Società Italiana Reumatologia

Manifestazioni Cardiovascolari e Metaboliche in Reumatologia
Approcci interdisciplinari in reumatologia

Cuore e sclerosi sistemica
Cardiopatia Restrittiva

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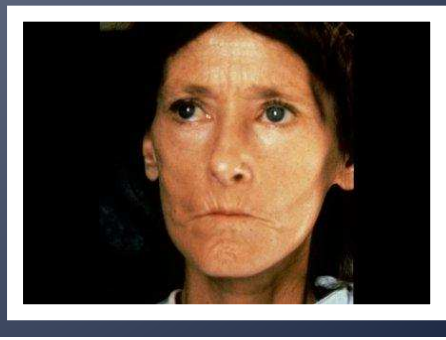
Classification of systemic sclerosis

- 1. Diffuse cutaneous systemic sclerosis
- 1) proximal skin thickening
- - distal and proximal extremity and often the trunk and face
- 2) tendency to rapid progression of skin change
- 3) rapid onset of disease following Raynaud's phenomenon
- 4) early appearance of visceral involvement
- 5) poor prognosis

Classification of systemic sclerosis

2. Limited cutaneous systemic sclerosis
   1) symmetric restricted fibrosis
      - affecting the distal extremities and face/neck
   2) prolonged delay in appearance of distinctive internal manifestation
   3) prominence of calcinosis and telangiectasia
   4) good prognosis

* CREST syndrome
  - calcinosis, Raynaud's phenomenon, esophageal dysmotility, sclerodactyly, telangiectasia



Classificazione

Limitata – Prognosi buona

Diffusa – Prognosi infausta

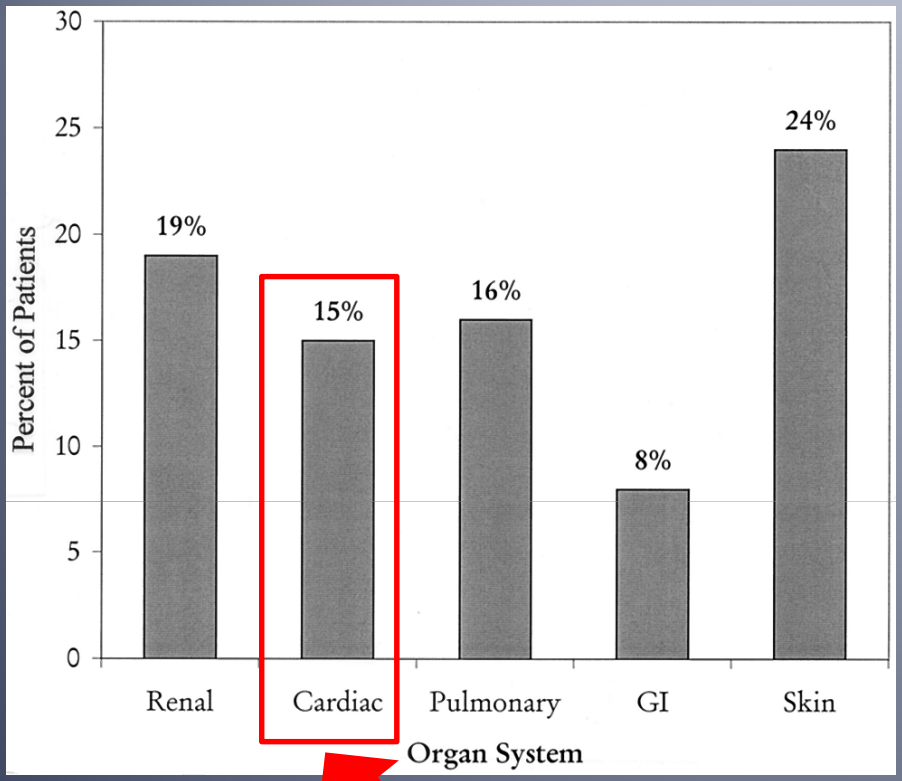
Extent of internal organ involvement influences survival in limited and diffuse forms of SSc

- **In diffuse SSc, mortality rate 5 to 8 times higher than general population[4]**
- **For those with limited skin involvement, mortality rate 2 times higher than general population[4]**

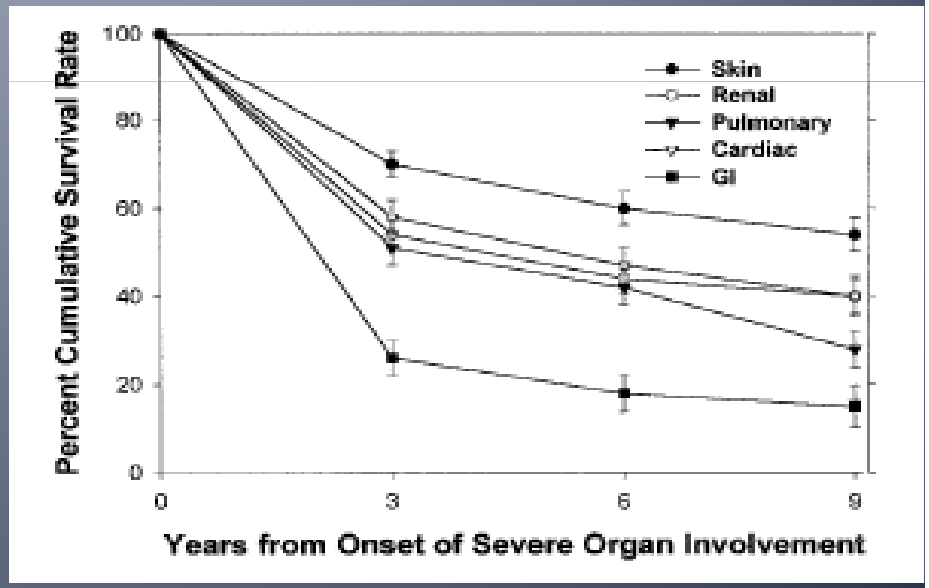
Lung disease most common scleroderma-related cause of death

4. *Denton C. UpToDate, 2004.*

Severe organ involvement in systemic sclerosis, results from the Pittsburgh study

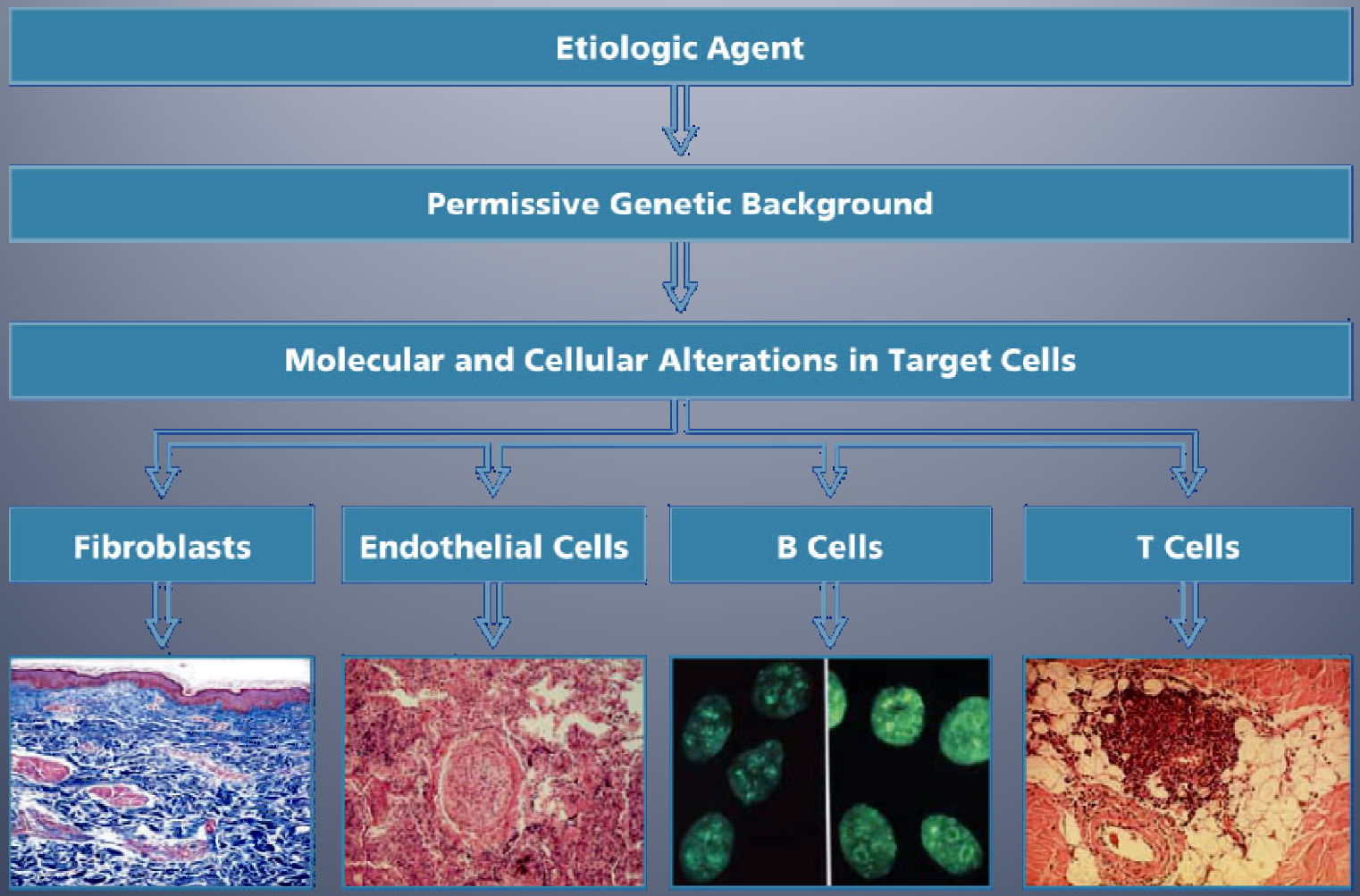


- CHF
- symptomatic pericarditis
- arrhythmia requiring treatment



Steen & Medsger, Arthritis Rheum 2000

Fisiopatologia



Fisiopatologia

- **Danno di arteriole e capillari**
- - cellule endoteliali
- - adesione e attivazione delle piastrine
- - rilascio di ET, trombossano A2
- - vasocostrizione & crescita di cellule endoteliali e fibroblasti
- - stenosi o occlusione, aumentata permeabilità capillare
- **Fibrosi**
- - alterata regolazione del fattore di di crescita dei fibroblasti
- - aumentata produzione della matrice extracellulare
- (collagene, fibronectina, and glicosaminoglicani)
- - ispessimento della cute & fibrosi di organi interni

Alterazioni cardiovascolari

- **In generale**
  - **Versamento pericardico**
  - **Aritmie**
  - **Disturbi del sistema di conduzione**
  - **Alterazioni valvolari (rare)**

Alterazioni cardiovascolari

Microcircolazione

- **Vasospasmo**
  - Precoce
  - Reversibile
- **Ridotta riserva coronarica**
  - Tardiva
  - Irreversibile

Fibrosi

- **Deposito di collagene nella matrice intracellulare**
  - Tardiva
  - Disfunzione sistolica e diastolica
  - Entrambi i ventricoli

Causes of restrictive cardiomyopathy

Infiltrative disorders
Amyloidosis
Haemosiderosis
Sarcoidosis
Endomyocardial fibroelastosis
Scleroderma
Radiotherapy
Idiopathic

CARDIOMIOPATIA RESTRITTIVA

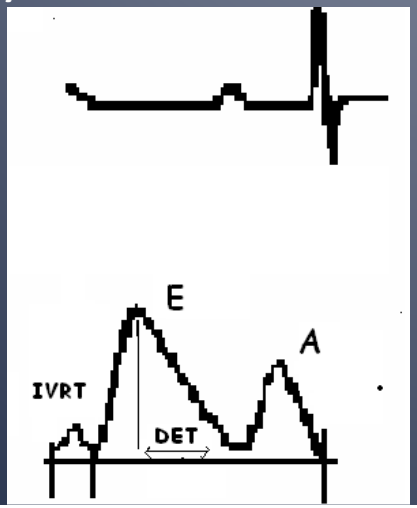
- meno comune
- funzione sistolica normale o solo lievemente ridotta
- normali spessori o aumentati
- normali volumi
- dilatazione di entrambi gli atri
- classificazione funzionale
- alterazione della funzione diastolica

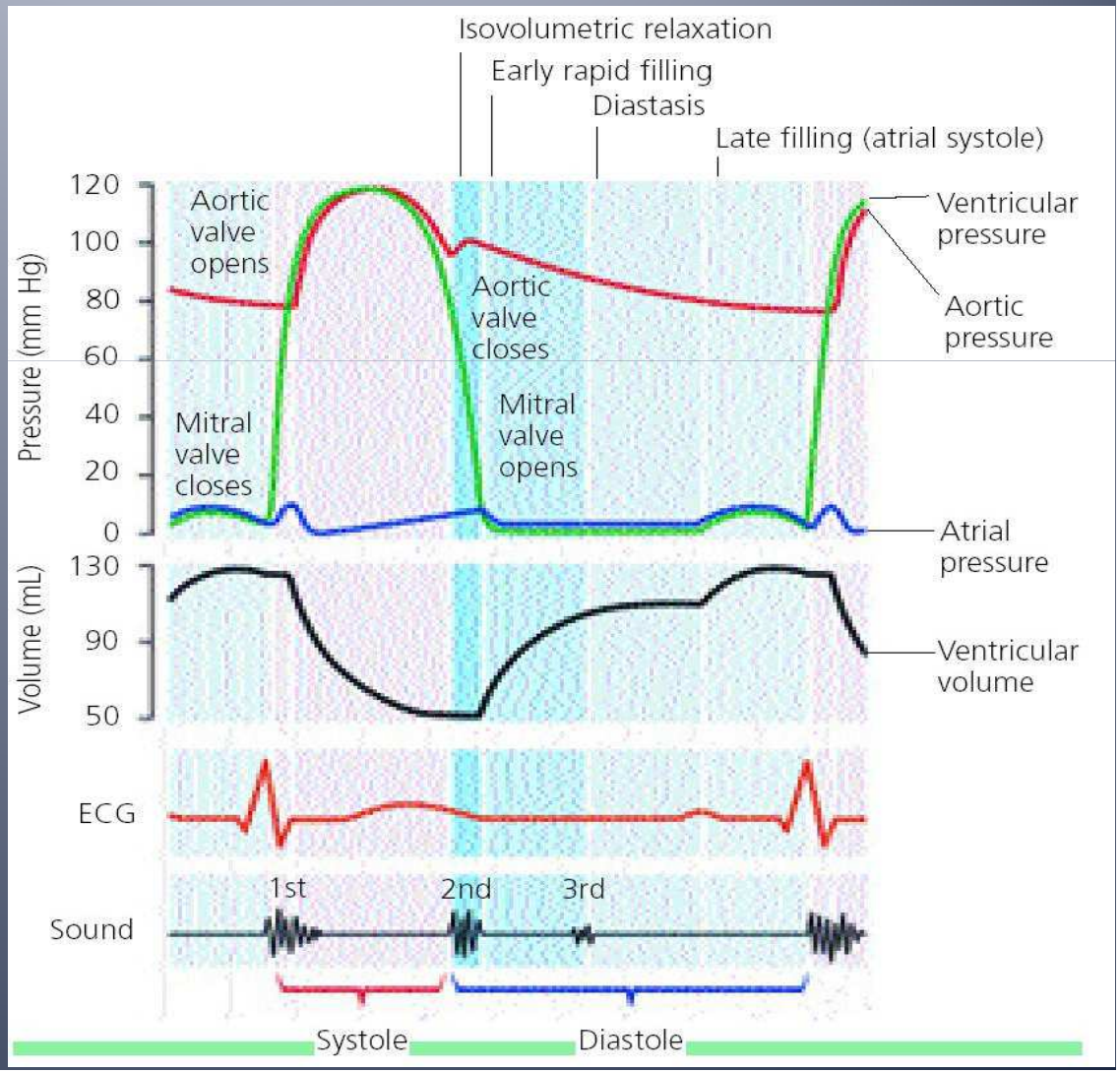
Diastole

E' un processo attivo che si estende dalla chiusura della valvola aortica al termine dell'afflusso mitralico

E' divisa in 4 fasi:

1) RILASCIAMENTO ISOVOLUMETRICO (RI)
2) RIEMPIMENTO RAPIDO (RR)
3) RIEMPIMENTO LENTO (diastasi)
4) SISTOLE ATRIALE





Definizioni

- **Anormalità diastolica:**

  alterazione del rilasciamento ventricolare identificata da ↑ IVRT o E/A patologico ma senza segni di aumentata PTD

  → pattern diastolico

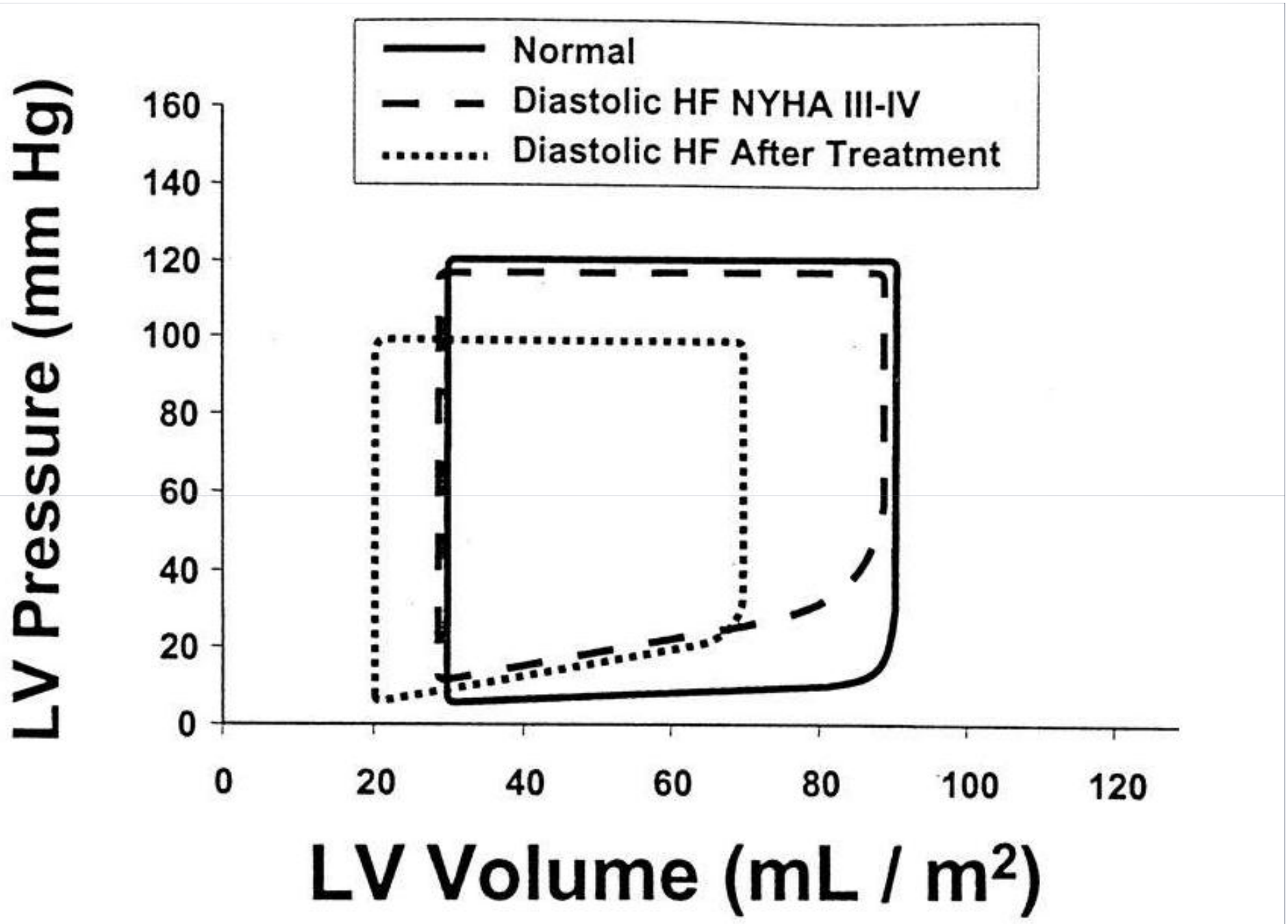
- **Disfunzione diastolica:**

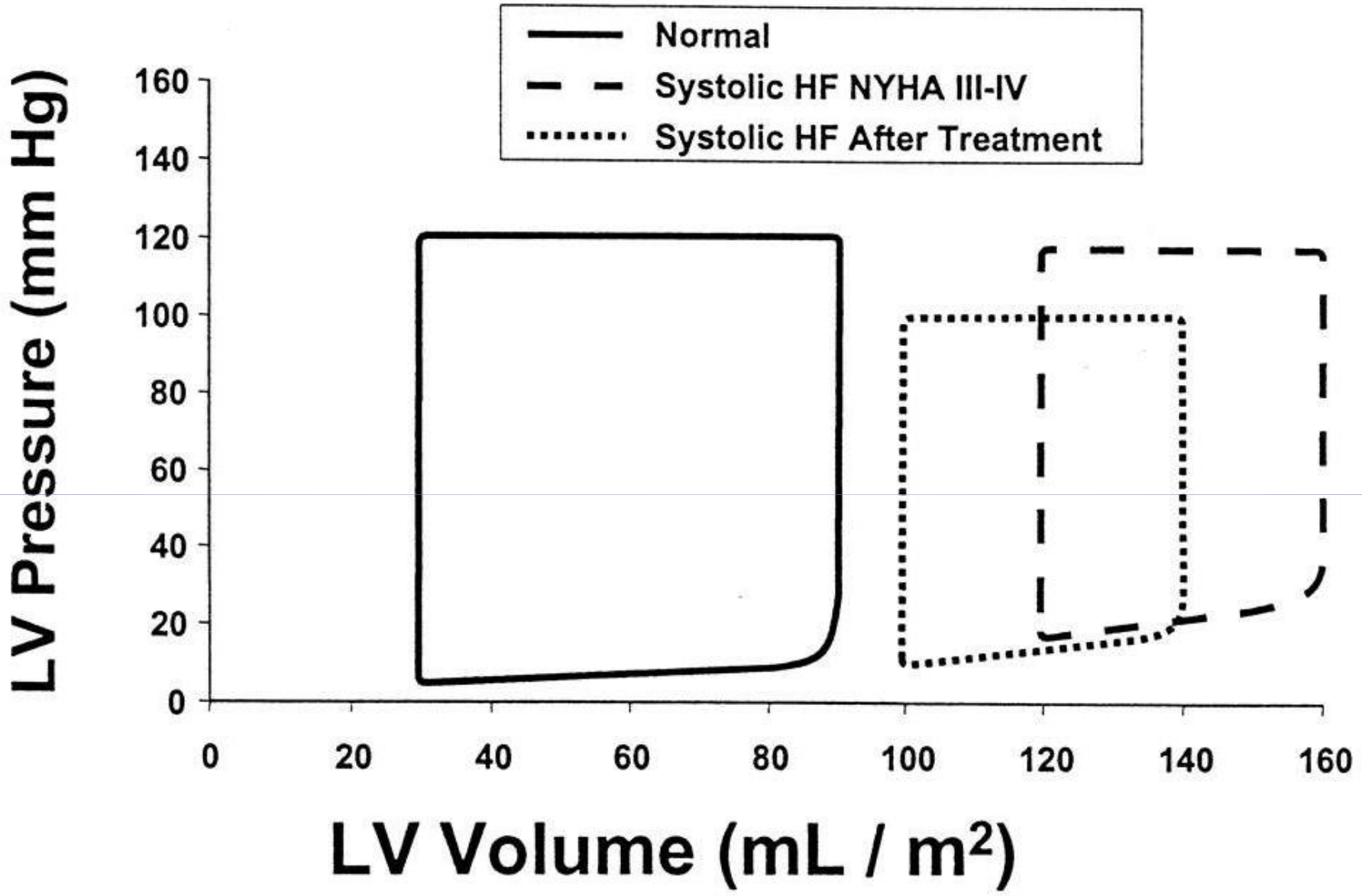
  viene identificata dai segni Doppler di un aumento della PTD o PA → disfunzione diastolica I,II,III-IV grado

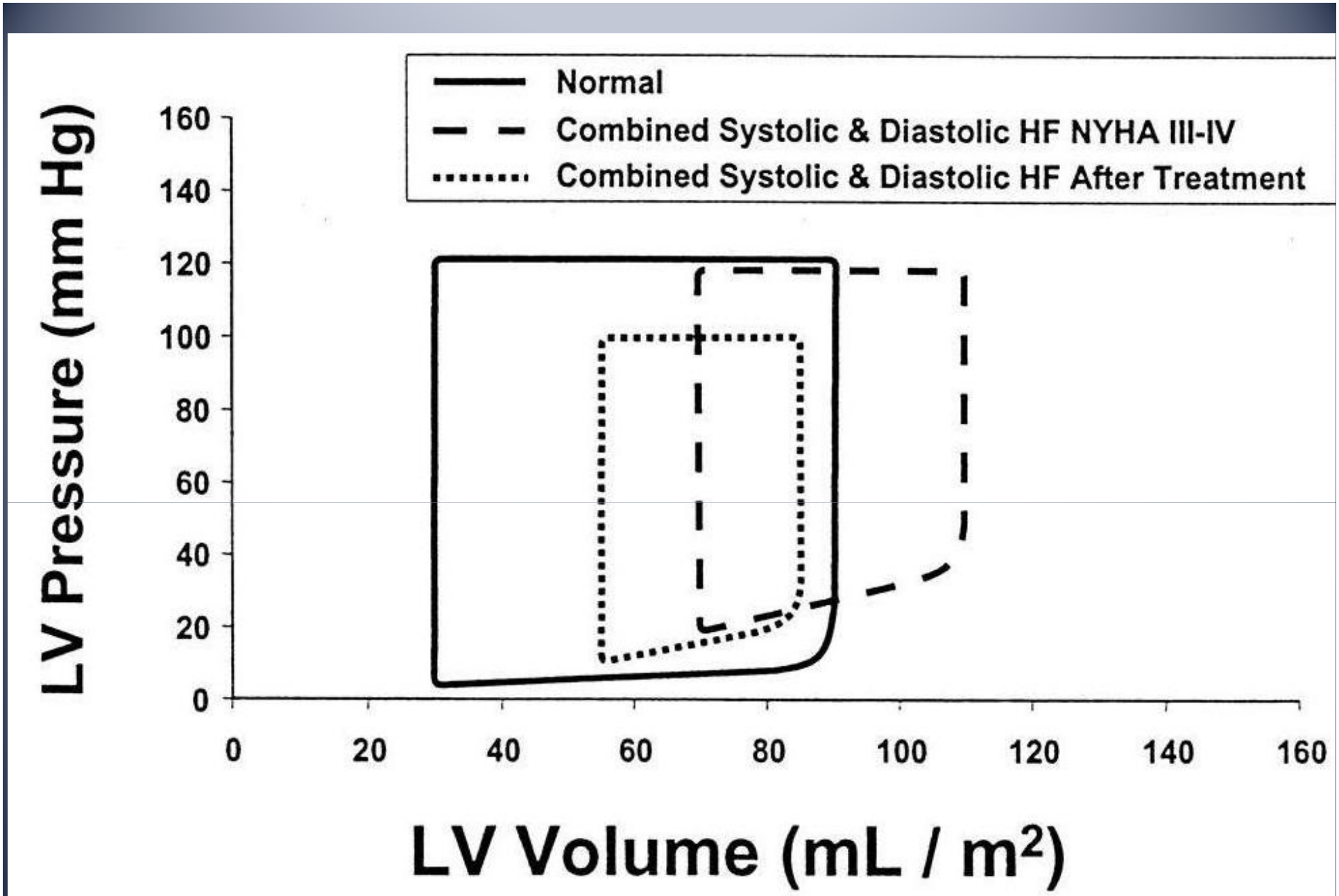
- **Scompenso diastolico:**

  disfunzione diastolica + sintomi della congestione venosa polmonare

*Ital Heart J Suppl 2000;1(10):1273-1280

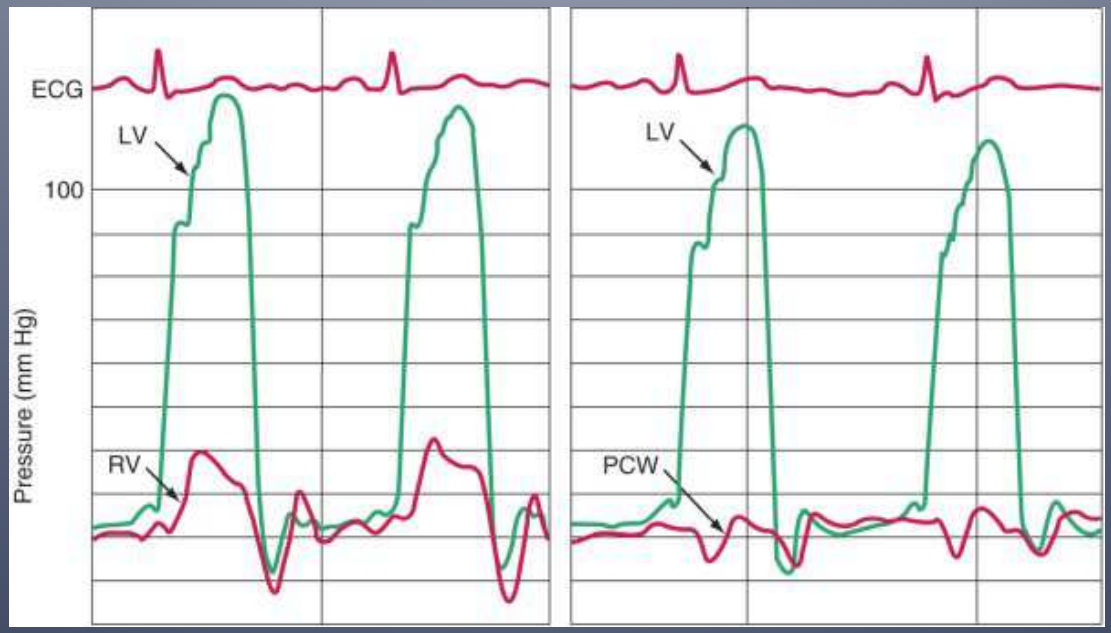

Normal
Diastolic HF NYHA III-IV
Diastolic HF After Treatment
LV Pressure (mm Hg)
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
LV Volume (mL / m²)


Normal
Systolic HF NYHA III-IV
Systolic HF After Treatment
LV Pressure (mm Hg)
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
LV Volume (mL / m²)


Normal
Combined Systolic & Diastolic HF NYHA III-IV
Combined Systolic & Diastolic HF After Treatment
LV Pressure (mm Hg)
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
140
160
LV Volume (mL / m²)

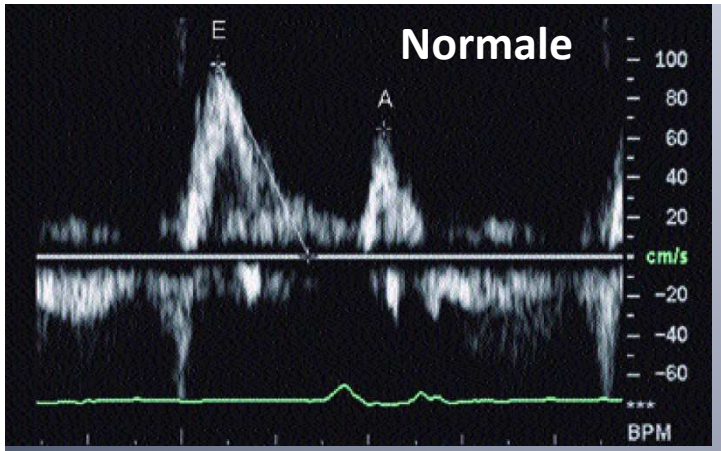
Valutazione della Funzione Diastolica

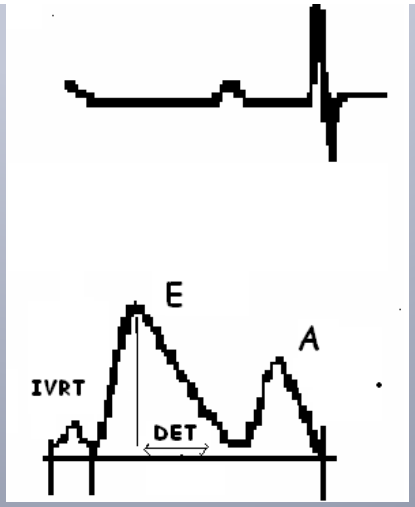
- **Cateterismo cardiaco** (gold standard): misura in maniera diretta la pressione diastolica ventricolare

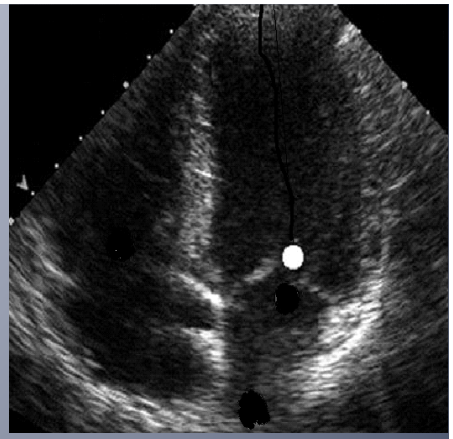


Valutazione della Funzione Diastolica

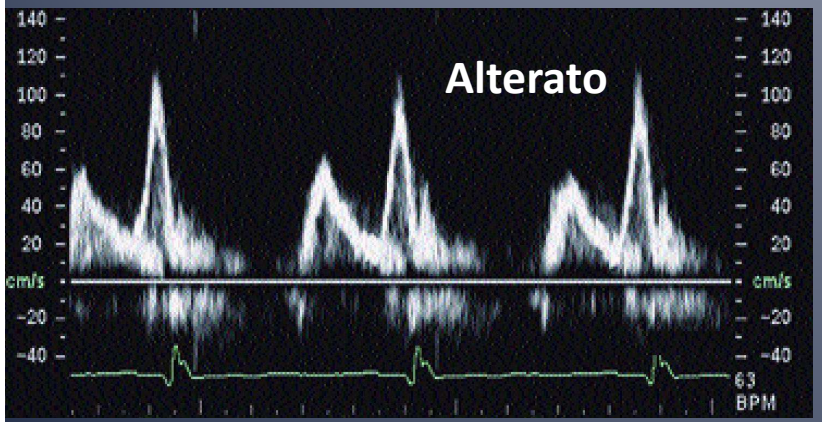
- **Ecocardiografia** (volumi, cinesi, spessori, funzione ventricolare, cavita' atriali, apparati valvolari, flussimetria, pericardio)
  - Doppler pulsato
  - Doppler Tessutale TDI
  - Flusso Venoso Polmonare
  - Color Doppler Mmode transmitralico
  - Speckel Tracking

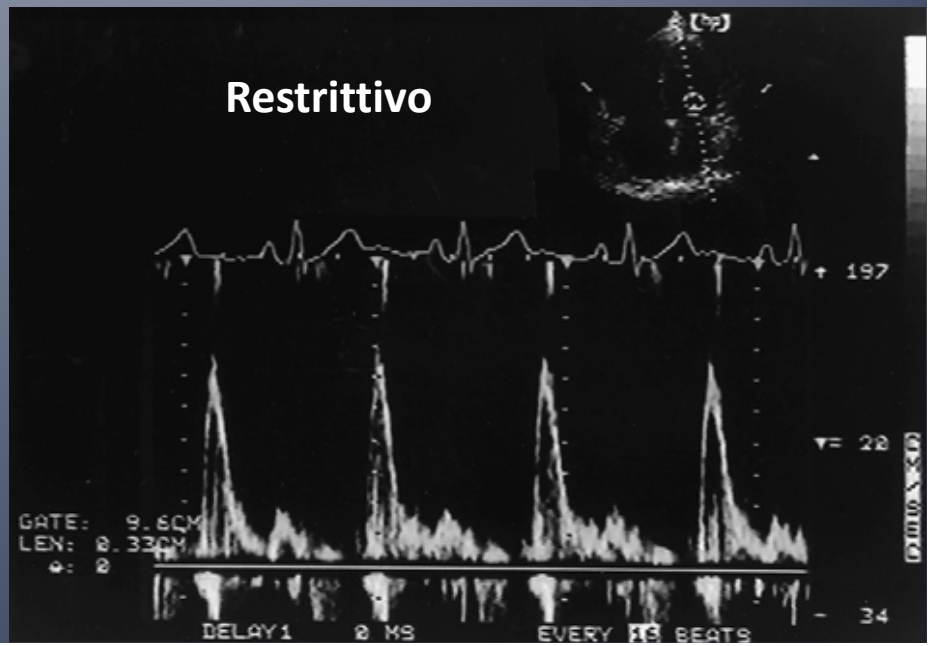






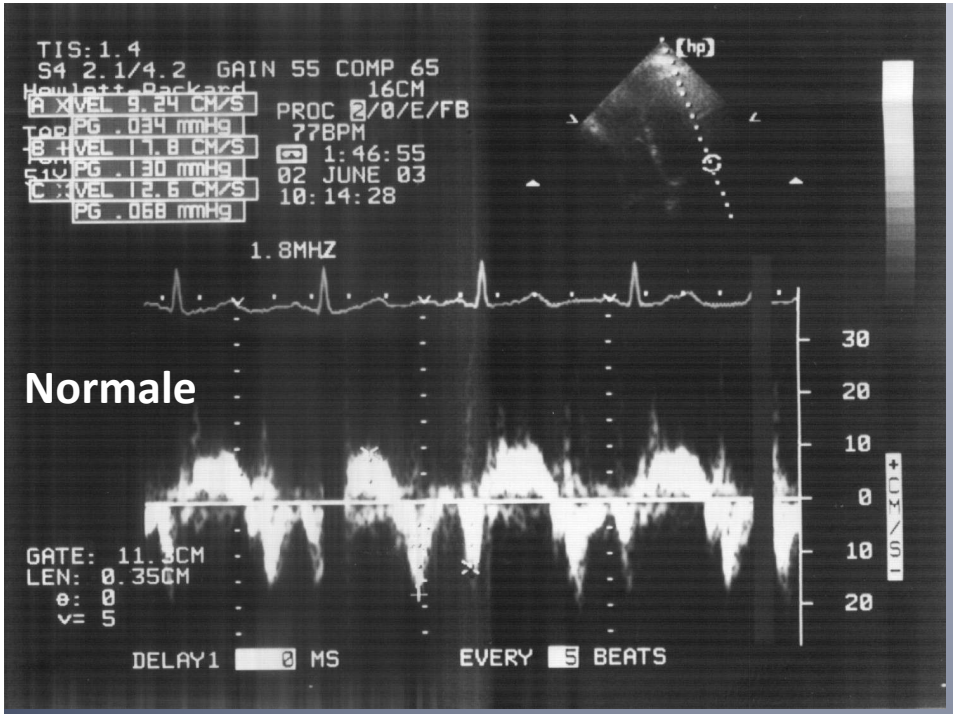
As diastolic function worsens and LV diastolic pressure rises, LV diastolic filling occurs primarily during early diastole, because the LV pressure at end-diastole is so high that atrial contraction contributes less to LV filling than normal.



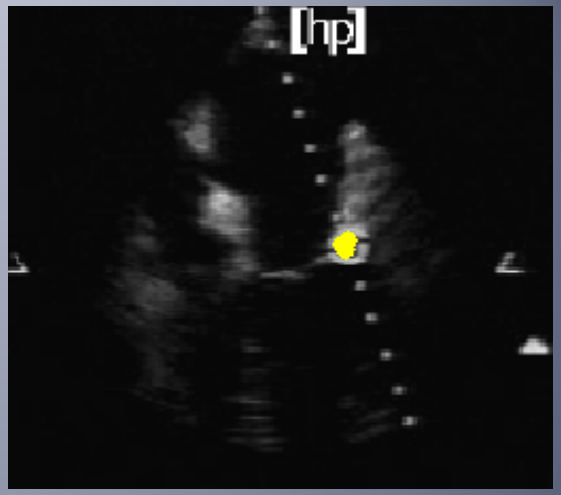


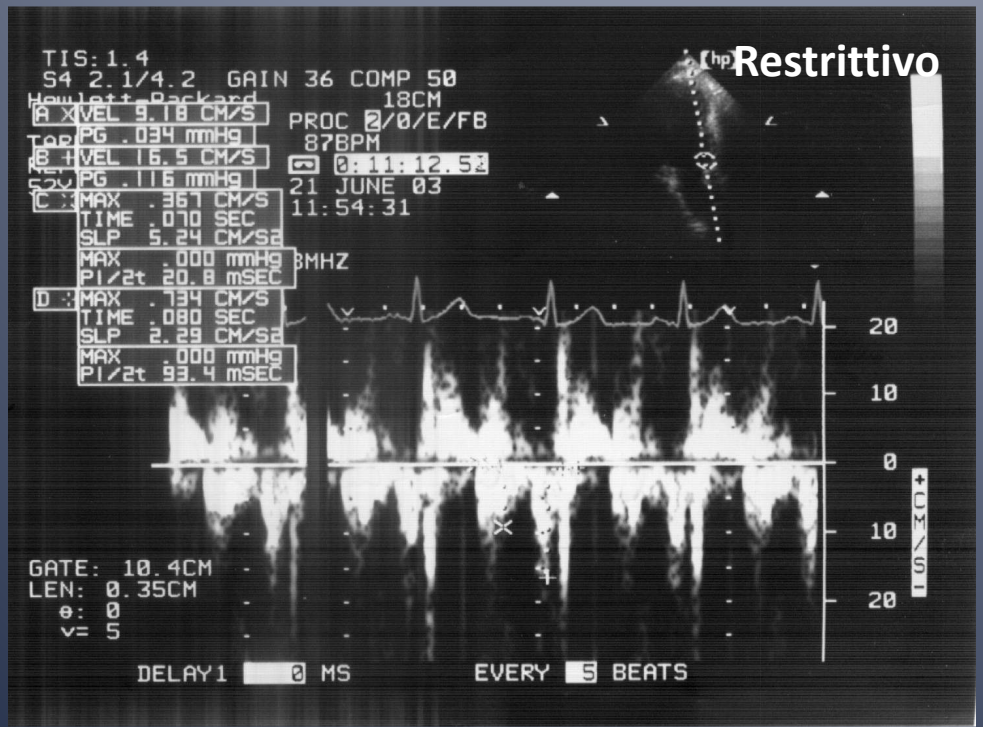
Valutazione della Funzione Diastolica

- **Ecocardiografia**
  - Doppler pulsato
  - Doppler Tessutale TDI
  - Flusso Venoso Polmonare
  - Color Doppler Mmode transmitralico
  - Speckel Tracking

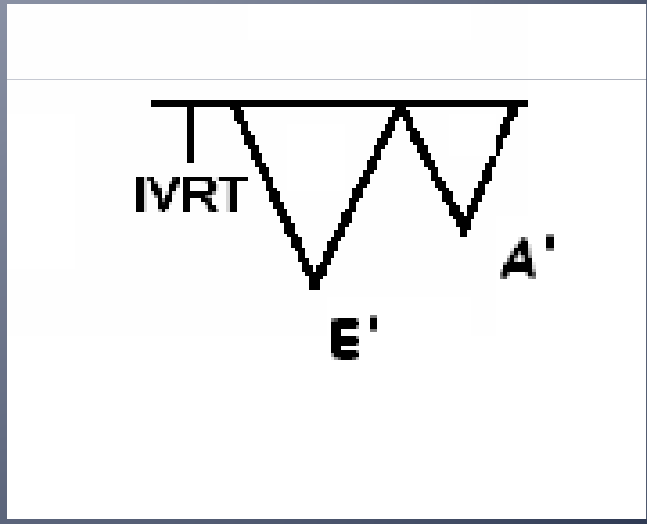


Normale





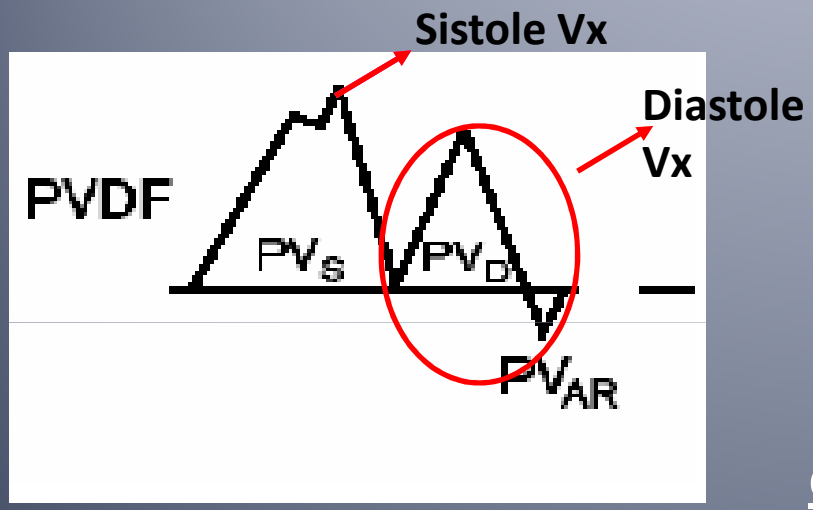
Restrittivo

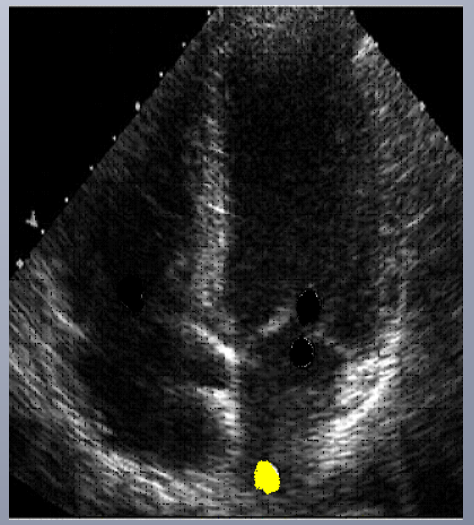


Valutazione della Funzione Diastolica

- **Ecocardiografia**
  - Doppler pulsato
  - Doppler Tessutale TDI
  - **Flusso Venoso Polmonare**
  - Color Doppler Mmode transmitralico
  - Speckel Tracking

NORMALE



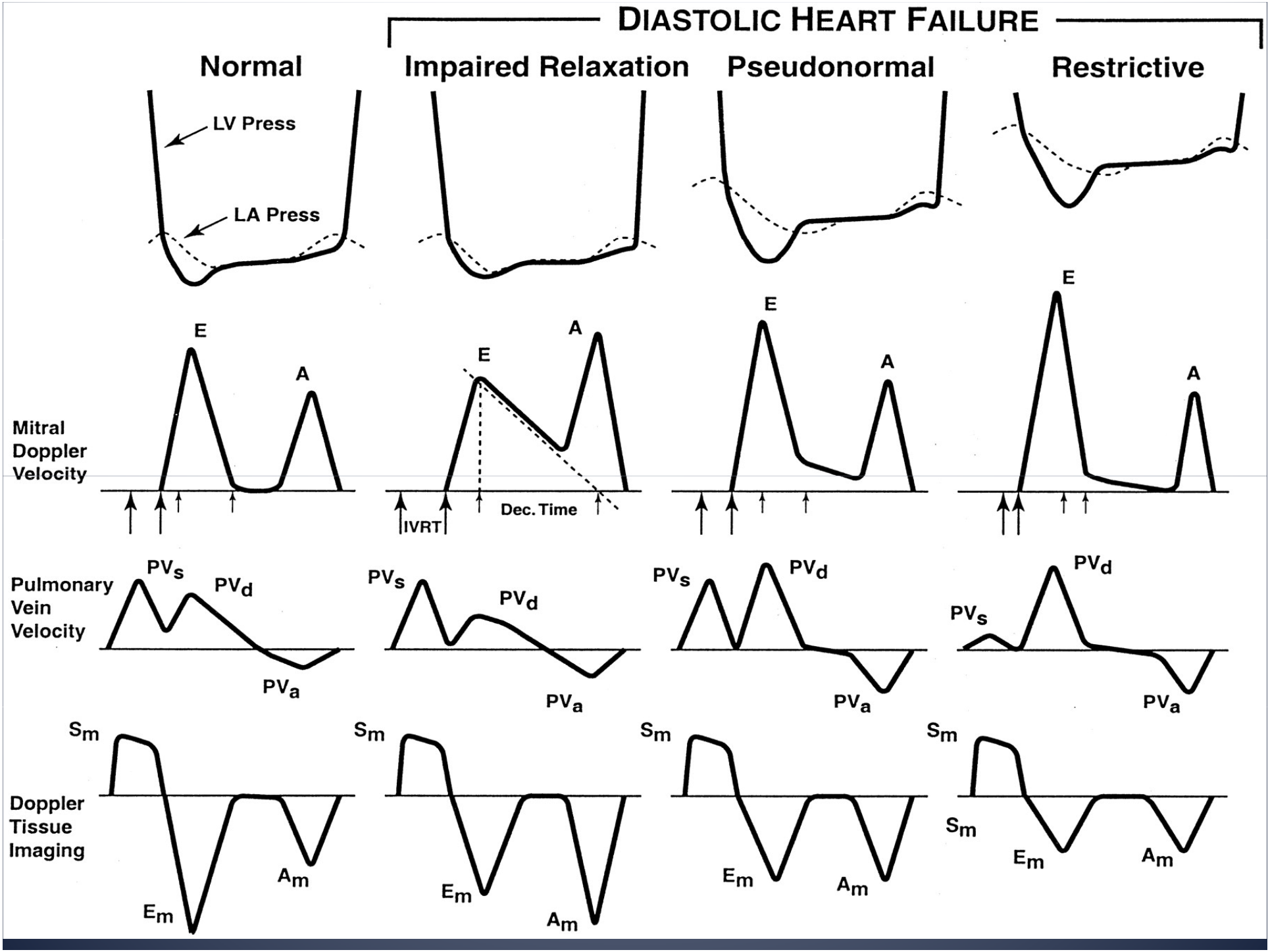


Doppler pulsato:
sbocco in Asx della vena polmonare superiore dx

onda S: - compliance e Pr.Asx media
- dislocamento sistolico dell'annulus mitralico
- IM

→ velocità inversamente correlata alla Pr.A

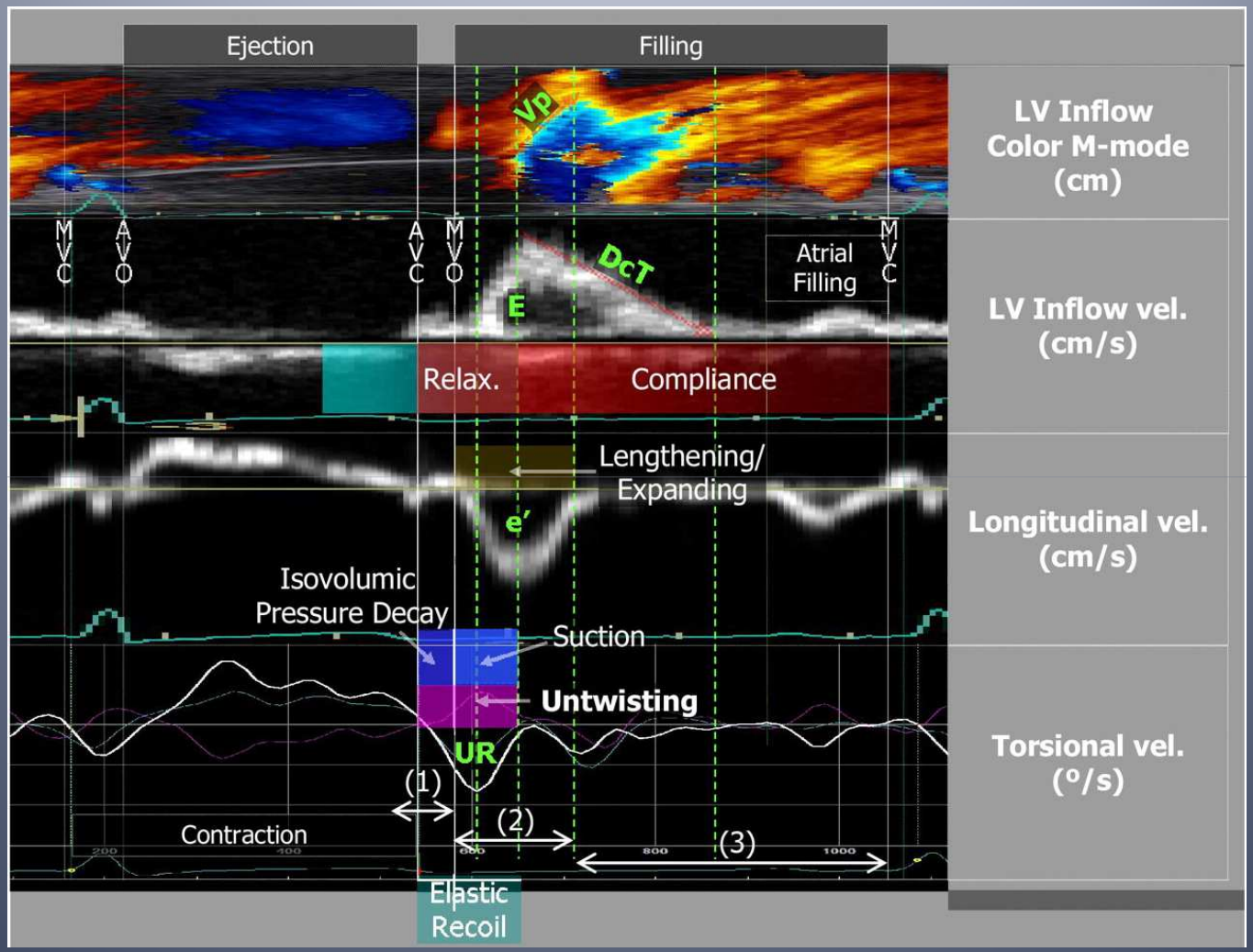
onda D: - influenzata dagli stessi fattori onda E


DIASTOLIC HEART FAILURE
Normal
Impaired Relaxation
Pseudonormal
Restrictive
LV Press
LA Press
Mitral Doppler Velocity
E
A
IVRT
Dec. Time
Pulmonary Vein Velocity
PVs
PVd
PVa
Doppler Tissue Imaging
Sm
Em
Am

Valutazione della Funzione Diastolica

- **Ecocardiografia**
  - Doppler pulsato
  - Doppler Tessutale TDI
  - Flusso Venoso Polmonare
  - **Color Doppler Mmode transmitralico**
  - Speckel Tracking

Sequence of Mechanical Events in Diastole



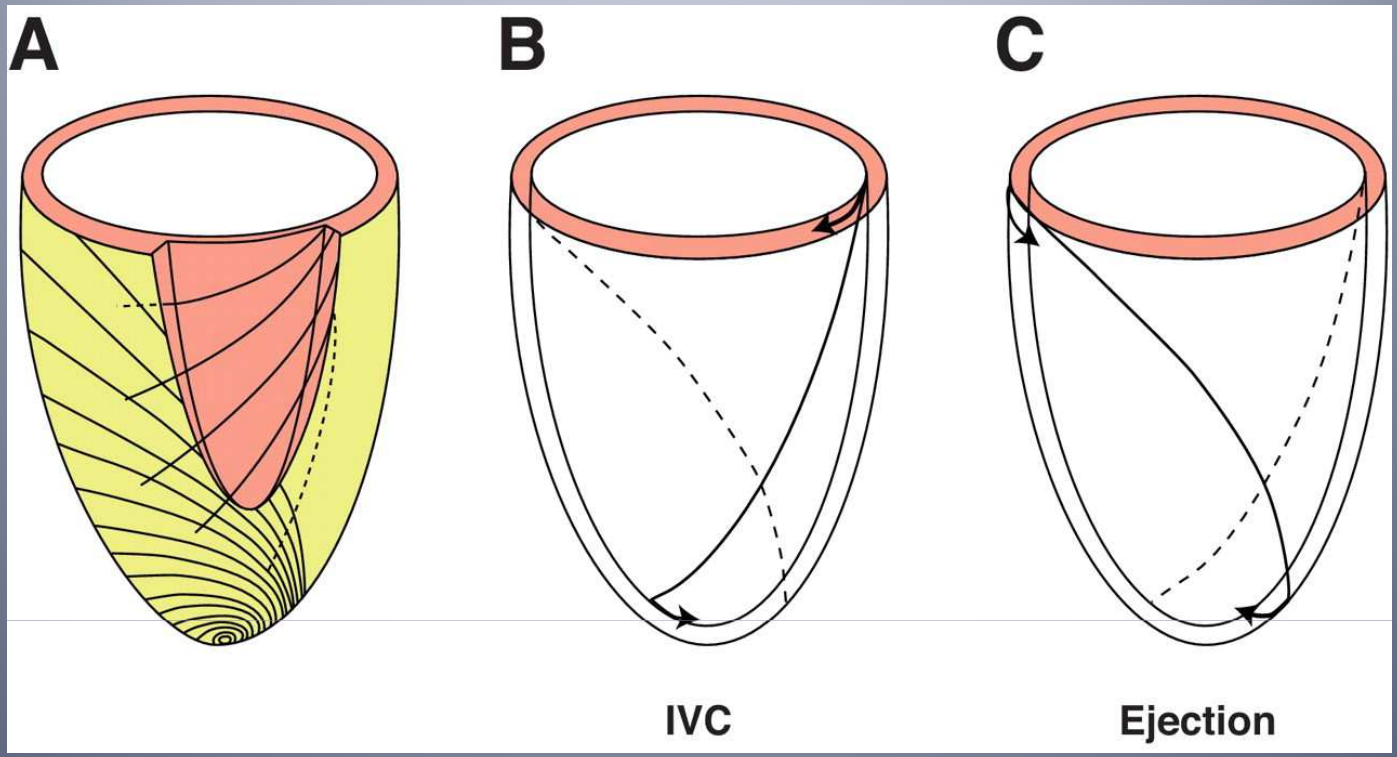
Notomi, Y. et al. J Am Coll Cardiol Img 2009;2:717-719

JACC cardiovascular Imaging

Valutazione della Funzione Diastolica

- **Ecocardiografia**
  - Doppler pulsato
  - Doppler Tessutale TDI
  - Flusso Venoso Polmonare
  - Color Doppler Mmode transmitralico
  - Speckel Tracking

DIASTOLE- Mechanism of LV Twist



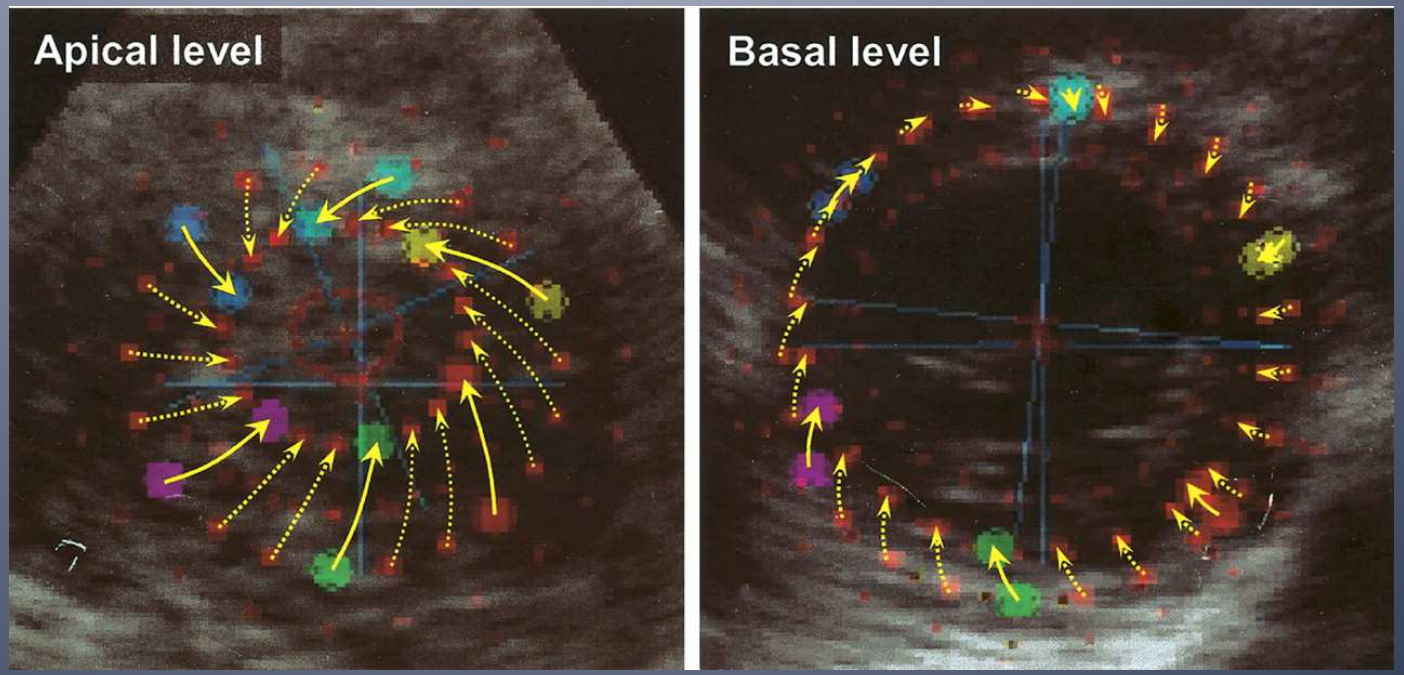
Bertini, M. et al. J Am Coll Cardiol Img 2009;2:1425-1435

- Is much more complicated than just filling
- New imaging techniques have revealed more complex anatomy than previously realized
- Now recognized that diastole consists of twisting motion

JACC cardiovascular Imaging

DIASTOLE- Mechanism of LV Twist

- This LV torsion generates stored energy (like a coil or spring) which is released in early diastole to produce ventricular recoil that leads to upward annular motion and suction

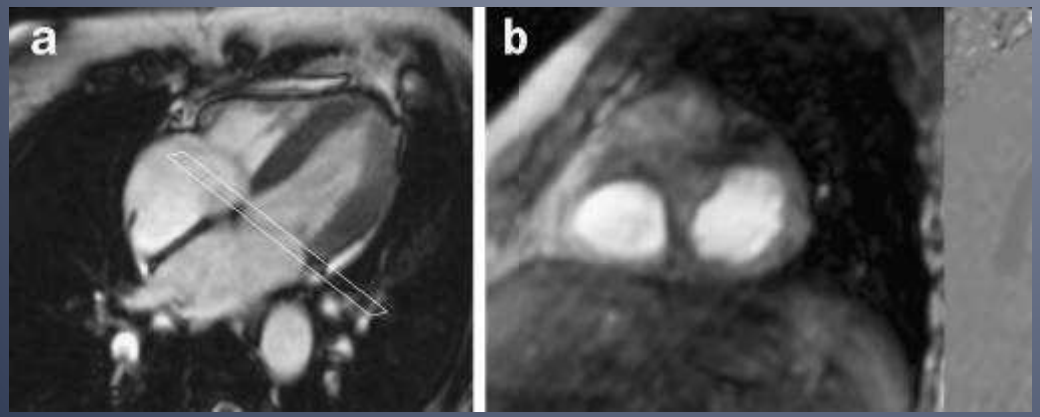


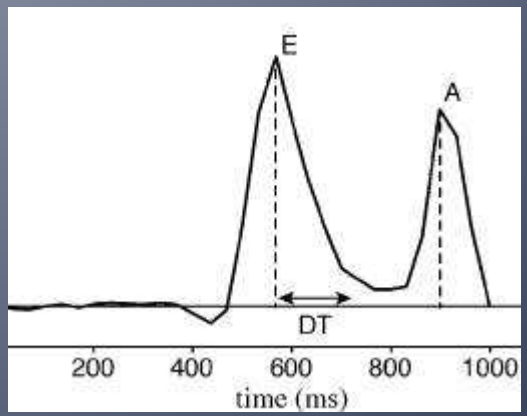
Notomi, Y. et al. J Am Coll Cardiol 2005;45:2034-2041

JACC Journal of the American College of Cardiology

Valutazione della Funzione Diastolica

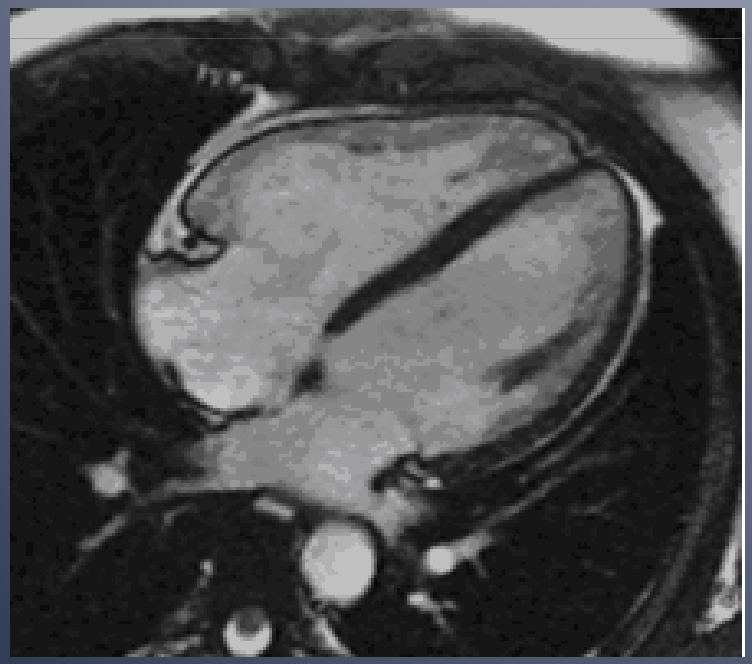
- **Risonanza MagneticaCardiaca (CMR) (volumi, cinesi, spessori, funzione ventricolare, cavita' atriali, apparati valvolari, flussimetria, pericardio)**

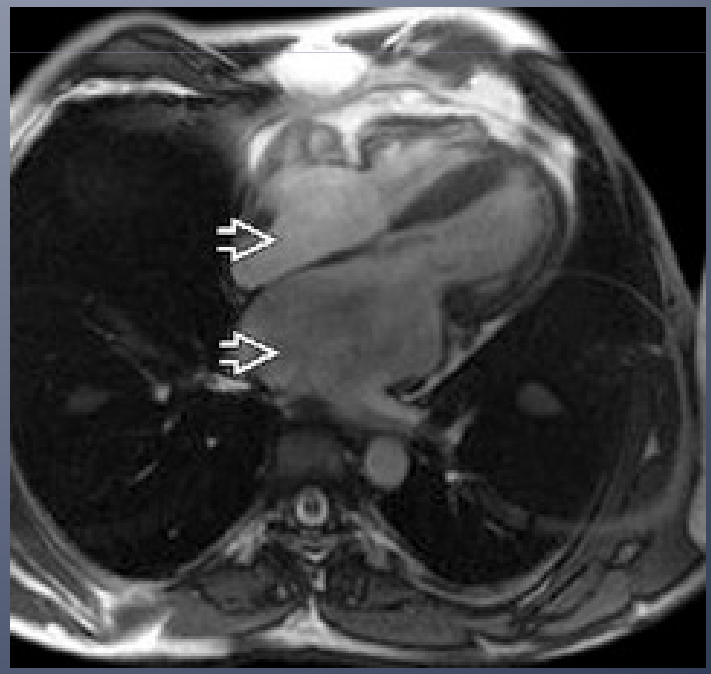




…inoltre

- **CMR permette migliore valutazione ventricolo destro**





High Prevalence of Right Ventricular Systolic Dysfunction in Early Systemic Sclerosis

CHRISTOPHE MEUNE, YANNICK ALLANORE, JEAN-YVES DEVAUX, ODILE DESSAULT, DENIS DUBOC, SIMON WEBER, and ANDRÉ KAHAN

ABSTRACT. Objective. To assess right ventricular (RV) function in patients with early systemic sclerosis (SSc) and the acute effects of calcium channel blockers on RV ejection fraction (RVEF).

Methods. Forty-two consecutive patients with SSc with less than 5 years' disease duration and normal pulmonary arterial pressure (35 women, 7 men; mean age 54.3 ± 9.7 years; 16 with diffuse and 26 with limited cutaneous forms, systolic pulmonary arterial pressure 30.3 ± 5.4 mmHg) were prospectively evaluated. All underwent pulmonary function testing, echocardiography, and radionuclide ventriculography at rest and 2 hours after receiving 40 mg oral nicardipine, and were compared at baseline with 20 gender and age matched controls.

Results. None of the patients with SSc had clinical evidence of heart failure. At baseline, SSc patients had significantly lower LVEF (68.5% ± 7.9 vs 72.4% ± 5.0, p = 0.049) and RVEF (36.5% ± 7.0 vs 45.8% ± 5.7, p < 0.0001). Sixteen patients had reduced RVEF (< 35%), 3 had reduced LVEF (< 55%), and 10 had reduced peak filling rate (PFR). RVEF correlated to both LVEF and PFR (r = 0.64, p < 0.0001, and r = 0.36, p = 0.0037, respectively), whereas no correlation was found with pulmonary function impairment or pulmonary arterial pressure. Nicardipine resulted in a significant increase in RVEF (from 36.5% ± 7.0 to 42.3% ± 8.4, p < 0.001) whereas afterload indicated by mean arterial pressure did not differ significantly.

Conclusion. Reduced RVEF appears to be a common feature in early SSc; it may be due to intrinsic myocardial involvement and is acutely improved by nicardipine. (J Rheumatol 2004;31:1941–5)

Coinvolgimento Ventricolo destro

Cardiac Magnetic Resonance Imaging Detects Subclinical Right Ventricular Impairment in Systemic Sclerosis

GIAN PAOLO BEZANTE, DANIELA ROLLANDO, MARTA SESSAREGO, NICOLETTA PANICO, MAURIZIO SETTI, GILBERTO FILACI, GIUSEPPE MOLINARI, MANRICO BALBI, MAURIZIO CUTOLO, ANTONIO BARSOTTI, FRANCESCO INDIVERI, and MASSIMO GHIO

ABSTRACT. ***Objective.*** To assess myocardial involvement in patients with systemic sclerosis (SSc) with no signs or symptoms of cardiac impairment (New York Heart Association functional class I).

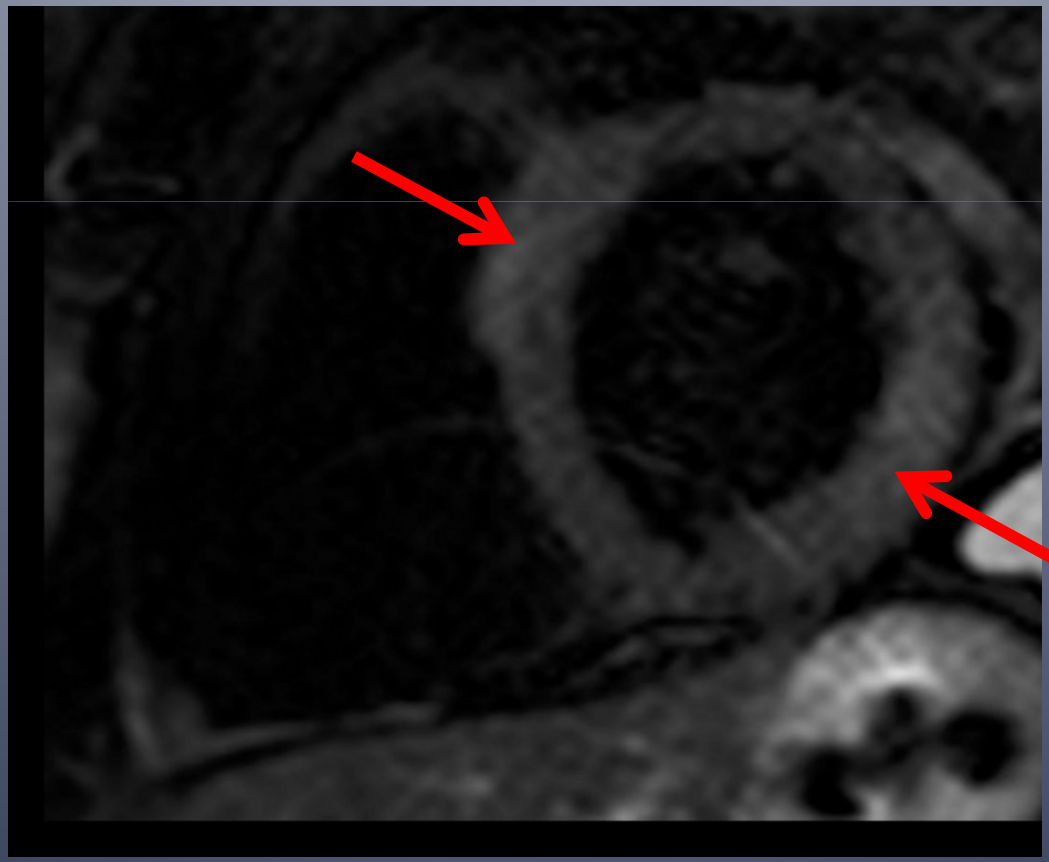
Methods. Fifty patients (45 women, 5 men, age 53.3 ± 12.9 yrs) who did not complain of serious diseases other than SSc were recruited out of 119 consecutive patients with SSc. Thirty-three were found to have limited cutaneous SSc (lSSc) and 17 diffuse SSc (dSSc). All underwent cardiovascular magnetic resonance imaging (MRI) to determine right and left systolic and diastolic volumes and ventricular ejection fractions (RVEF and LVEF). Thirty-one healthy subjects matched for sex, age, and body surface area (BSA) were studied as controls. Diffusion lung capacity test (DLCO) and high resolution computed tomography were performed to evaluate lung involvement.

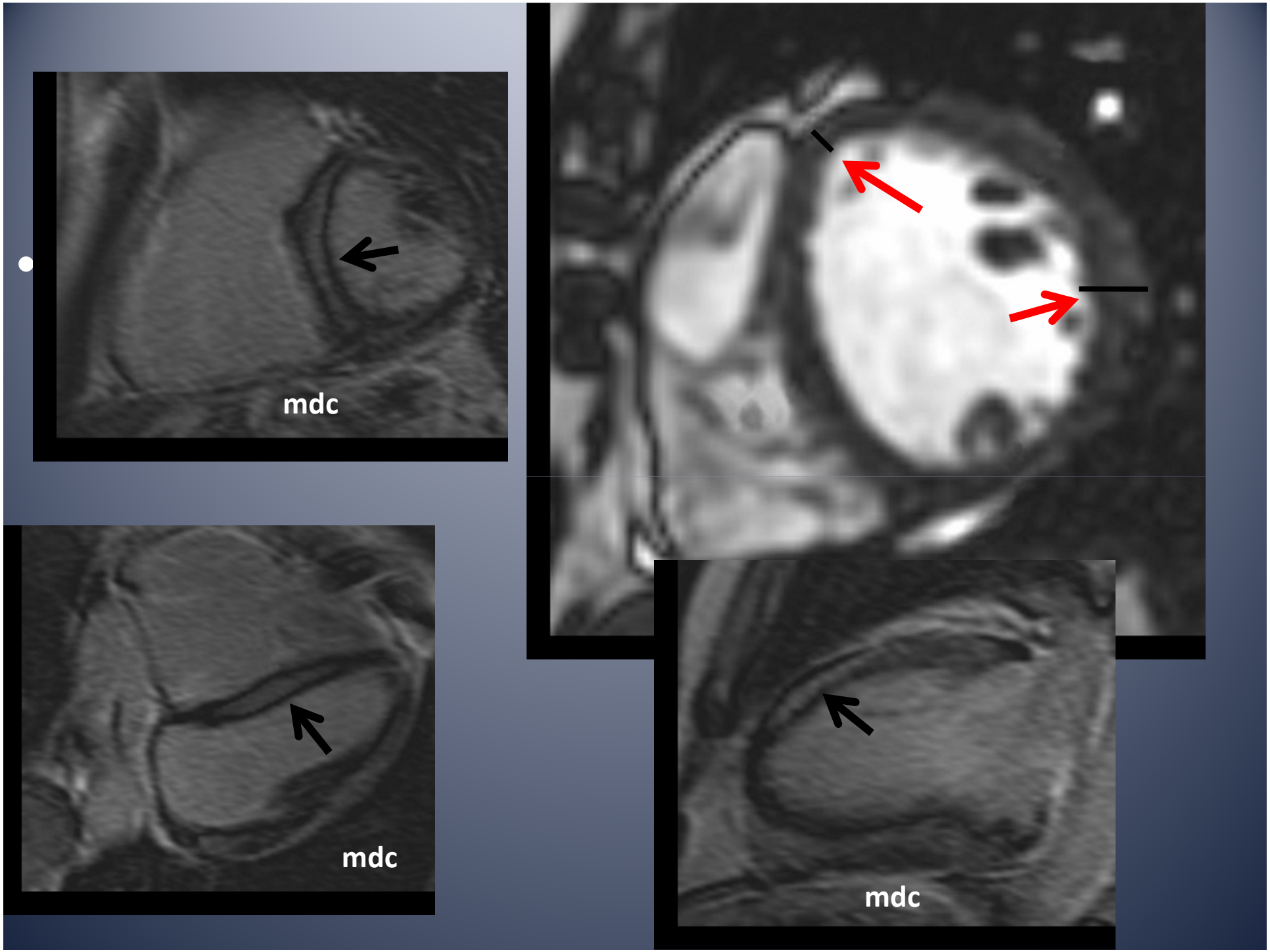
Results. Disease duration between patients with lSSc (14.1 ± 11.4 yrs) and those with dSSc (6.9 ± 4.4yrs) was found to be significantly different (p < 0.003). lSSc patients were older than those with dSSc (54.8 ± 13.7 yrs vs 50.4 ± 9.9 yrs, respectively; p < 0.04). Anticentromere antibodies and Scl-70 were positive in 23 (46%) and 17 patients (34%). Except for the left and right systolic volumes, all unadjusted cardiac MRI measures were significantly reduced in SSc compared to the controls (p < 0.001 and p < 0.009). These differences persisted after adjustment for subjects' height and BSA. Raw RVEF data and RVEF data matched for height and BSA were significantly reduced in dSSc patients in comparison to lSSc (p < 0.03).

Conclusion. Compromised RVF was found in patients with asymptomatic SSc. Unlike standard diagnostic techniques, cardiac MRI appears to be a rapid and noninvasive means of determining subclinical right myocardial involvement that is otherwise undetected in patients with SSc. (First Release Nov 1 2007; J Rheumatol 2007;34:2431–7)

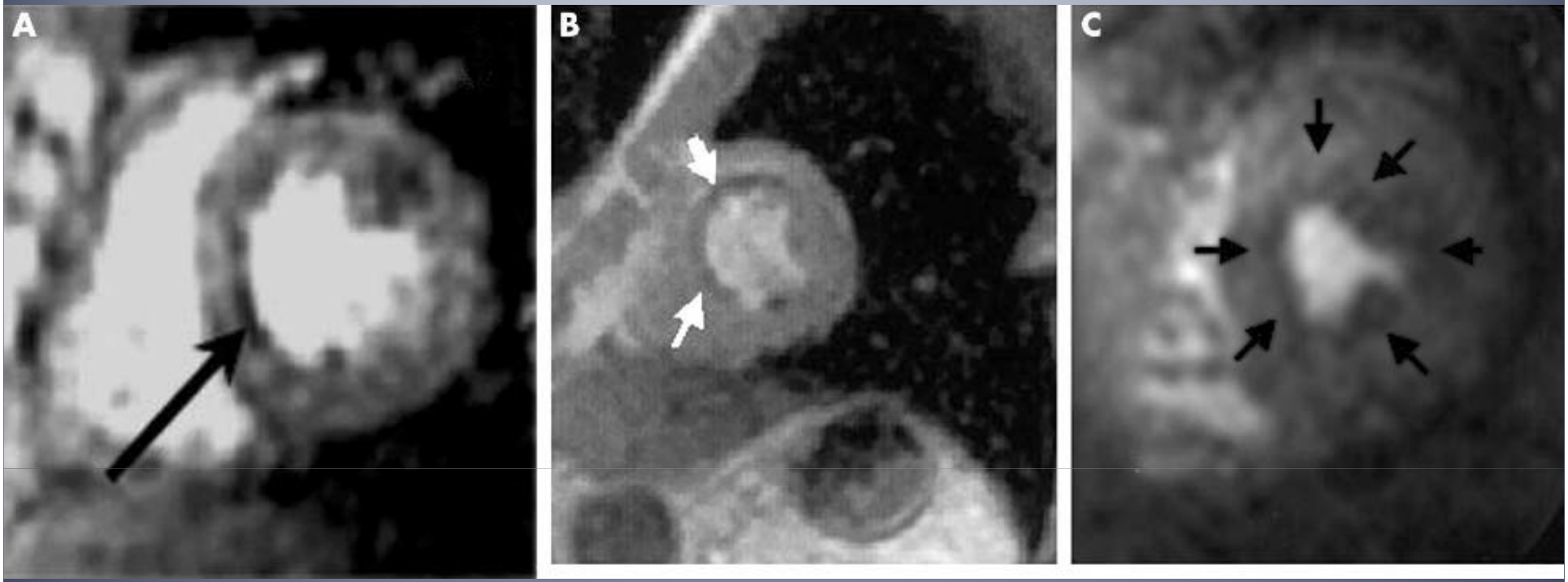
Risonanza MagneticaCardiaca

CMR consente una caratterizzazione tessutale




mdc
mdc
mdc

Perfusione



Our main finding was that 14 days of treatment with nifedipine improved both myocardial perfusion and function, as evaluated by two modern, highly sensitive and quantitative methods, MRI and TDE.

Ann Rheum Dis 2005;64:1268–1273.

Short-term treatment with bosentan simultaneously improves myocardial perfusion and function, as evaluated by highly sensitive and quantitative methods, in patients with SSc. Whether additional remodeling effect may be observed after longterm treatment with bosentan remains to be determined.

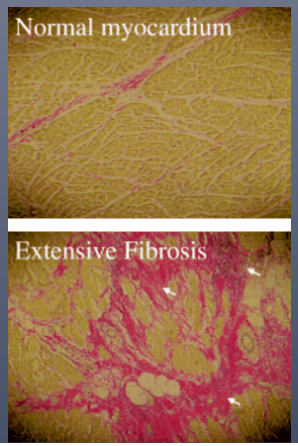
J Rheumatol 2006;33;2464-2469

Work-up

- Echocardiography
- MRI?
- Plasma BNP
- ECG Holter
- Exercise test
- Myocardial biopsy?

Screening for biological markers of possible cardiac dysfunction can be beneficial. One increasingly common example of these surrogate measures is B-type natriuretic peptide (BNP), which is secreted from cardiomyocytes in response to atrial or ventricular wall stretch. Plasma concentrations of BNP correlate with the risk of death and cardiovascular events [15] and N-terminal portion of pro-BNP (NT-pro-BNP) can be measured in clinical practice

Rheumatology 2009;48:iii45–iii48



Disfunzione Diastolica vs Scompenso Diastolico

- **Diastole: Fase della rivoluzione cardiaca caratterizzata dal rilassamento della muscolatura degli atri e dei ventricoli con conseguente dilatazione delle loro cavità**
- **La disfunzione diastolica avviene quando processo è rallentato o incompleto**

- **Lo scompenso cardiaco è una complessa sindrome clinica che risulta da alterazioni strutturali o funzionali che rendono il ventricolo incapace di riempirsi o di produrre gettata cardiaca sufficiente**

In particolare

- Lo **Scompenso Diastolico** è una sindrome clinica caratterizzata dai sintomi e segni dello scompenso con **funzione sistolica (EF) conservata e anormale funzione diastolica**

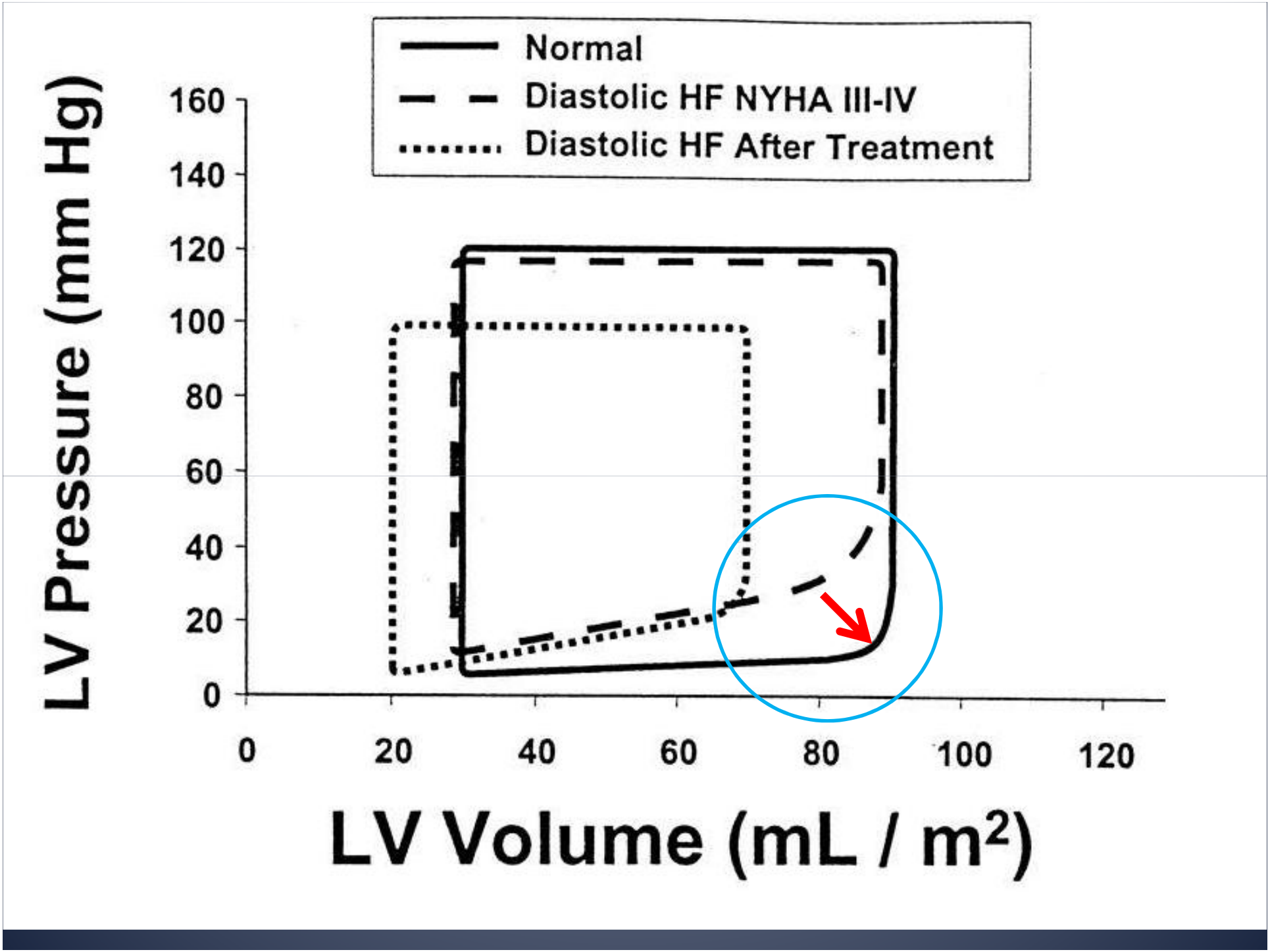
- Questo avviene quando il ventricolo è incapace di riempirsi con un volume di sangue adeguato a un normale valore di pressione diastolica tale da mantenere un appropriata gettata sistolica

Prevalence of Specific Signs and Symptoms in Patients with Systolic or Diastolic Heart Failure

Signs and symptoms	*Prevalence (%)*	
	Diastolic heart failure: EF >50%	*Systolic heart failure: EF <50%*
History		
Dyspnea on exertion	85	96
Paroxysmal nocturnal dyspnea	55	50
Orthopnea	60	73
Physical examination		
Jugular venous distention	35	46
Rales	72	70
Displaced apical impulse	50	60
S3	45	65
S4	45	66
Hepatomegaly	15	16
Edema	30	40
Chest radiograph		
Cardiomegaly	90	96
Pulmonary venous hypertension	75	80

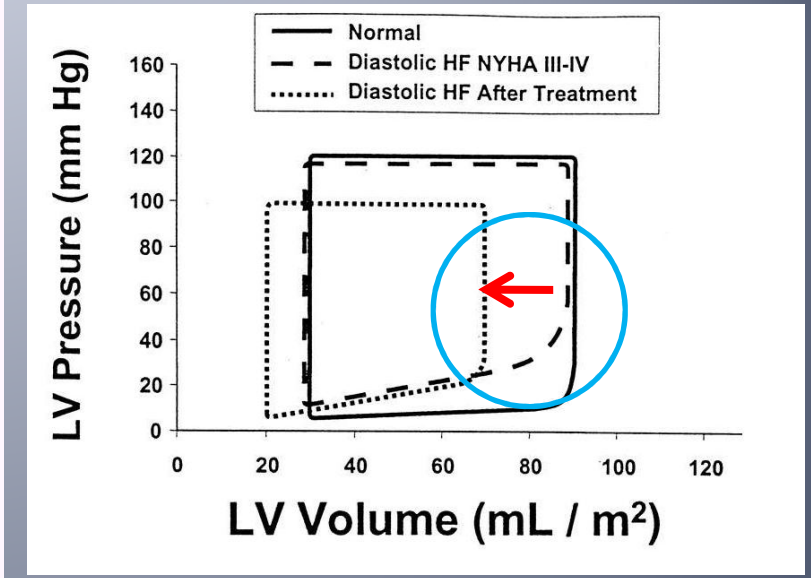
Trattamento: quale?

- Non esistono trials multicentrici, randomizzati, in doppio cieco, controllati vs placebo nei pazienti con scompenso diastolico
- Le Linee-guida si basano su studi di piccoli gruppi di pazienti o su esperienza clinica o su concetti basati sulla fisiopatologia


Normal
Diastolic HF NYHA III-IV
Diastolic HF After Treatment
LV Pressure (mm Hg)
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
LV Volume (mL / m²)

Diastolic Heart Failure: Treatment

- Symptom-targeted treatment
  - Decrease pulmonary venous pressure
    - Reduce LV volume
    - Maintain atrial contraction
    - Prevent tachycardia
  - Improve exercise tolerance
  - Use positive inotropic agents with caution
  - Nonpharmacological treatment
    - Restrict sodium to prevent volume overload
    - Restrict fluid to prevent volume overload
    - Perform moderate aerobic exercise to improve cardiovascular conditioning, decrease heart rate, and maintain skeletal muscle function
  - Pharmacological treatment
    - Diuretics, including loop diuretics, thiazides, spironolactone
    - Long-acting nitrates
    - β-Adrenergic blockers
    - Calcium channel blockers
    - Renin-angiotensin-aldosterone antagonists, including ACE inhibitors, angiotensin II receptor blockers, and aldosterone antagonists
- Disease-targeted treatment
  - Prevent/treat myocardial ischemia
  - Prevent/regress ventricular hypertrophy
- Mechanism-targeted treatment
  - Modify myocardial and extramyocardial mechanisms
  - Modify intracellular and extracellular mechanisms



Fondamentale!!!

Trattare la malattia di base

Quando?

Early and widespread subclinical cardiac dysfunction is understood

to occur in many SSc patients. Several in vivo studies, using

SPECT, echocardiography and MRI, have shown **a higher incidence of abnormalities compared with post-mortem** findings

[3, 4, 7, 13, 14]. These results suggest the existence of reversible

functional and vasospastic abnormalities (demonstrated by

SPECT, echocardiography and MRI) as well as fixed abnormalities

due to fibrosis or organic abnormalities of small coronary

vessels (demonstrated by post-mortem studies and the methods

used in vivo)

Rheumatology 2009;48:iii45–iii48

Symptom-Targeted Treatment:

Decrease LV Diastolic Pressure

The initial step in treating patients presenting with diastolic heart failure is to reduce pulmonary congestion by decreasing LV volume, maintaining synchronous atrial contraction, and increasing the duration of diastole by reducing heart rate.

By decreasing LV diastolic volumes, LV pressures "slide" down the curvilinear diastolic pressure-volume relationship toward a lower, less steep portion of this curve.

LV diastolic pressures can be decreased by reducing total blood volume, decreasing central blood volume (nitrates), and blunting neurohumoral activation.

Treatment with diuretics and nitrates should be initiated at low doses to avoid hypotension and fatigue.

Hypotension can be a significant problem.

Tachycardia is poorly tolerated in patients with diastolic HF for several reasons.

β-Blockers and some calcium channel blockers can thus be used to prevent excessive tachycardia and produce a relative bradycardia (60-70 bpm).

Improve Exercise Tolerance:

Patients with diastolic HF have a marked limitation in exercise tolerance. This could be due to:

-The inability to use the Frank-Starling mechanism.

-The abnormal relaxation velocity–versus–heart rate relationship.

-The presence of an exaggerated rise in blood pressure in response to exercise.

β-Blockers, calcium channel blockers, and AT_1 antagonists may have a salutary effect on symptoms and exercise capacity in many patients with diastolic HF.

However, the beneficial effect of these agents on exercise tolerance is not always paralleled by improved LV diastolic function or increased relaxation rate.

Use Positive Inotropic Drugs With Caution:

They are generally not used in the treatment of patients with isolated diastolic HF (little potential benefit, potential to worsen the pathophysiological)

May be beneficial in the short-term treatment of pulmonary edema associated with diastolic heart failure because they enhance SR function, promote more rapid and complete relaxation, increase splanchnic blood flow, increase venous capacitance, and facilitate diuresis.

Treatment of Systolic Versus Diastolic HF

With a number of notable exceptions, many of the drugs used to treat diastolic heart failure are in fact the same as those used to treat systolic heart failure.

However, the rationale for their use, the patho-physiological process that is being altered by the drug, and the dosing regimen may be entirely different depending on whether the patient has systolic or diastolic heart failure.

For example, β-blockers. In diastolic heart failure, however, β-blockers are used to decrease heart rate, increase the duration of diastole, and modify the hemodynamic response to exercise.

In systolic HF, β-blockers are used chronically to increase inotropic state and modify LV remodeling. In systolic heart failure, β-blockers must be titrated slowly and carefully over an extended time period.

This is generally not necessary in diastolic HF.

Diuretics, the doses of diuretics used to treat diastolic HF are generally smaller than the doses used in systolic HF.

Some drugs are used only to treat either systolic or diastolic HF but not both. For example, calcium channel blockers such as diltiazem, nifedipine, and verapamil have no place in the treatment of systolic HF.

Mechanism-Targeted Treatment (Future Directions):

An ideal therapeutic agent should target the underlying mechanisms that cause diastolic HF.

A therapeutic agent might improve Ca^{++} homeostasis and energetics, blunt neurohumoral activation, or prevent and regress fibrosis.

Fortunately, some pharmaceutical agents that fit these design characteristics are already in existence, and many more are under development.

Unfortunately, randomized, double-blind, placebo-controlled, multicenter trials that examine the efficacy of these agents used either singly or in combination have been slow to develop.

Difficulties for these kinds of studies:

- Lack of recognition of the importance of diastolic HF.
- Inability to define a homogeneous study population.
- Lack of agreement on the definition and diagnostic criteria for diastolic HF.

2013 dicembre

Evaluation of cardiac abnormalities by Doppler echocardiography in a large nationwide multicentric cohort of patients with systemic sclerosis

P de Groote,[1] V Gressin,[2] E Hachulla,[3] P Carpentier,[4] L Guillevin,[5] A Kahan,[5] J Cabane,[6] C Francès,[7] N Lamblin,[1] E Diot,[8] F Patat,[8] J Sibilia,[9] H Petit,[9] J-L Cracowski,[4] P Clerson,[10] M Humbert,[11] for the ItinerAIR-Scleroderma Investigators

Cardiac Magnetic Resonance Imaging Detects Subclinical Right Ventricular Impairment in Systemic Sclerosis

GIAN PAOLO BEZANTE, DANIELA ROLLANDO, MARTA SESSAREGO, NICOLETTA PANICO, MAURIZIO SETTI, GILBERTO FILACI, GIUSEPPE MOLINARI, MANRICO BALBI, MAURIZIO CUTOLO, ANTONIO BARSOTTI, FRANCESCO INDIVERI, and MASSIMO GHIO

ABSTRACT. ***Objective.*** To assess myocardial involvement in patients with systemic sclerosis (SSc) with no signs or symptoms of cardiac impairment (New York Heart Association functional class I).

Methods. Fifty patients (45 women, 5 men, age 53.3 ± 12.9 yrs) who did not complain of serious diseases other than SSc were recruited out of 119 consecutive patients with SSc. Thirty-three were found to have limited cutaneous SSc (lSSc) and 17 diffuse SSc (dSSc). All underwent cardiovascular magnetic resonance imaging (MRI) to determine right and left systolic and diastolic volumes and ventricular ejection fractions (RVEF and LVEF). Thirty-one healthy subjects matched for sex, age, and body surface area (BSA) were studied as controls. Diffusion lung capacity test (DLCO) and high resolution computed tomography were performed to evaluate lung involvement.

Results. Disease duration between patients with lSSc (14.1 ± 11.4 yrs) and those with dSSc (6.9 ± 4.4yrs) was found to be significantly different ($p < 0.003$). lSSc patients were older than those with dSSc (54.8 ± 13.7 yrs vs 50.4 ± 9.9 yrs, respectively; $p < 0.04$). Anticentromere antibodies and Scl-70 were positive in 23 (46%) and 17 patients (34%). Except for the left and right systolic volumes, all unadjusted cardiac MRI measures were significantly reduced in SSc compared to the controls ($p < 0.001$ and $p < 0.009$). These differences persisted after adjustment for subjects' height and BSA. Raw RVEF data and RVEF data matched for height and BSA were significantly reduced in dSSc patients in comparison to lSSc ($p < 0.03$).

Conclusion. Compromised RVF was found in patients with asymptomatic SSc. Unlike standard diagnostic techniques, cardiac MRI appears to be a rapid and noninvasive means of determining subclinical right myocardial involvement that is otherwise undetected in patients with SSc. (First Release Nov 1 2007; J Rheumatol 2007;34:2431–7)