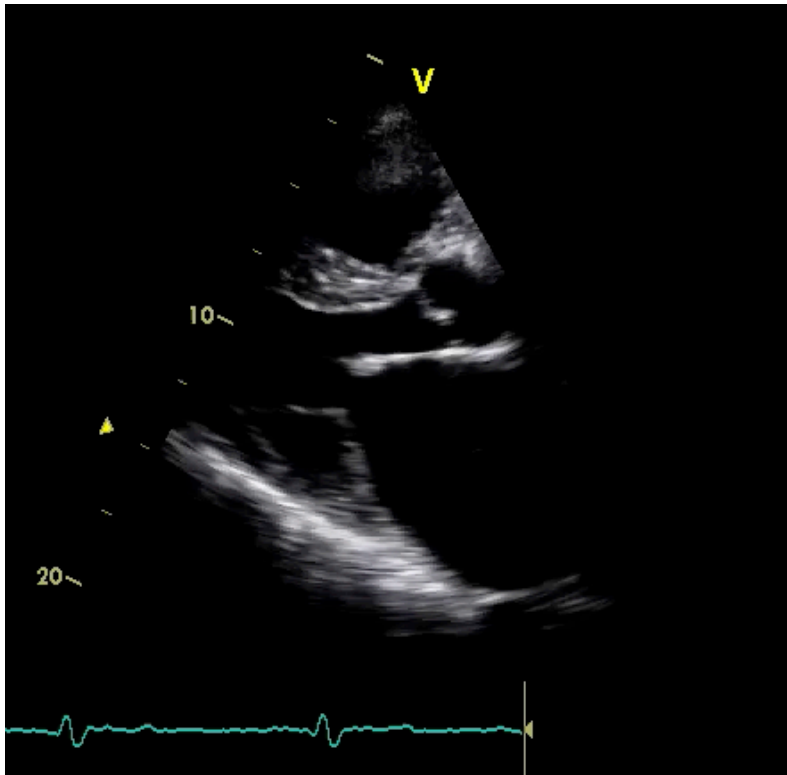


Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Pericardial disease

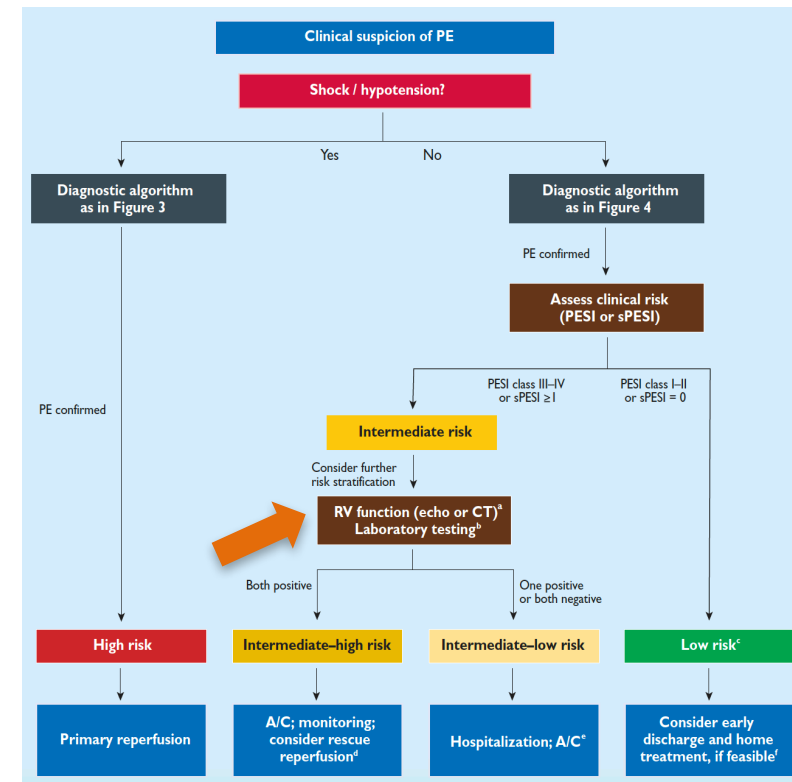
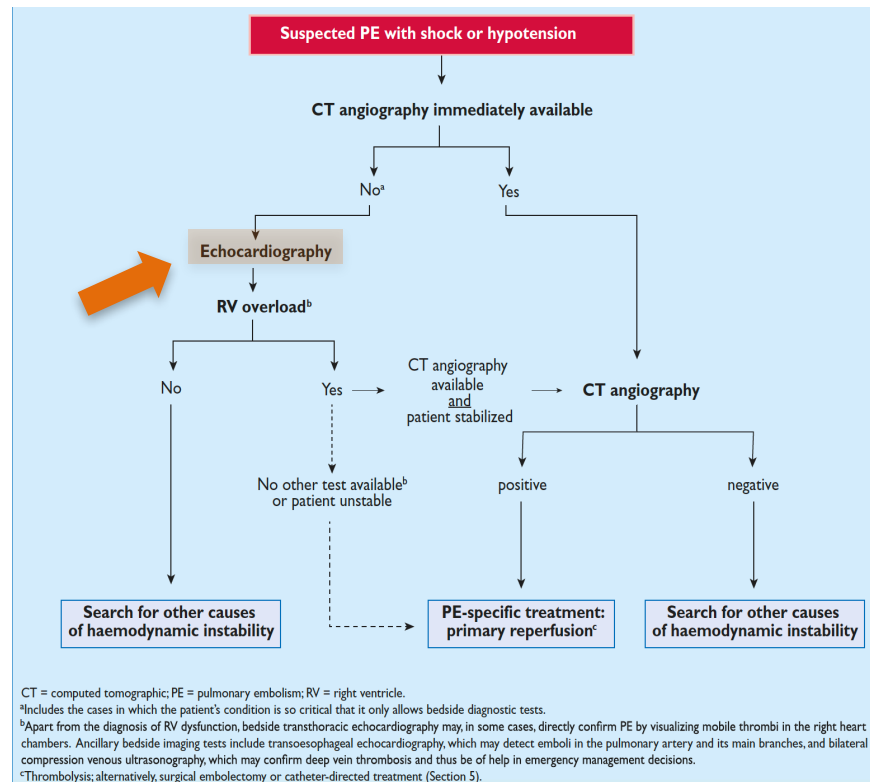
- Constrictive pericarditis



Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Pulmonary embolism

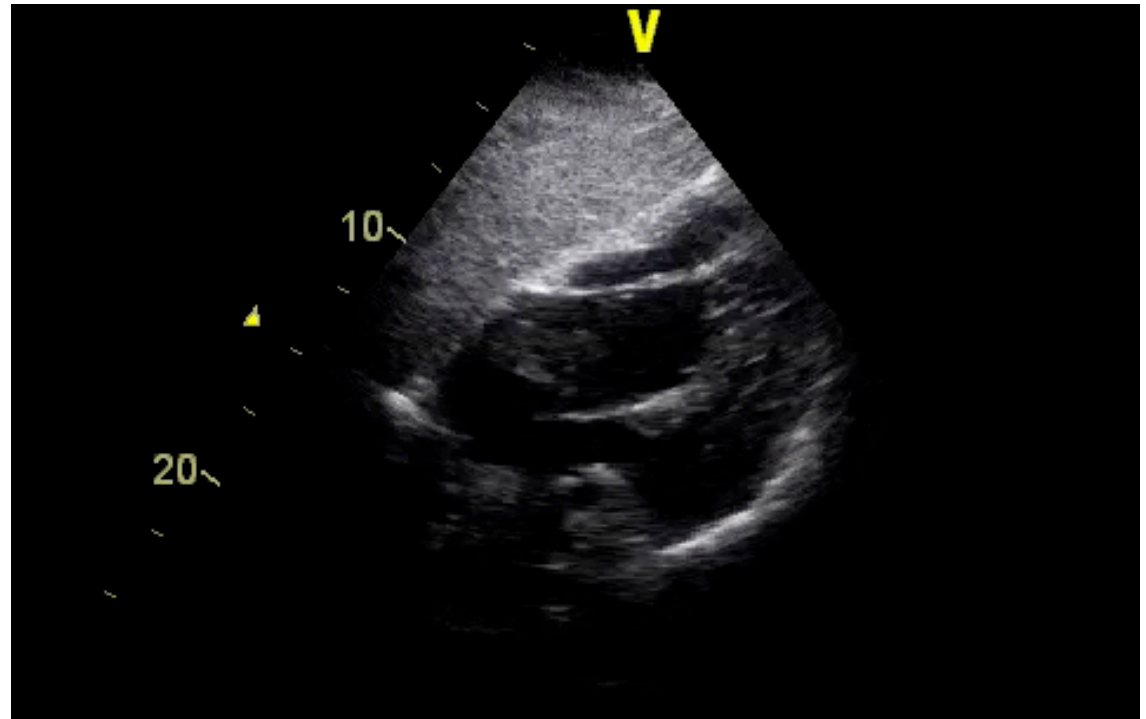
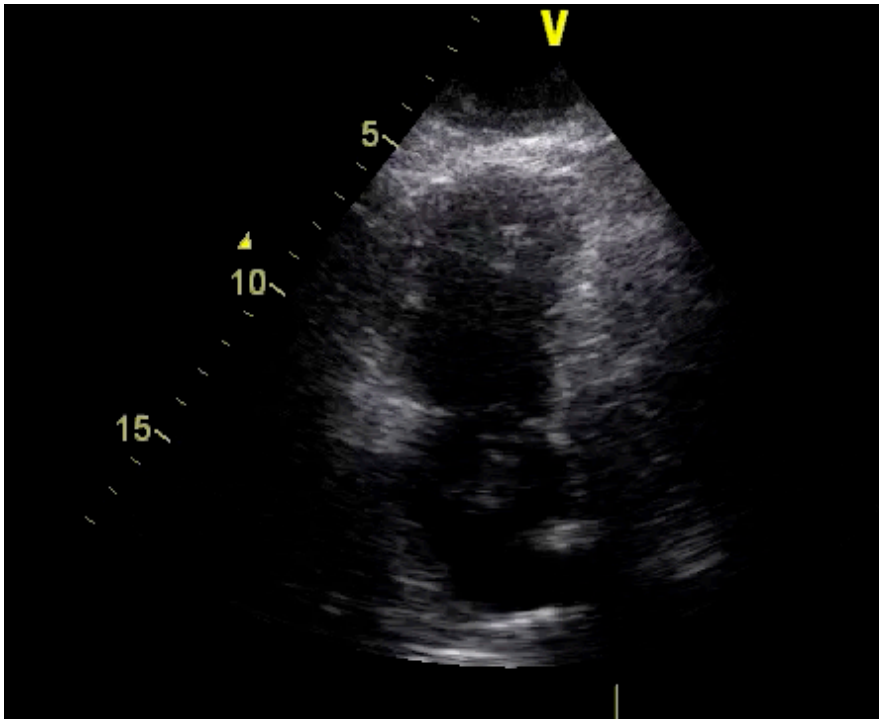


Konstantinides et al., EHJ. 2015

Imaging techniques in acute cardiovascular care

- **Echocardiography in specif scenarios**

Pulmonary embolism

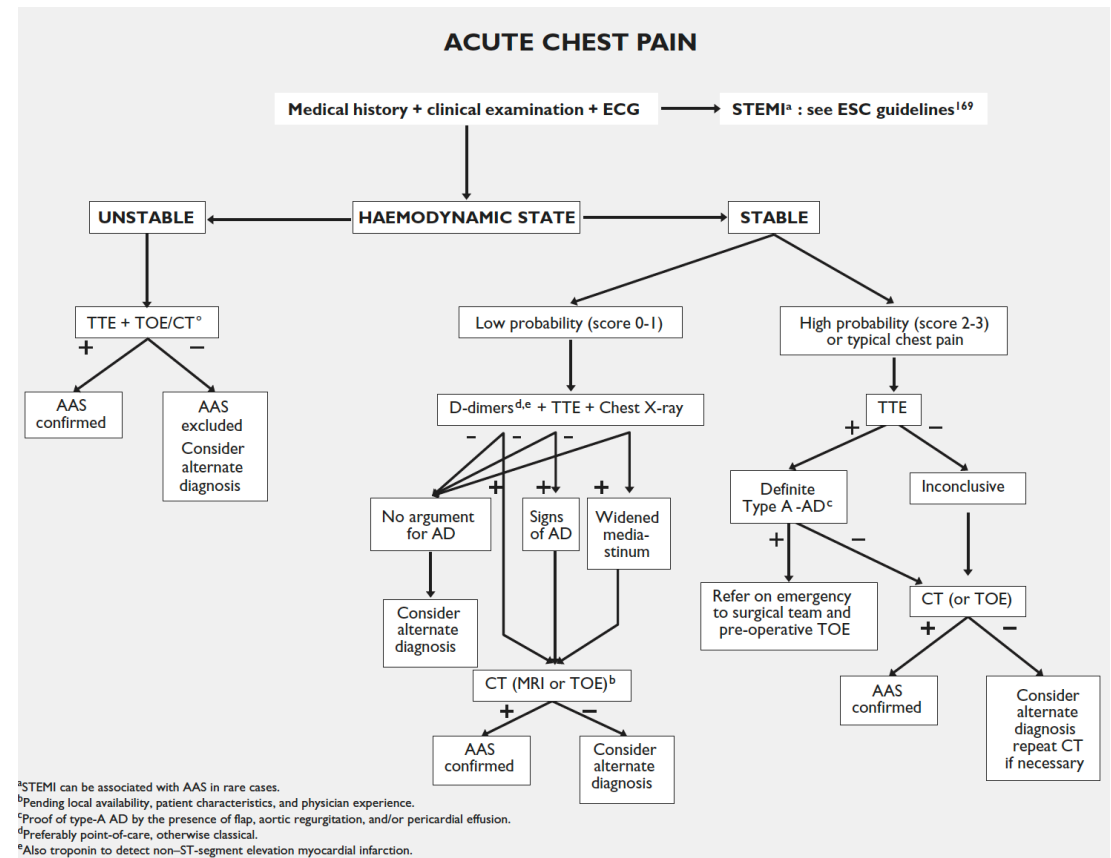


Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Aortic emergencies

- Aortic dissection
- Intramural haematoma
- Penetrating ulcer
- Symptomatic aneyrism



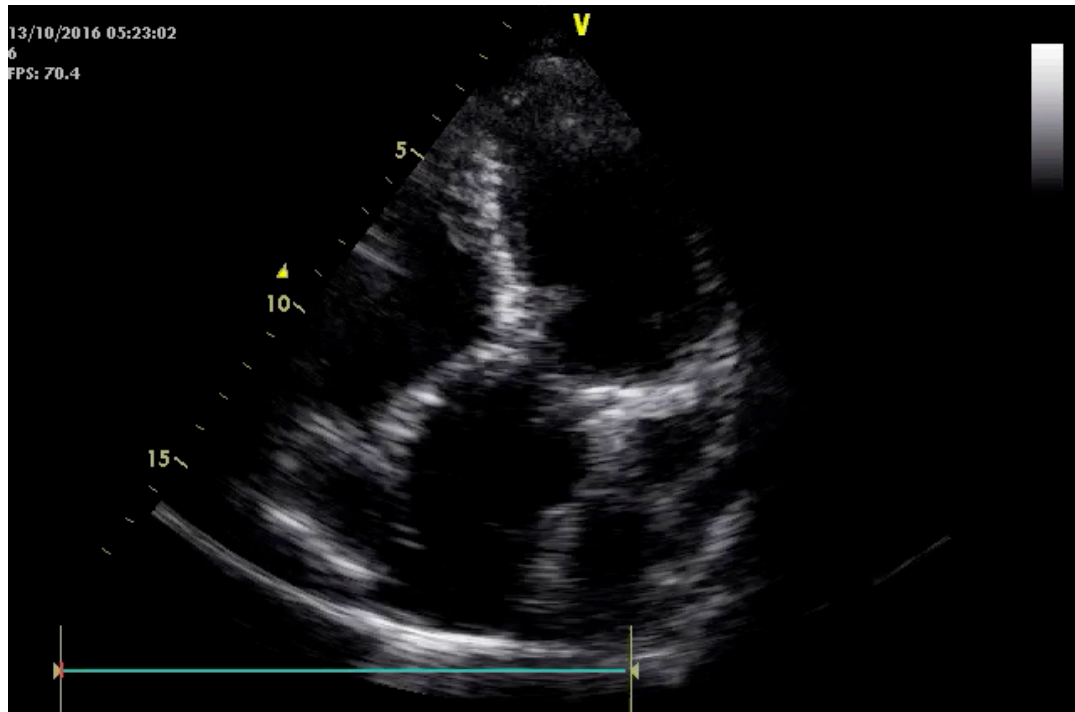
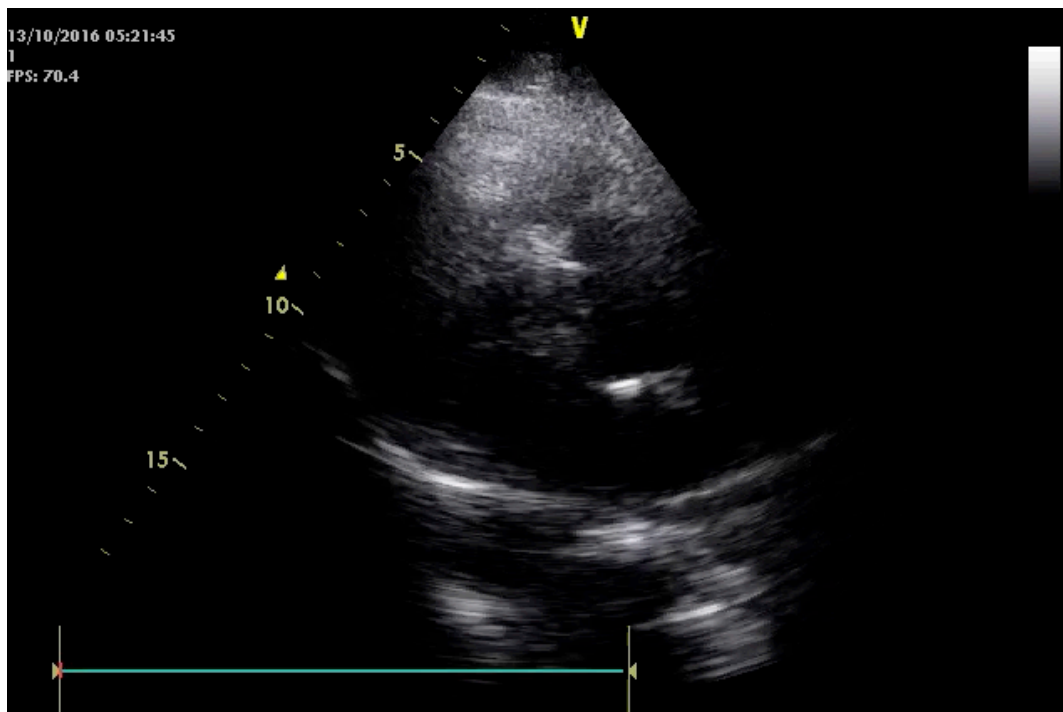
Erbel et al., EHJ. 2014

Imaging techniques in acute cardiovascular care

■ Echocardiography in specif scenarios

Aortic emergencies

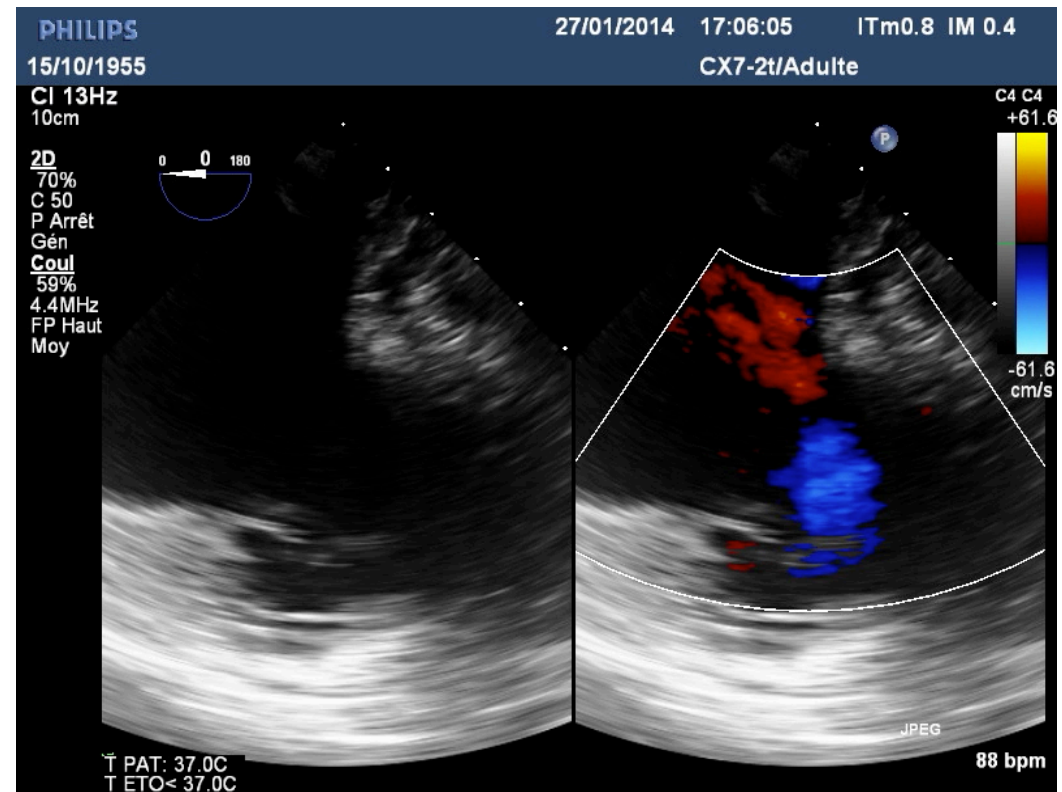
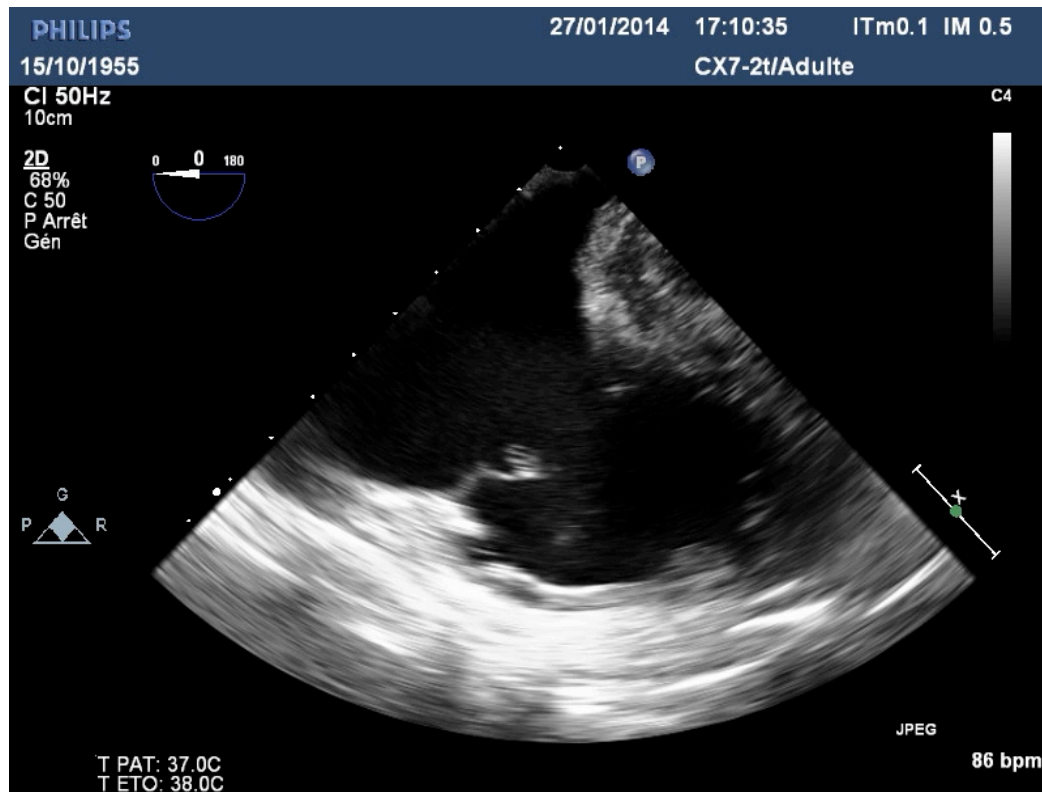
- Aortic dissection



Imaging techniques in acute cardiovascular care

- **Echocardiography in specif scenarios**

Traumatic cardiac injury



Imaging techniques in acute cardiovascular care

- **Computed tomography angiography**

- Coronary
- Pulmonary
- Aorta

Imaging techniques in acute cardiovascular care

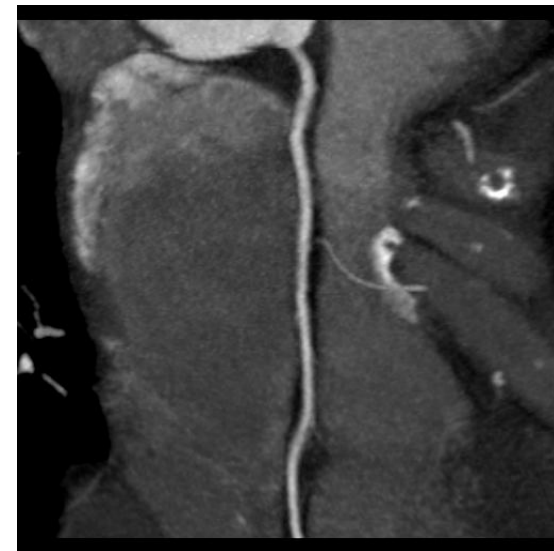
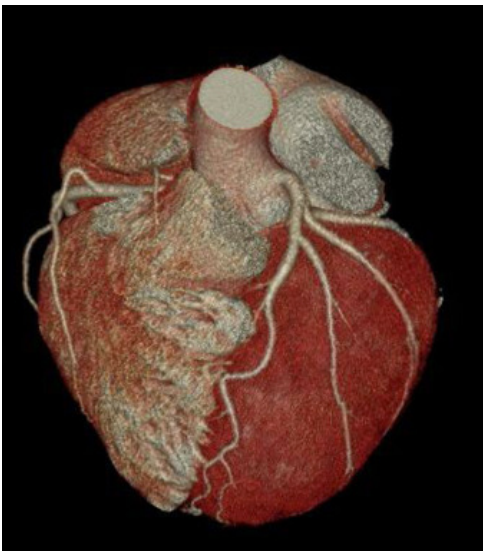
- **Computed tomography angiography**
 - **Coronary**

MDCT coronary angiography should be considered as an alternative to invasive angiography to exclude ACS when there is a low to intermediate likelihood of CAD and when cardiac troponin and/or ECG are inconclusive.

Ila

A

Roffi et al., EHJ. 2016



Tatiana Guimarães, Santa Maria University Hospital, Lisboa, Portugal

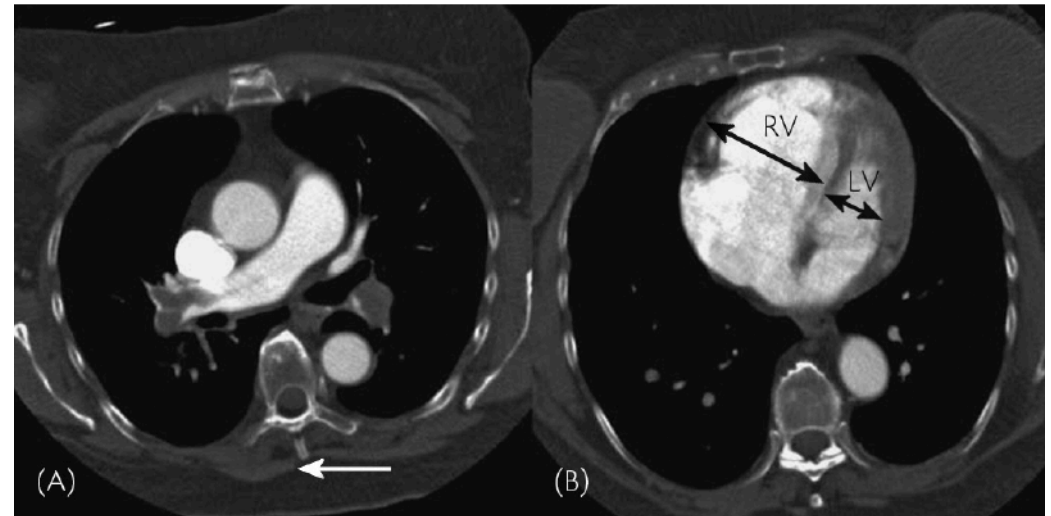
Imaging techniques in acute cardiovascular care

■ Computed tomography angiography

• Pulmonary

CT angiography ^d		
Normal CT angiography safely excludes PE in patients with low or intermediate clinical probability or PE-unlikely.	I	A
Normal CT angiography may safely exclude PE in patients with high clinical probability or PE-likely.	Ila	B
CT angiography showing a segmental or more proximal thrombus confirms PE.	I	B
Further testing to confirm PE may be considered in case of isolated sub-segmental clots.	Ilb	C

Konstantinides et al., EHJ. 2015



(A) Massive emboli in the left and right pulmonary arteries (B) Severe dilation of the right ventricle

Imaging techniques in acute cardiovascular care

■ Computed tomography angiography

• Aorta

In stable patients with a suspicion of AAS, the following imaging modalities are recommended (or should be considered) according to local availability and expertise:

- CT
- MRI
- TOE

In case of initially negative imaging with persistence of suspicion of AAS, repetitive imaging (CT or MRI) is recommended.

Chest X-ray may be considered in cases of low clinical probability of AAS.

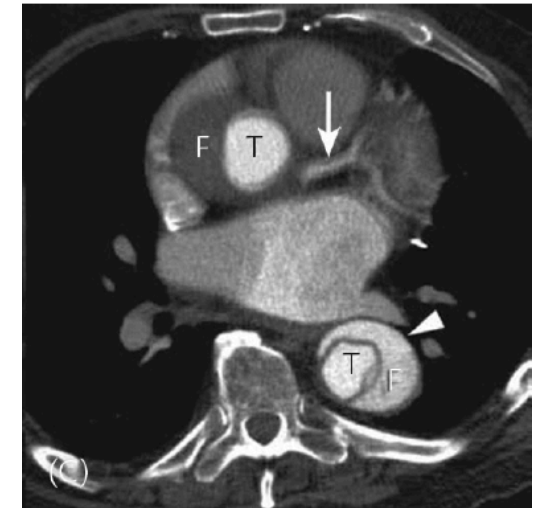
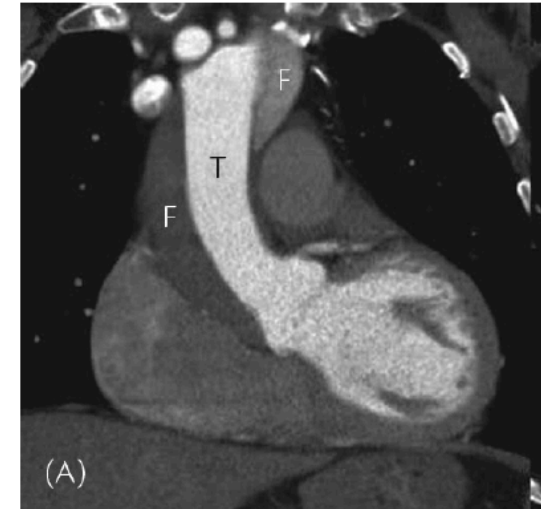
In case of uncomplicated Type B AD treated medically, repeated imaging (CT or MRI)^e during the first days is recommended.

In unstable^d patients with a suspicion of AAS, the following imaging modalities are recommended according to local availability and expertise:

- TOE
- CT

I

I



Type A aortic dissection

Imaging techniques in acute cardiovascular care

■ Computed tomography angiography

• “Triple rule out”

- ✓ Exclude potentially life-threatening causes of acute chest pain
- ✓ Faster algorithm
- ✓ Low admission rates

Chae MK et al., J. Cardiovasc Comput Tomograf., 2016
Turaco M et al., ESC Textbook, 2015

- ✗ Radiation exposure
- ✗ Contrast
- ✗ More RCT are need ...

Imaging techniques in acute cardiovascular care

■ Cardiac magnetic resonance

✓ Etiology

- Acute coronary syndrome/MINOCA
- Myocarditis
- Pericarditis
- Takotsubo syndrome
- Aortic disease
- ...

✓ Left/right ventricular function

✓ Ischaemia/viability

✓ Prognosis

✗ Hemodynamic instability

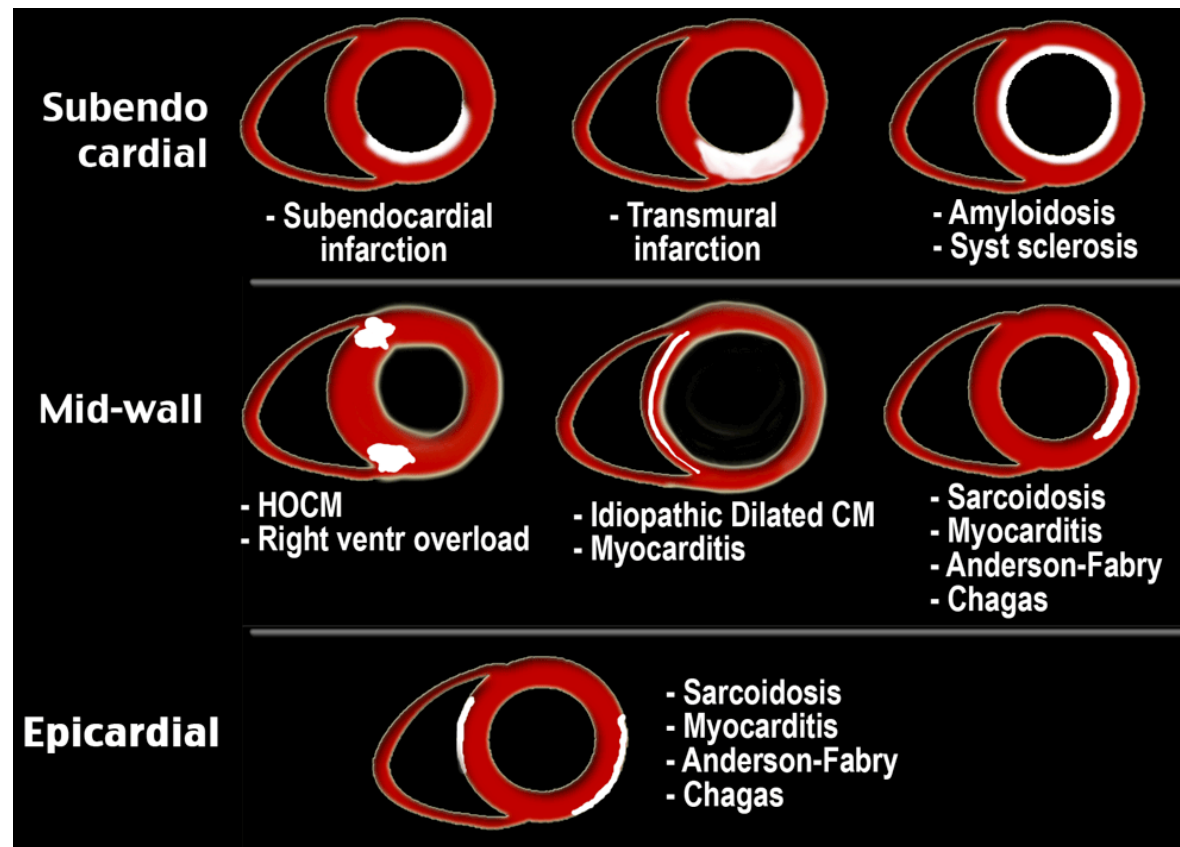
✗ Metallic implants, devices, ...

✗ Gadolinium contrast

Imaging techniques in acute cardiovascular care

■ Cardiac magnetic resonance

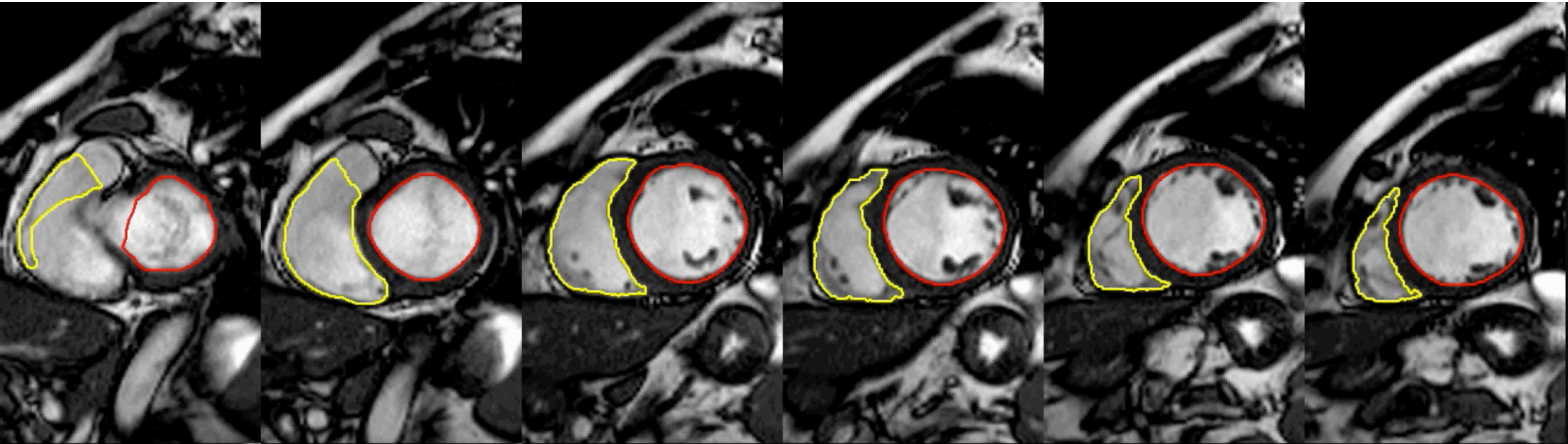
✓ Etiology



Imaging techniques in acute cardiovascular care

- **Cardiac magnetic resonance**

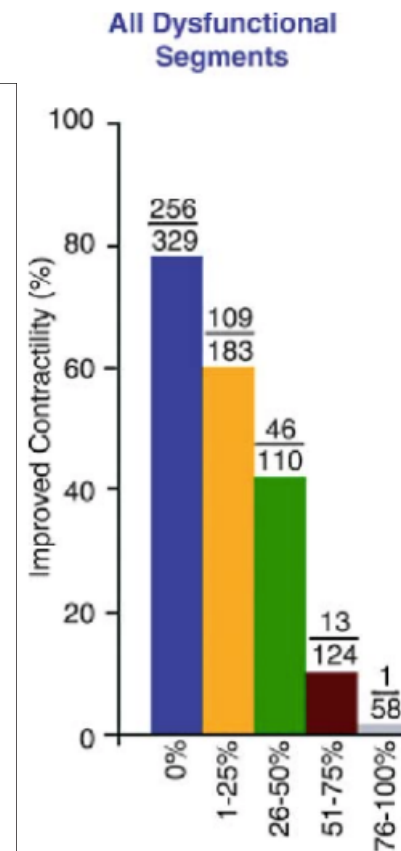
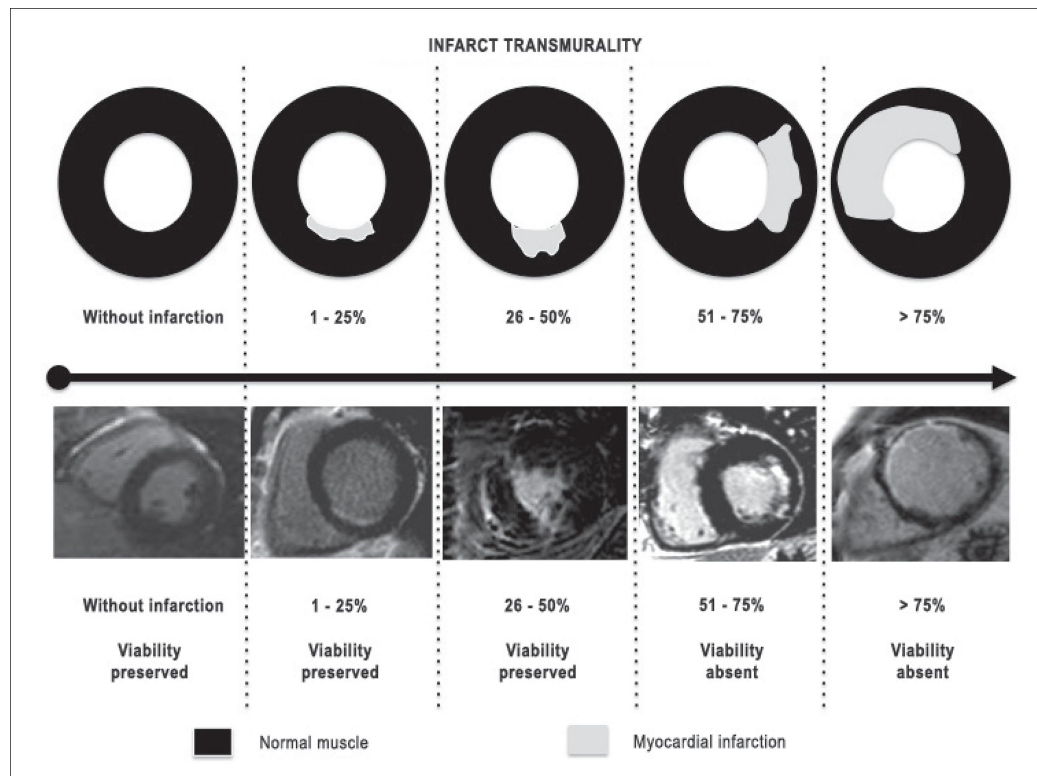
- ✓ Left/right ventricular function



Imaging techniques in acute cardiovascular care

■ Cardiac magnetic resonance

✓ Viability



Kim *et al.* N Eng J Med 2000

Tatiana Guimarães, Santa Maria University Hospital, Lisboa, Portugal

Imaging techniques in acute cardiovascular care

■ Cardiac magnetic resonance

✓ Viability

TABLE 3 Comparison of the PARR-2 and STICH Trials		
	PARR-2	STICH (Viability Substudy)
Study design	Randomized controlled trial	Randomized controlled trial
Premise	Comparison of an imaging-guided strategy to standard care for ischemic cardiomyopathy	Outcome of revascularization vs. optimal medical therapy for ischemic cardiomyopathy
Number of patients	430	601
Centers	Multicenter (9 centers)	Multicenter (99 centers)
Enrollment period	2000-2004	2002-2007
Viability test	PET	Echocardiography SPECT
Study endpoints	Primary: occurrence of cardiac death, MI, or hospital stays for cardiac cause Secondary: time to occurrence of the primary endpoint and time to cardiac death	Primary: rate of death due to any cause Secondary: rate of death due to cardiovascular causes and rate of death due to any cause or hospitalization for cardiovascular causes
Intervention	CABG/PCI	CABG
Patient characteristics, n or n (%)		
% Female	16	13
Baseline LVEF, %	27	27
NYHA functional class II to IV	352 (82)	574 (96)
CCS II-IV	198 (46)	271 (45)
Prior CABG	80 (19)	16 (3)
Prior MI	346 (80)	481 (80)
Chronic renal insufficiency	146 (34)	43 (7)
Diabetes mellitus	167 (39)	224 (37)
Median follow-up, yrs	1	5.1
Caveats	25% of the FDG-PET study group were not managed according to imaging recommendations - Patients assigned to CABG had lower rates of cardiovascular death and of the composite endpoint of death of any cause or hospitalization for cardiovascular causes	- Viability study nonrandomized 83% of subjects in the viability substudy were Caucasian compared with 54% of subjects in the STICH trial who did not have a viability test - Subgroups of patients assigned to the FDG PET group who had recent angiography or who adhered to imaging recommendations had better outcomes
Main result	No difference between an imaging-guided strategy and standard care	No incremental benefit of revascularization strategy over optimal medical therapy

Anavekar et al. Revascularization in Severe LV Dysfunction. JACC Vol. 67, No. 24, 2016

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Imaging techniques in acute cardiovascular care

■ TAKE HOME MESSAGES

- Imaging techniques are indispensable for clinical decision-making
- **Chest X-ray** is an easy-to-use and may reveal unsuspected clinical conditions
- **FoCUS** and **lung ultrasound** are extension of the clinical examination
- “**Triple rule-out**” approach may improve the triage of patients presenting with acute chest pain
- Current applications of **cardiac magnetic resonance** offer a wide spectrum of indications in the setting of acute cardiac care