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Novel non invasive imaging approaches to cardiovascular diseases

Maurizio Galderisi, MD
Laboratory of Standard and Advanced Echocardiography
Federico II University Hospital
Chair Educational committee EACVI

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Cardiology of Campus "Federico II"

The Division of Cardiology of the Federico II University belongs to the Academic Department of Advanced Biomedical Sciences. The Division is composed by: 1 full professor, 6 associate professors, 2 assistant professors.

The Division is responsible of the teaching activity in CV diseases at the Master Degree in Medicine (6 years duration), at the Specialist Degrees in Cardiology, Emergency Medicine and Internal Medicine (with Dpts of Clinical and Experimental Medicine and of Translational Medical Sciences).

At the latest Italian evaluation of the scientific activity within the VQR 2004-10 performed by the national agency of evaluation of the Universities (ANVUR), the Division of Cardiology of the Federico II University resulted at the 7th place within the chart of the national divisions of cardiology: absolute mark of 13.80, average mark of 0.69 with 75% of Q1 scientific output and 5% Q2 scientific output.

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Post-graduated Specialization

***School of Cardiology**:
Director: Prof. Pasquale Perrone Filardi
9 annual fellows for a 4-years program

***School of Emergency Medicine:**
Director: Prof. Nicola De Luca
4 annual fellows for a 5 years program

*Cooperation programs with national and foreign Universities

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Scientific Scores

Total HI Index = 340

Total Number of articles published on PubMed = 1840

Total IF of the last two years > 300

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Areas of specialization and expertise

Coronary and peripheral artery disease: molecular mechanisms of development and progression of atherosclerotic plaque; identification of novel genetic and hematologic markers; mechanisms of regulation of post-ischemic angiogenesis; role of adult stem cells in therapy of ischemic cardiomyopathy; impact of different coronary stents on clinical outcome of patients with acute or stable coronary artery disease; impact of peripheral artery angioplasty on cardiovascular outcome; patho-physiology of unstable plaque and role of the immune system; role of platelet micro-RNAs in plaque instability; role of cytokines derived from adipose tissue in the patho-physiology of the acute coronary syndromes; pharmacology therapy of acute coronary syndromes; brain protection during carotid angioplasty; treatment of in-stent restenosis following angioplasty of the superficial femoral artery; role of beta-adrenergic receptor pathways in the modulation of coronary artery disease.

Cardiovascular diseases: molecular mechanisms of transition from hypertrophic cardiomyopathies to heart failure with particular interest on signaling pathways and on strategies to develop new therapies; role of adult stem cells in therapy of heart failure; role of beta-adrenergic receptor pathways in heart failure; molecular mechanisms involved in pathogenesis of congenital cardiomyopathies; molecular mechanisms and novel therapeutic strategies in right heart ventricular failure; molecular mechanisms related to development of myocardial fibrosis, heart failure and post-ischemic ventricular remodeling in patients with severe peripheral artery disease.

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Areas of specialization and expertise

Arrhythmias: Molecular mechanisms of the principal cardiac arrhythmias and development of novel interventional and therapeutic strategies.

Platelet biology: Molecular mechanisms of platelet response to different inhibitors and clinical impact on patients undergoing myocardial revascularization

Arterial and renal hypertension: Registry of diagnosis of arterial hypertension and progression of hypertensive cardiovascular involvement on a total of 15000 outpatients with a follow-up period of 15 years (Campania Salute Network)
Molecular mechanisms and novel therapeutic strategies.

Structural heart disease: Molecular mechanisms involved in heart remodeling after percutaneous aortic valve implantation and MitraClip;

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Areas of specialization and expertise

Non invasive cardiac imaging

Echocardiography:
Transthoracic Standard Echocardiography and Transesophageal Echocardiography
Speckle Tracking and Automated Function Imaging technology
Real-time three-dimensional echocardiography
Physical and Pharmacologic (Dipyridamole and DobutaminE Stress Echocardiography, assessment of Doppler-derived coronary flow reserve)
Interventional echocardiography

Nuclear Cardiology:
SPECT and PET
Cardio Computer Tomography

Cardio MRI
Cine cardio MRI
Cardio MRI with late gadolinium enhancement
T1 mapping

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In-hospital activities

1000 annual admissions to CCU for acute coronary syndromes

2800 annual coronary angiographies and 1500 percutaneous coronary interventions

200 implantation of pacemakers, ICD and CRT

1300 monitoring visits of patients with implanted pacemakers

10000 annual outpatients visits at cardiology clinic and hypertensive clinic of Campania Salute Network

6000 annual echocardiographic exams including TTE. TEE, stress-echo, advanced ultrasound techniques and interventional echo

3000 annual echo-Doppler vascular exams for assessment of carotid and peripheral vascular diseases

2050 effort ECG test

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Where eagles dare

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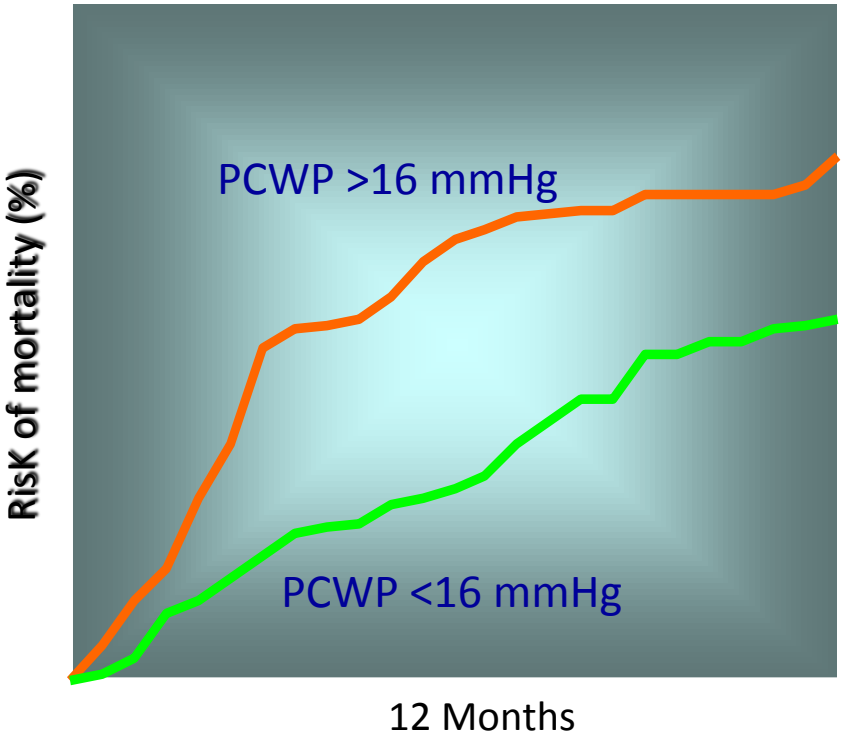
Eagles = Hemodynamics
The power of Cath-Lab

Wedge Pressure & Prognosis



Fonarow GC & Stevenson LW, *Circulation 1994;90:I-488*

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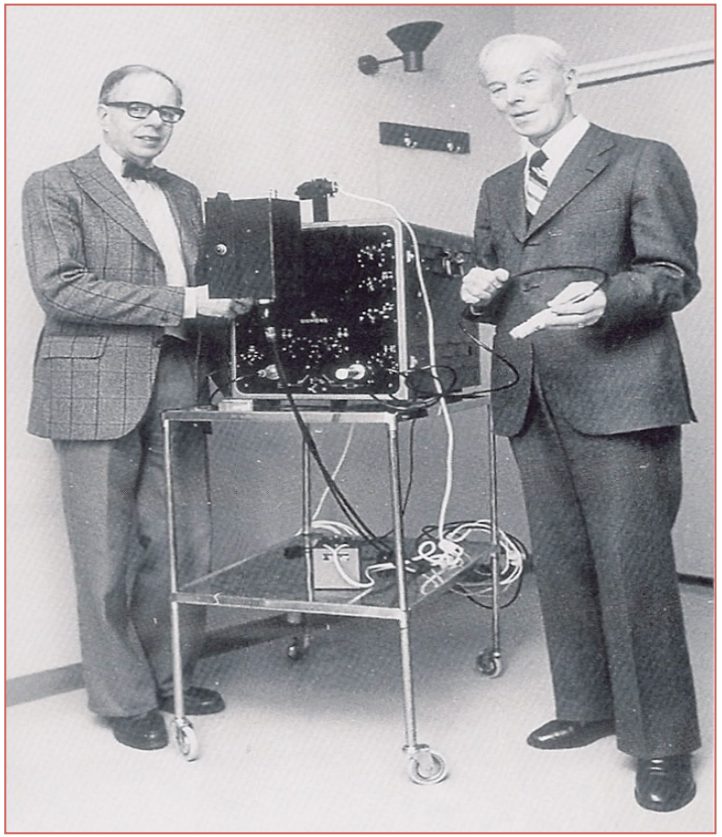
The birthday of Echocardiography: 1954



Inge Edler & Carl Hellmuth Herz

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Campania Salute Network

International Journal of Cardiology 184 (2015) 417–419

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

Prevalence and characteristics of true and apparent treatment resistant hypertension in the Campania Salute Network

Raffaele Izzo [a,b], Eugenio Stabile [a,c,*], Giovanni Esposito [a,c], Valentina Trimarco [a,d], Marina De Marco [a,b], Andrea Sica [a,b], Maria Virginia Manzi [a,b], Giuseppe Gargiulo [a,c], Gabriele Schiattarella [a,c], Francesco Rozza [e], Nicola De Luca [a,b], Giovanni de Simone [a,b]

European Heart Journal Advance Access published July 23, 2013

European Heart Journal
doi:10.1093/eurheartj/eht281

CLINICAL RESEARCH

Hypertensive target organ damage predicts incident diabetes mellitus

Raffaele Izzo[1], Giovanni de Simone[1]*, Valentina Trimarco[2], Eva Gerdts[1,3,4], Renata Giudice[1], Olga Vaccaro[5], Nicola De Luca[1], and Bruno Trimarco[6]

Journal of Human Hypertension (2015), 1–5

www.nature.com/jhh

ORIGINAL ARTICLE

Identification of phenotypes at risk of transition from diastolic hypertension to isolated systolic hypertension

R Esposito[1,2,5], R Izzo[1,2,5], M Galderisi[1,2], M De Marco[1,2], E Stabile[1,3], G Esposito[1,3], V Trimarco[1,4], F Rozza[1,2], N De Luca[1,2] and G de Simone[1,2]

International Journal of Cardiology 199 (2015) 290–295

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Cardiovascular ultrasound exploration contributes to predict incident atrial fibrillation in arterial hypertension: The Campania Salute Network

Maria-Angela Losi [a,b,1], Raffaele Izzo [a,c,1], Marina De Marco [a,c], Grazia Canciello [a,b], Antonio Rapacciuolo [a,b], Valentina Trimarco [a,d], Eugenio Stabile [a,b], Francesco Rozza [a,c], Giovanni Esposito [a,b], Nicola De Luca [a,c], Giovanni de Simone [a,c,*], Bruno Trimarco [a,b]

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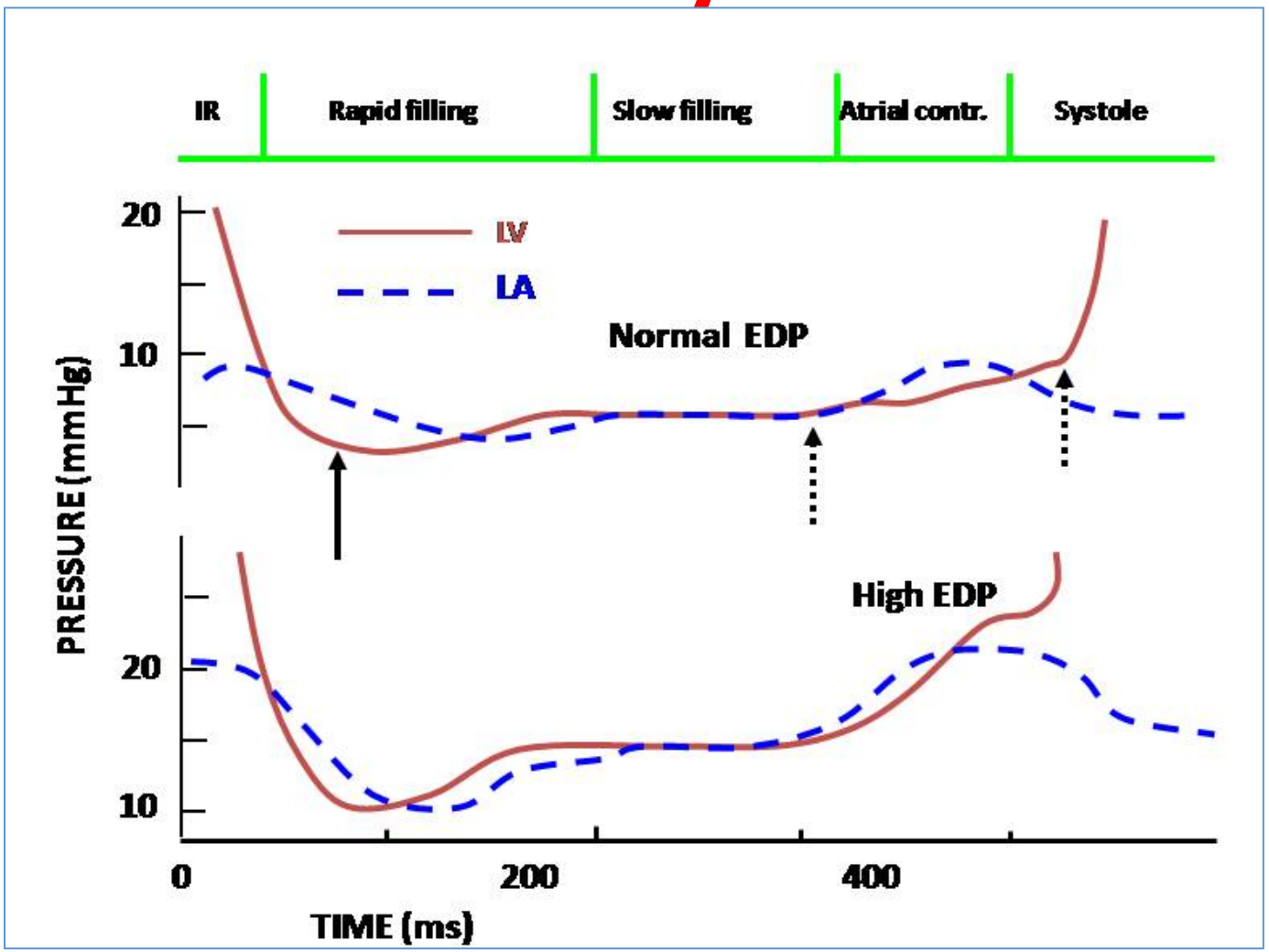
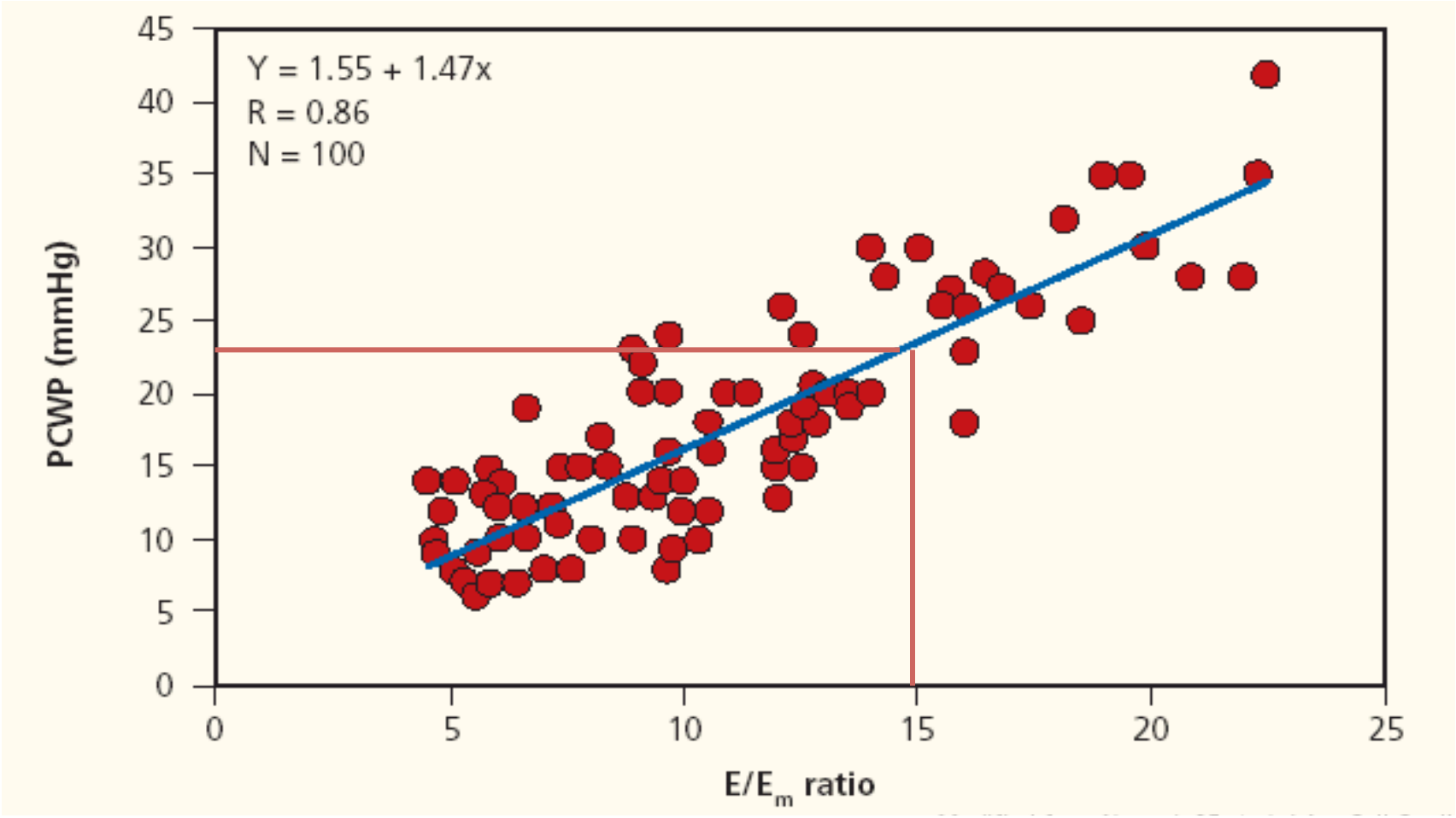
Doppler measurements vs. Intra-cavitary Pressures



Wedge Pressure vs. E/e' Ratio



Nagueh SF et al, J Am Coll Cardiol 1997

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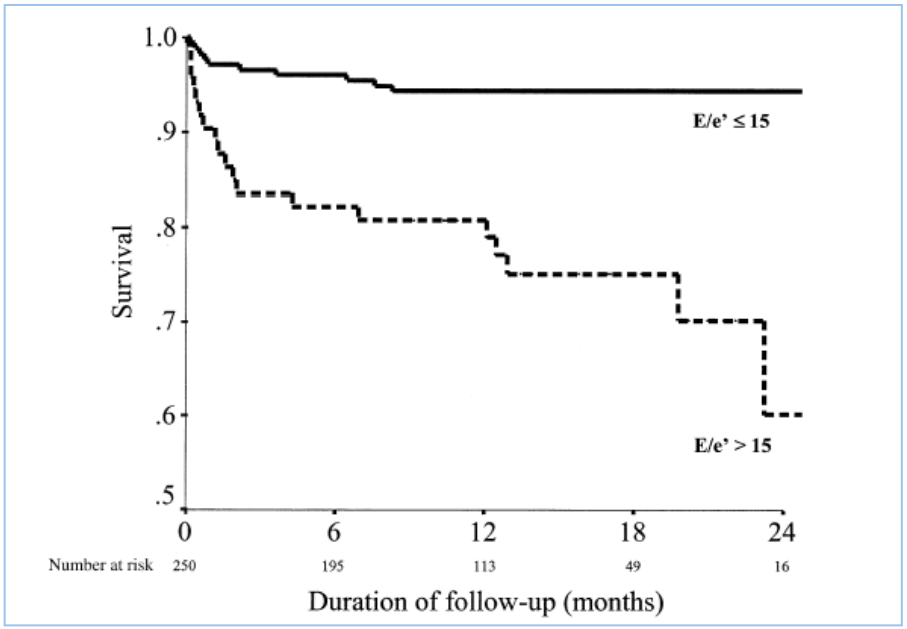
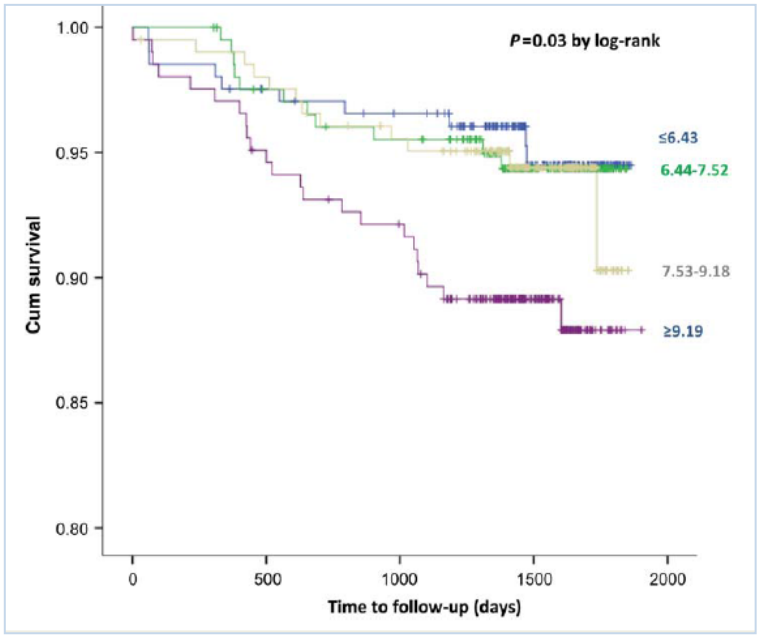
E/e' ratio & Prognosis

Post Acute Myocardial Infarction



Hillis et al, J Am Coll Cardiol 2004;43:360-367

Arterial Hypertension



Sharp ASP et al, Eur Heart J 2010;31:747-752

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Cardiovascular Pathophysiology & Therapeutics

European Heart Journal Advance Access published June 14, 2013

European Heart Journal
doi:10.1093/eurheartj/eht151

ESH AND ESC GUIDELINES

2013 ESH/ESC Guidelines for the management of arterial hypertension

The Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC)

Authors/Task Force Members: Giuseppe Mancia (Chairperson) (Italy)*, Robert Fagard (Chairperson) (Belgium)*, Krzysztof Narkiewicz (Section co-ordinator) (Poland), Josep Redon (Section co-ordinator) (Spain), Alberto Zanchetti (Section co-ordinator) (Italy), Michael Böhm (Germany), Thierry Christiaens (Belgium), Renata Cifkova (Czech Republic), Guy De Backer (Belgium), Anna Dominiczak (UK), Maurizio Galderisi (Italy), Diederick E. Grobbee (Netherlands), Tiny Jaarsma (Sweden), Paulus Kirchhof (Germany/UK), Sverre E. Kjeldsen (Norway), Stéphane Laurent (France), Athanasios J. Manolis (Greece), Peter M. Nilsson (Sweden), Luis Miguel Ruilope (Spain), Roland E. Schmieder (Germany), Per Anton Sirnes (Norway), Peter Sleight (UK), Margus Viigimaa (Estonia), Bernard Waeber (Switzerland), Faiez Zannad (France)

Diagnosis of target cardiac damage

Parameter	Abnormal if
LV mass index (g/m²)	>95 (women) >115 (men)
Relative wall thickness (RWT)	>0.42
Diastolic function: Septal e' velocity (cm/sec) Lateral e' velocity (cm/sec) LA volume index (mL/m²)	 <8 <10 ≥34
LV Filling pressures : E / e' (averaged) ratio	 ≥13

LA = left atrium; LV = left ventricle; RWT = relative wall thickness.

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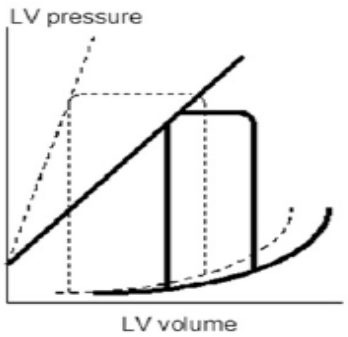
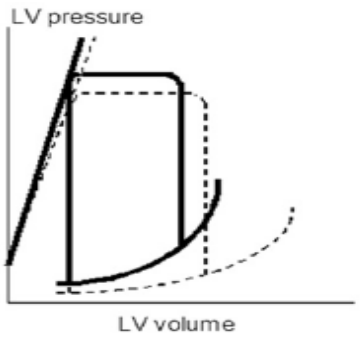
Heart Failure is only one !!!

	HF with impaired LVEF	HFNEF
LV morphology		
Pressure-volume loop		
LVEDV	↑	normal
LV mass	eccentric LV hypertrophy	concentric LV hypertrophy or concentric LV remodeling
Left atrium	dilated	dilated
LVEF	↓	normal
dp/dt	↓	normal
LVEDP	↑	↑
β	normal	↑
E/E´	↑	↑
BNP/NT-proBNP	↑	↑

Maeder T & Kaye DM, J Am Coll Cardiol 2009;53:905-918

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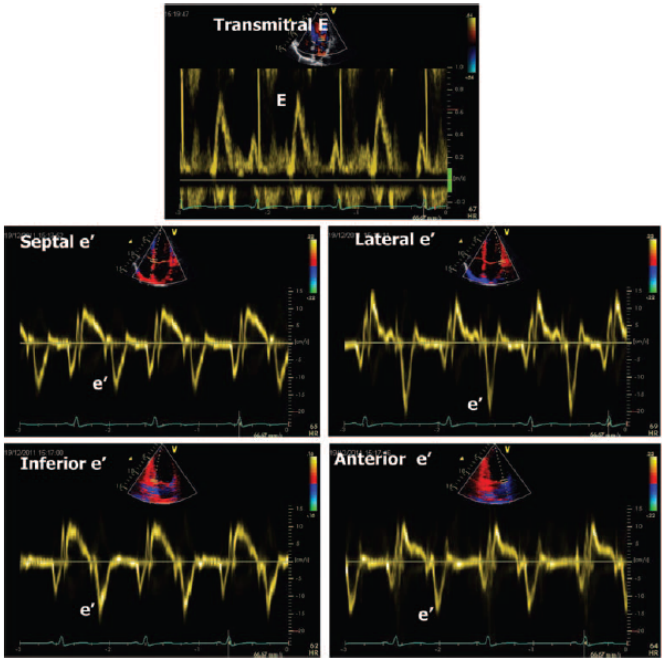
LV Filling Pressures

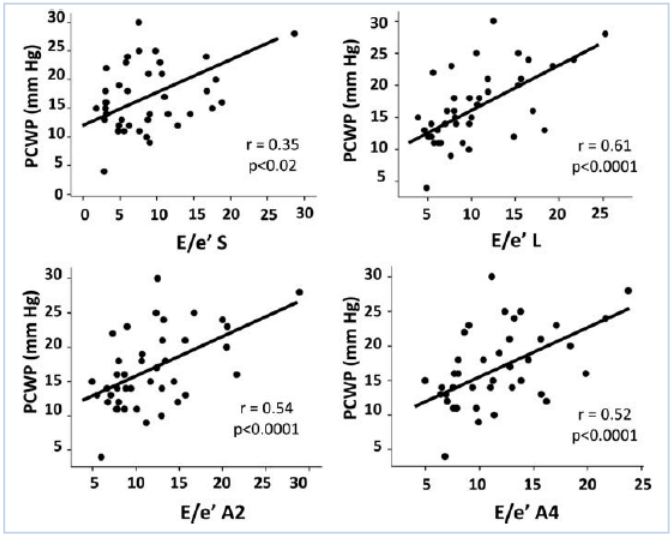
European Heart Journal - Cardiovascular Imaging Advance Access published October 26, 2012

European Heart Journal – Cardiovascular Imaging
doi:10.1093/ehjci/jes216

Site-dependency of the *E*/*e*′ ratio in predicting invasive left ventricular filling pressure in patients with suspected or ascertained coronary artery disease

Maurizio Galderisi[1]*, Antonio Rapacciuolo[2], Roberta Esposito[1], Marco Versiero[2], Vincenzo Schiano-Lomoriello[1], Ciro Santoro[1], Federico Piscione[2], and Giovanni de Simone[1]





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LV Filling Pressures

European Heart Journal – Cardiovascular Imaging (2014) **15**, 810–816
doi:10.1093/ehjci/jeu022

European multicentre validation study of the accuracy of E/e′ ratio in estimating invasive left ventricular filling pressure: EURO-FILLING study

Maurizio Galderisi[1*†], Patrizio Lancellotti[2†], Erwan Donal[3], Nuno Cardim[4], Thor Edvardsen[5], Gilbert Habib[6], Julien Magne[2], Gerald Maurer[7], and Bogdan A. Popescu[8]

Hemodynamists at Federico II Univ:
Prof. Giovanni Esposito
Prof. Antonio Rapacciuolo
Prof. Plinio Cirillo
Dr. Eugenio Stabile

Table I Main studies which assessed simultaneously E/e′ ratio and invasive left ventricular filling pressures

Authors, journal, and year	Clinical setting	Sample size (*n*)	Tissue Doppler sampling	Invasive parameter	Correlation E/e′ vs. cath
Nagueh SF *et al.*, *J Am Coll Cardiol*, 1997	Patients with and without HF	60	Lateral	PCWP	$r = 0.87$
Nagueh SF *et al.*, *Circulation*, 1998	Patients with ST and HF	100	Lateral	PCWP	$r = 0.86$
Nagueh SF *et al.*, *Circulation*, 1999	HCM patients	35	Lateral	Pre-A pressure	$r = 0.76$
Ommen SR *et al.*, *Circulation*, 2000	HF patients	100	Lateral, septal, Avg	M-LVDP	$r = 0.51$ lateral $r = 0.64$ septal $r = 0.62$ avg
Dokanish H *et al.*, *Circulation*, 2004	ICU patients	50	Avg	PCWP	$r = 0.69$
Mullens S *et al.*, *Circulation*, 2009	HF patients with low EF (≤30%)	106	Lateral, septal, Avg	PCWP	$r = 0.14$ lateral $r = 0.18$ septal $r = 0.18$ avg
Bhella PS *et al.*, *Circ Cardiovasc Imag*, 2011	HF patients with normal EF (>50%)	47	Septal	PCWP	$r^2 = 0.37$
Nagueh SF *Circ Cardiovasc Imag*, 2011	Patients with decompensated HF	79	Average	PCWP	$r = 0.61$

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Stress Echo

Diastolic Stress Echo

International Journal of Cardiology 191 (2015) 181–183

Contents lists available at ScienceDirect

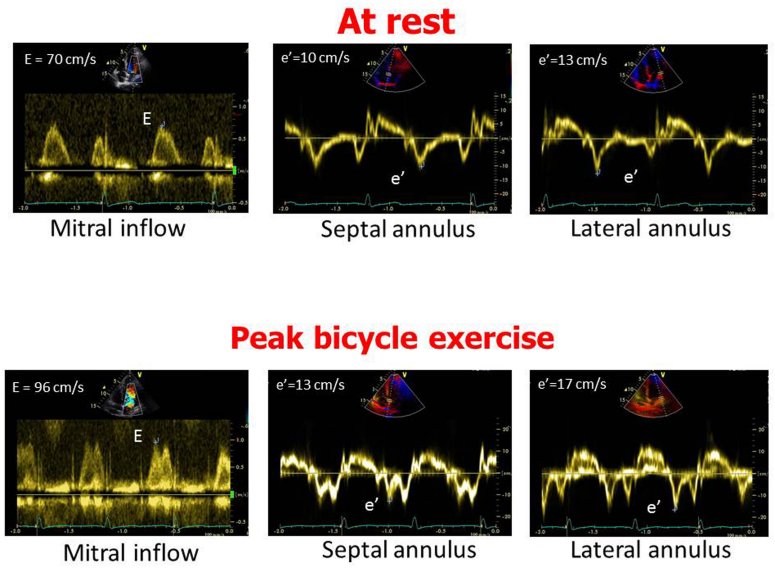
International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

Diastolic bicycle stress echocardiography: Normal reference values in a middle age population

Vincenzo Schiano-Lomoriello, Ciro Santoro, Giovanni de Simone, Bruno Trimarco, Maurizio Galderisi *



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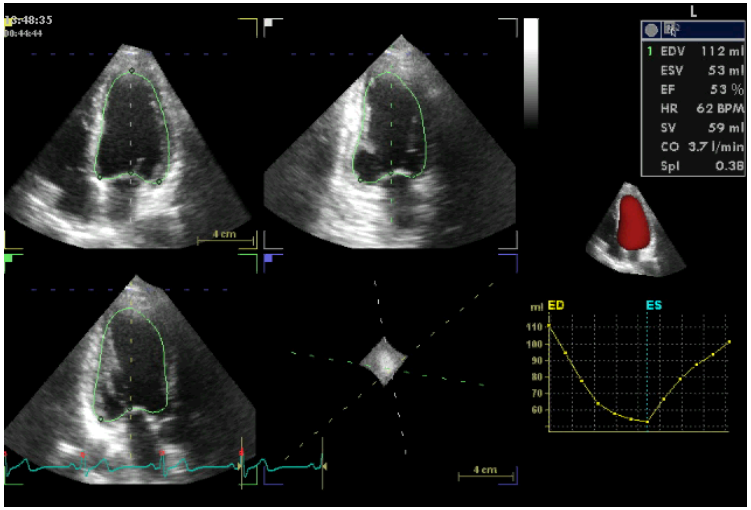
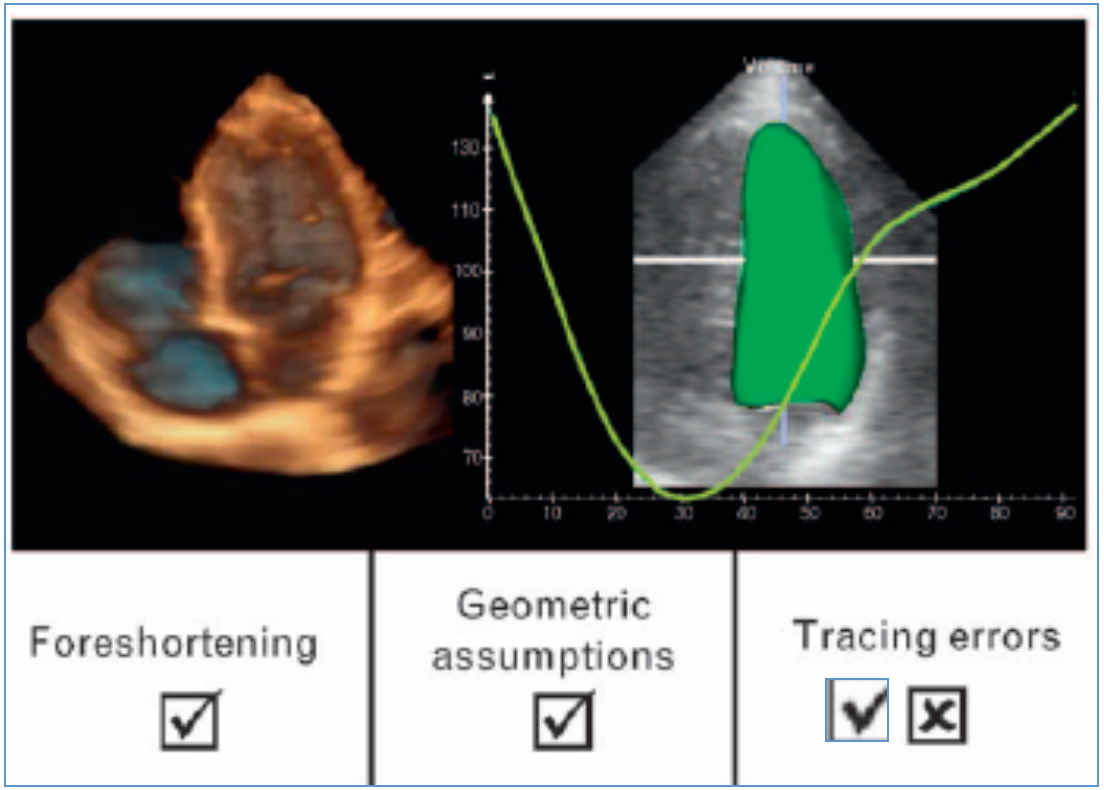
Real time 3D Echo Ejection Fraction

Advantages of 3D direct volumetric analysis





Lack of dependence on:
1. **Geometric modeling**
2. **Image plane positioning**

Improved accuracy and reproducibility

Mor Avi V et al, *Circulation* 2009;119:314-329

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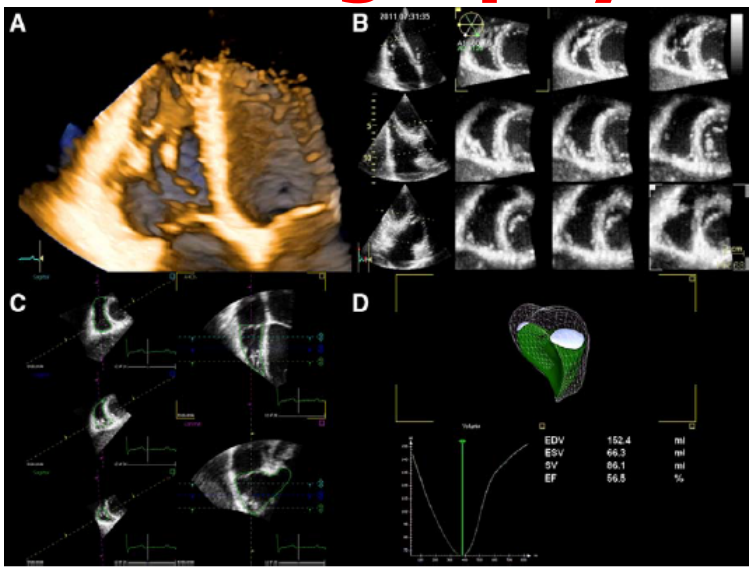
Real-time 3D Echocardiography

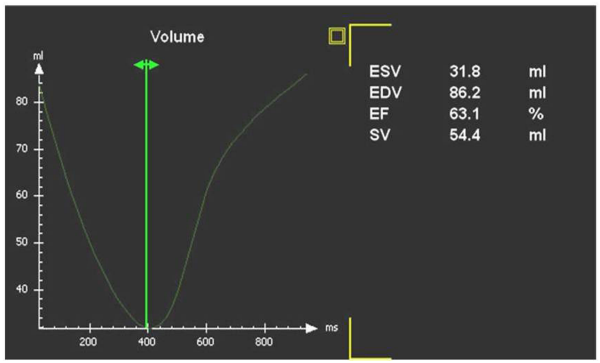
Age-, Body Size-, and Sex-Specific Reference Values for Right Ventricular Volumes and Ejection Fraction by Three-Dimensional Echocardiography

A Multicenter Echocardiographic Study in 507 Healthy Volunteers

Francesco Maffessanti, PhD*; Denisa Muraru, MD*; Roberta Esposito, MD; Paola Gripari, MD; Davide Ermacora, MD; Ciro Santoro, MD; Gloria Tamborini, MD; Maurizio Galderisi, MD; Ma

Circ Cardiovasc Imaging 2013;6:700-710.





3D derived RV volume in a rower

DOI: 10.1111/echo.12499

Echocardiography

ORIGINAL INVESTIGATION

Nonsymmetric Myocardial Contribution to Supranormal Right Ventricular Function in the Athlete's Heart: Combined Assessment by Speckle Tracking and Real Time Three-Dimensional Echocardiography

Roberta Esposito, M.D.,* Maurizio Galderisi, M.D., F.E.S.C.,* Vincenzo Schiano-Lomoriello, M.D.,* Alessandro Santoro, M.D.,* Daniela De Palma, M.D.,* Renato Ippolito, M.D.,* Riccardo Muscariello, M.D.,* Ciro Santoro, M.D.,* Germano Guerra, M.D.,† Matteo Cameli, M.D.,‡ Sergio Mondillo, M.D.,‡ and Giovanni De Simone, M.D., F.A.C.C.*

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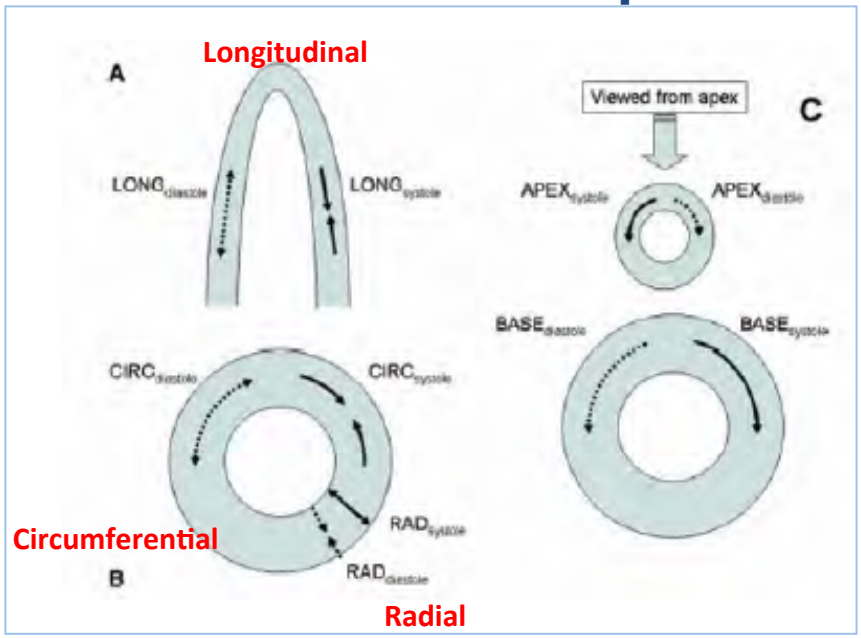
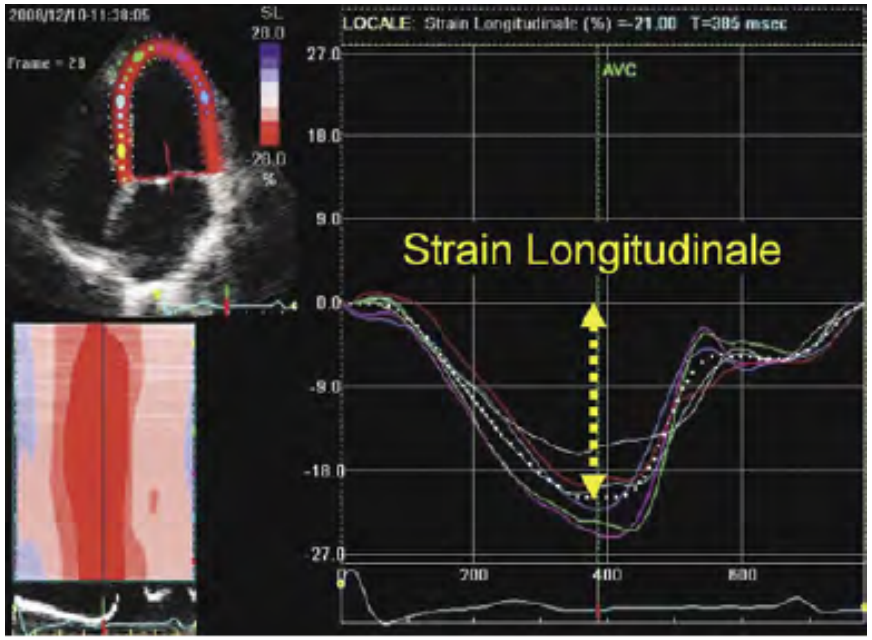
Speckle Tracking & Strain Imaging

Diretional Strain Components





Longitudinal dysfunction is early

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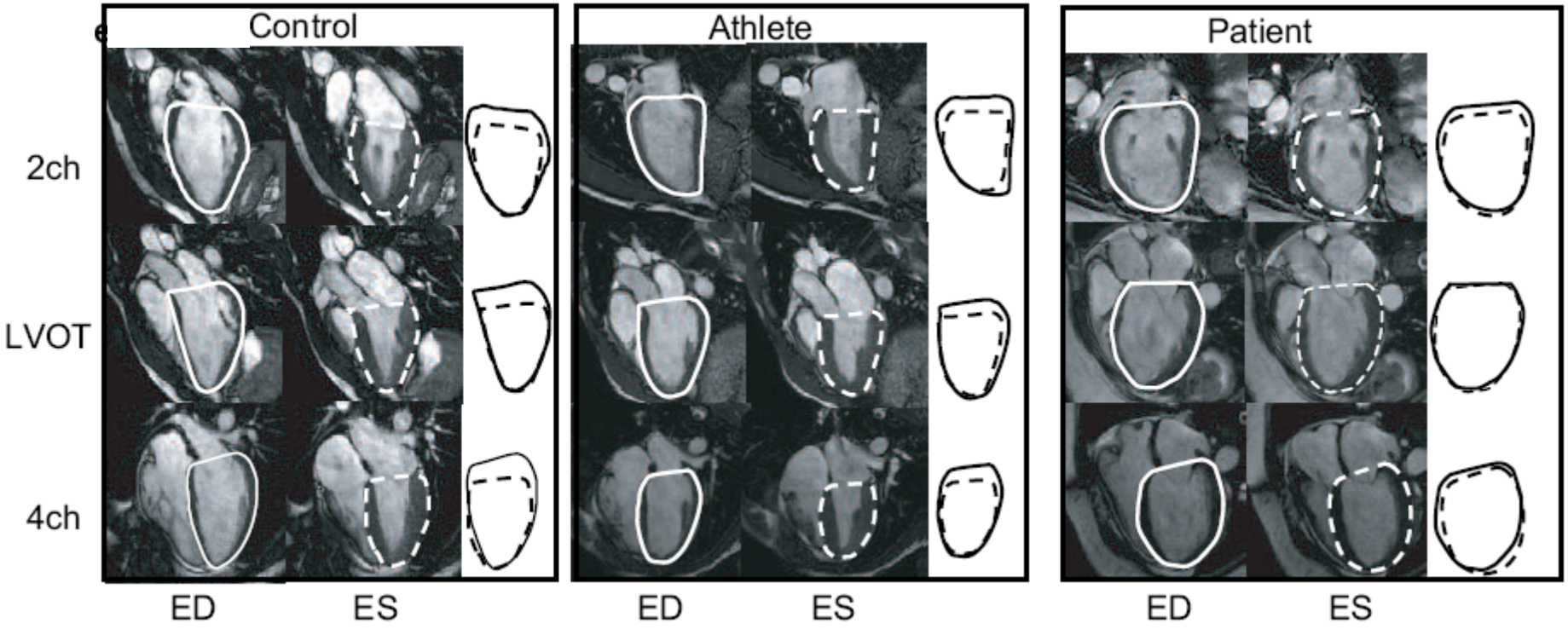
The value of Longitudinal Function

The importance of LV base



Longitudinal function of LV base contributes to 60% of stroke volume

Carlsson M et al, *Am J Physiol Heart Circ Physiol* 2007;292:H1452-H1459

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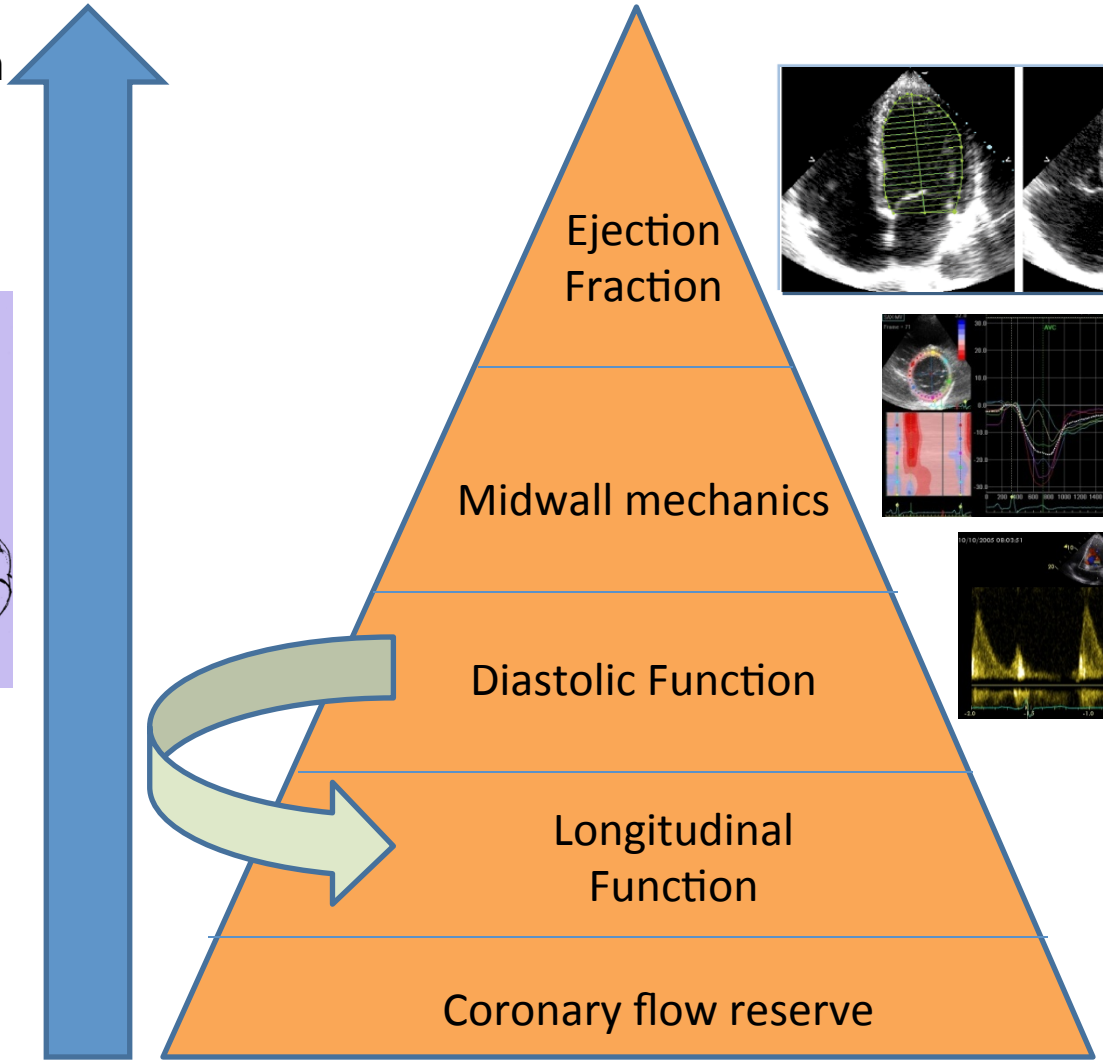
The progression of LV dysfunction

Overt dysfunction



Subclinical dysfunction

Galderisi M, *Am J Hypertens* 2011;24:507-517

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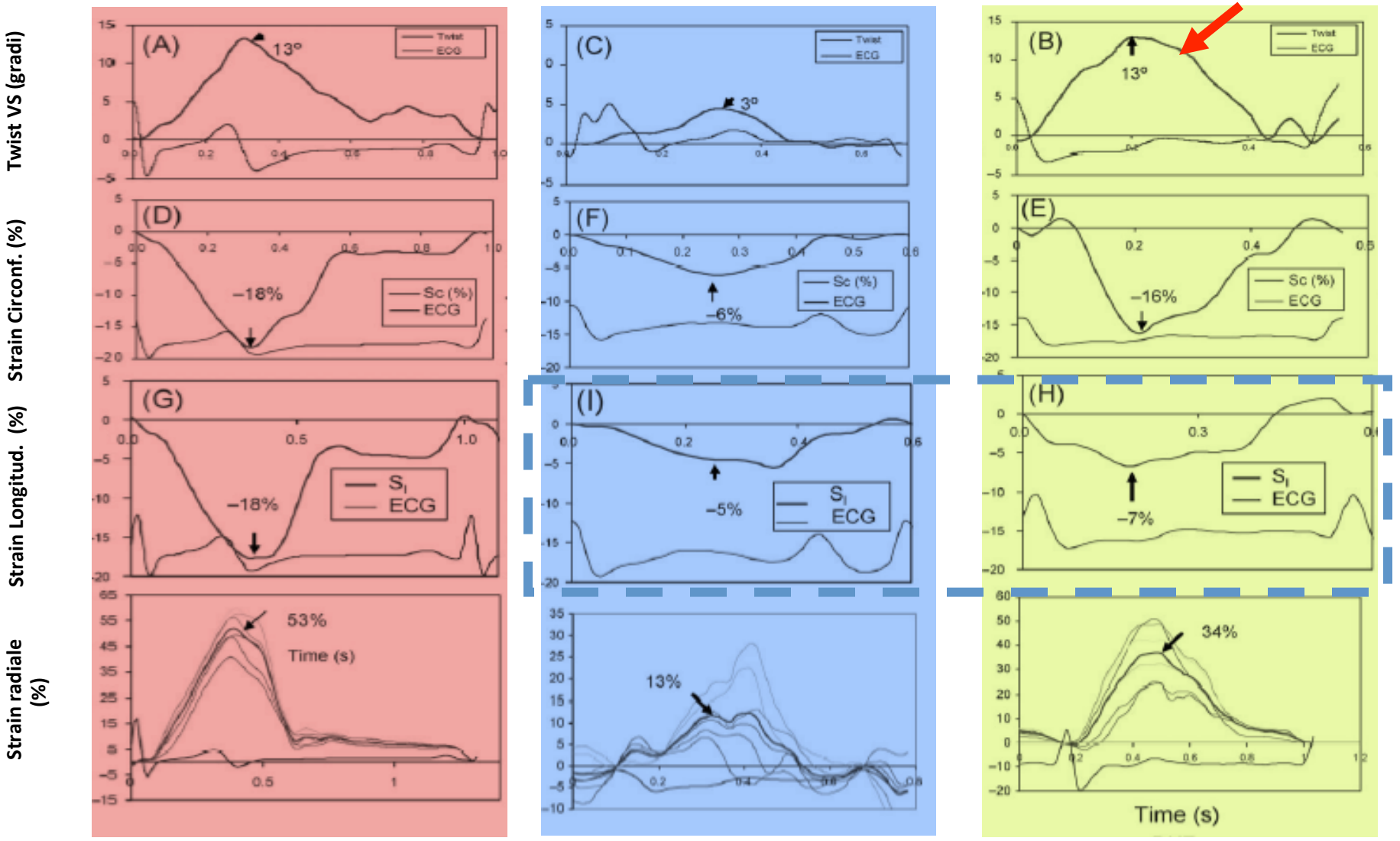
Longitudinal dysfunction always !



Wang J et al, *Eur Heart J* 2008;29:1283-1289

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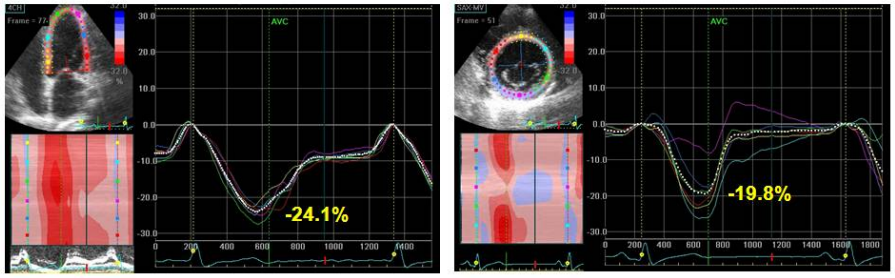
Speckle Tracking & Strain

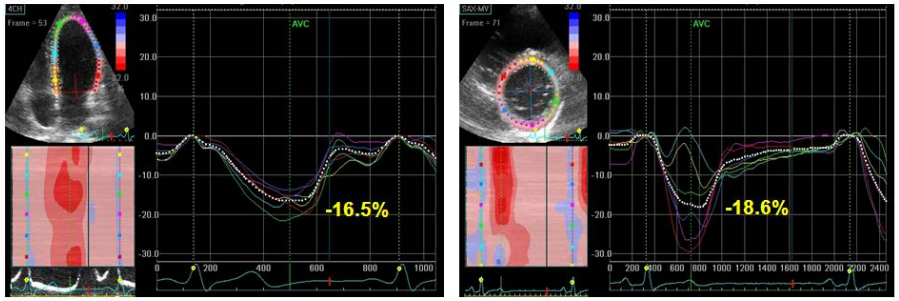
Differences of Myocardial Systolic Deformation and Correlates of Diastolic Function in Competitive Rowers and Young Hypertensives: A Speckle-Tracking Echocardiography Study

Maurizio Galderisi, MD, Vincenzo Schiano Lomoriello, MD, Alessandro Santoro, MD, Roberta Esposito, MD, Marinella Olibet, MD, Rosa Raia, MD, Matteo Nicola Dario Di Minno, MD, Germano Guerra, MD, Donato Mele, MD, and Gaetano Lombardi, MD, *Naples, Campobasso, and Ferrara, Italy*

(J Am Soc Echocardiogr 2010;23:1190-8.)

Athlete





Hypertensive

Contents lists available at ScienceDirect
International Journal of Cardiology
journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

Early changes of myocardial deformation properties in patients with dystrophia myotonica type 1: A three-dimensional Speckle Tracking echocardiographic study

Maurizio Galderisi [a,*], Francesco De Stefano [a], Ciro Santoro [a], Agostino Buonauro [a], Daniela De Palma [a], Fiore Manganelli [b], Lucia Ruggiero [b], Lucio Santoro [b], Giovanni de Simone [a]

European Heart Journal - Cardiovascular Imaging Advance Access published February 9, 2012
European Heart Journal – Cardiovascular Imaging
doi:10.1093/ehjci/jes026

Correlates of global area strain in native hypertensive patients: a three-dimensional speckle-tracking echocardiography study

Maurizio Galderisi*, Roberta Esposito, Vincenzo Schiano-Lomoriello, Alessandro Santoro, Renato Ippolito, Pierluigi Schiattarella, Pasquale Strazzullo, and Giovanni de Simone

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Cardiovascular Pathophysiology & Therapeutics

Cardiotoxicity

European Heart Journal – Cardiovascular Imaging (2015) **16**, 466–470
doi:10.1093/ehjci/jev024

REVIEW

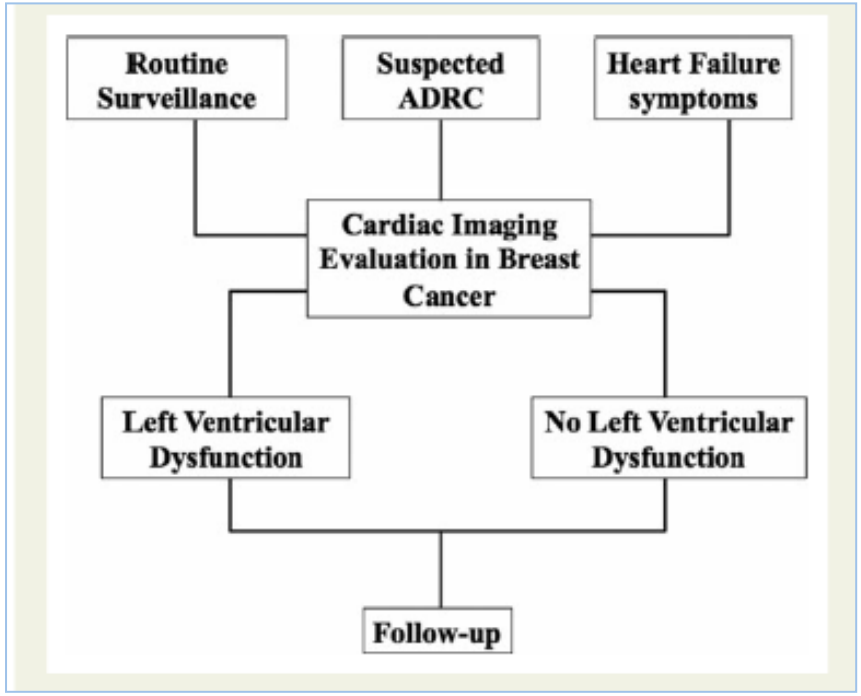
EACVI/HFA Cardiac Oncology Toxicity Registry in breast cancer patients: rationale, study design, and methodology (EACVI/HFA COT Registry)—EURObservational Research Program of the European Society of Cardiology

Patrizio Lancellotti[1]*, Stefan D. Anker[2], Erwan Donal[3], Thor Edvardsen[4,5], Bogdan A. Popescu[6], Dimitrios Farmakis[7], Gerasimos Filippatos[7], Gilbert Habib[8,9], Aldo P. Maggioni[10,11], Guy Jerusalem[12], and Maurizio Galderisi[13]

Oncologists at Federico II Univ:
Prof Sabino De Placido
Dr. Grazia Arpino

Expert consensus for multimodality imaging evaluation of adult patients during and after cancer therapy: a report from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Juan Carlos Plana[1], Maurizio Galderisi[2], Ana Barac[3], Michael S. Ewer[4], Bonnie Ky[5], Marielle Scherrer-Crosbie[6], Javier Ganame[7], Igal A. Sebag[8], Deborah A. Agler[1], Luigi P. Badano[9], Jose Banchs[4], Daniela Cardinale[10], Joseph Carver[11], Manuel Cerqueira[1], Jeanne M. DeCara[12], Thor Edvardsen[13], Scott D. Flamm[1], Thomas Force[14], Brian P. Griffin[1], Guy Jerusalem[15], Jennifer E. Liu[16], Andreia Magalhães[17], Thomas Marwick[18], Liza Y. Sanchez[4], Rosa Sicari[19], Hector R. Villarraga[20], and Patrizio Lancellotti[15]



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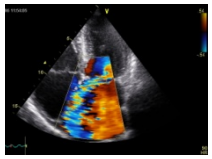
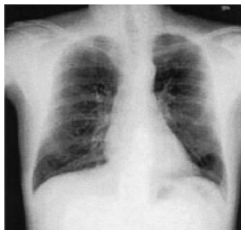
Modern diagnostics by Cardiac Imaging

Echocardiography

Green, Cheap

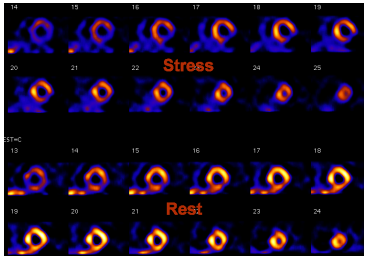


X-Ray



Radiations
Cheap

Nuclear Cardiology

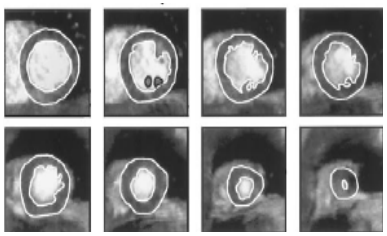


Radiations
Expensive

CT scan

Radiations
Expensive

C-MRI



Green
Expensive

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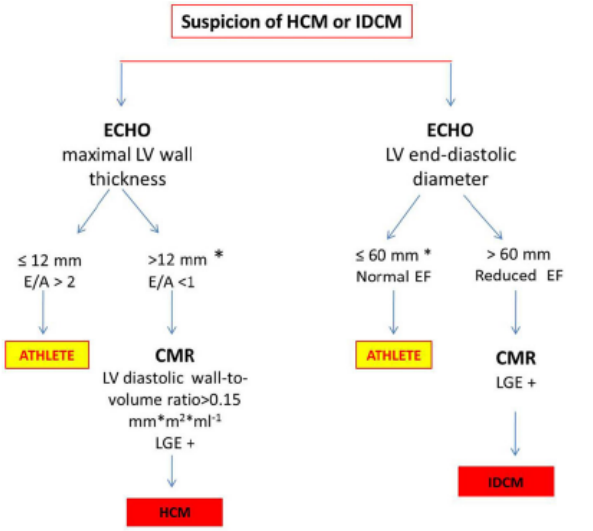
EACVI recommendations & expert consensus

Non-invasive cardiac imaging evaluation of patients with chronic systolic heart failure: a report from the European Association of Cardiovascular Imaging (EACVI)

A. Gimelli, P. Lancellotti, L.P. Badano, M. Lombardi, B. Gerber, S. Plein, D. Neglia, T. Edvardsen, A. Kitsiou, AJHA Scholte, S. Schröder, B. Cosyns, P. Gargiulo, JL. Zamorano, P. Perrone-Filardi *Eur Heart J* 2014

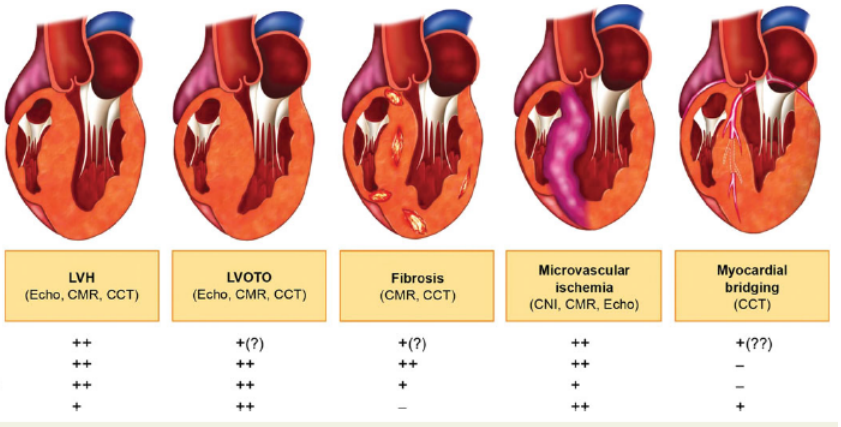
The multi-modality cardiac imaging approach to the Athlete's heart: an expert consensus of the European Association of Cardiovascular Imaging

Maurizio Galderisi[1]*, (Chair), Nuno Cardim[2], (Co-chair), Antonello D'Andrea[3], Oliver Bruder[4], Bernard Cosyns[5], Laurent Davin[6], Erwan Donal[7], Thor Edvardsen[8], Antonio Freitas[9], Gilbert Habib[10], Anastasia Kitsiou[11], Sven Plein[12], Steffen E. Petersen[13], Bogdan A. Popescu[14], Stephen Schroeder[15], Christof Burgstahler[16], and Patrizio Lancellotti[17]



Role of multimodality cardiac imaging in the management of patients with hypertrophic cardiomyopathy: an expert consensus of the European Association of Cardiovascular Imaging Endorsed by the Saudi Heart Association

Nuno Cardim[1]*, (Chair), Maurizio Galderisi[2], (Co-chair), Thor Edvardsen[3], Sven Plein[4], Bogdan A. Popescu[5], Antonello D'Andrea[6], Oliver Bruder[7], Bernard Cosyns[8], Laurent Davin[9], Erwan Donal[10,11], Antonio Freitas[12], Gilbert Habib[13,14], Anastasia Kitsiou[15], Steffen E. Petersen[16], Stephen Schroeder[17], and Patrizio Lancellotti[18,19]



	LVH (Echo, CMR, CCT)	LVOTO (Echo, CMR, CCT)	Fibrosis (CMR, CCT)	Microvascular ischemia (CNI, CMR, Echo)	Myocardial bridging (CCT)
SCD	++	+(?)	+(?)	++	+(??)
HF	++	++	++	++	–
AF/STROKE	++	++	+	+	–
ANGINA	+	++	–	++	+

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Diastolic Function

Diastolic dysfunction & LGE CMR

C. Contaldi et al. / International Journal of Cardiology 202 (2016) 84–86

Contents lists available at ScienceDirect

International Journal of Cardiology

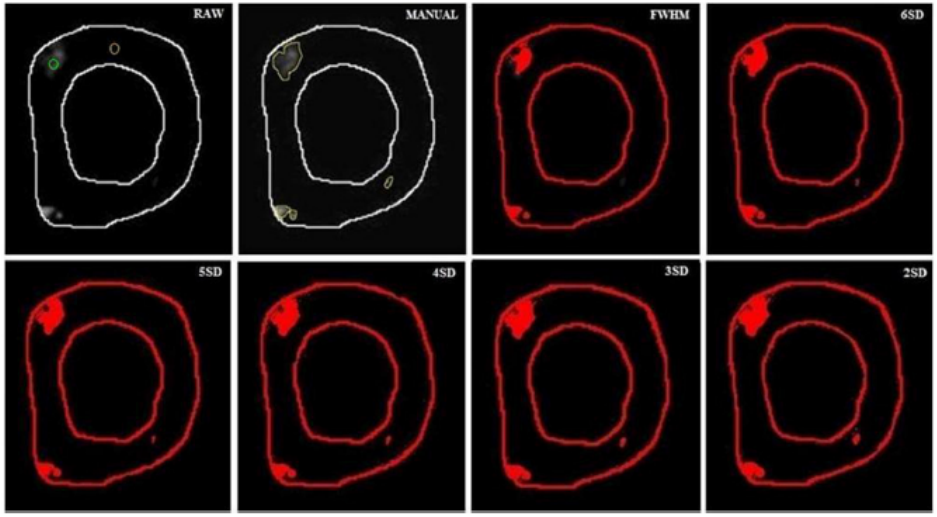
journal homepage: www.elsevier.com/locate/ijcard

Correspondence

Assessment of the relationships between left ventricular filling pressures and longitudinal dysfunction with myocardial fibrosis in uncomplicated hypertensive patients

Carla Contaldi, Massimo Imbriaco, Gianmarco Alcidi, Andrea Ponsiglione, Ciro Santoro, Marta Puglia, Luigi Barbuto, Alberto Cuocolo, Bruno Trimarco, Maurizio Galderisi *

Radiologists at Federico II Univ.:
Prof. Alberto Cuocolo
Prof. Massimo Imbriaco



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Stress Echo

Coronary Flow Reserve

Eur J Nucl Med Mol Imaging (2012) 39:1199–1206
DOI 10.1007/s00259-012-2117-9

ORIGINAL ARTICLE

Effects of type 2 diabetes mellitus on coronary microvascular function and myocardial perfusion in patients without obstructive coronary artery disease

Caterina Marciano · Maurizio Galderisi · Paola Gargiulo · Wanda Acampa · Carmen D'Amore · Roberta Esposito · Enza Capasso · Gianluigi Savarese · Laura Casaretti · Francesco Lo Iudice · Giovanni Esposito · Giuseppe Rengo · Dario Leosco · Alberto Cuocolo · Pasquale Perrone-Filardi

Galderisi *et al. Cardiovascular Ultrasound* 2012, **10**:20
http://www.cardiovascularultrasound.com/content/10/1/20

CARDIOVASCULAR ULTRASOUND

RESEARCH Open Access

The impact of aging and atherosclerotic risk factors on transthoracic coronary flow reserve in subjects with normal coronary angiography

Maurizio Galderisi[1,6*], Fausto Rigo[2], Sonia Gherardi[3], Lauro Cortigiani[4], Ciro Santoro[1], Rosa Sicari[5] and Eugenio Picano[5]

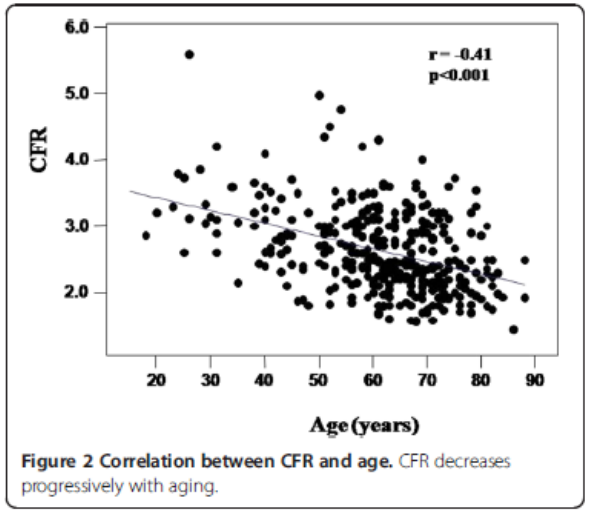

Figure 2 Correlation between CFR and age. CFR decreases progressively with aging.

Circulation Journal
Official Journal of the Japanese Circulation Society
http://www.j-circ.or.jp

ORIGINAL ARTICLE
Ischemic Heart Disease

Coronary Microvascular Dysfunction in Asymptomatic Patients Affected by Systemic Sclerosis

– Limited vs. Diffuse Form –

Alessia Faccini, MD; Eustachio Agricola, MD; Michele Oppizzi, MD; Alberto Margonato, MD; Maurizio Galderisi, MD; Maria Grazia Sabbadini, MD; Stefano Franchini, MD; Paolo G Camici, MD

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Cardiovascular Pathophysiology & Therapeutics

Pocket size imaging device

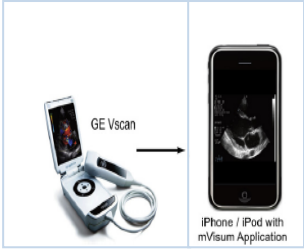
Schiano-Lomoriello *et al. Cardiovascular Ultrasound* (2015) 13:33
DOI 10.1186/s12947-015-0024-5

CARDIOVASCULAR ULTRASOUND

RESEARCH Open Access

Early markers of right heart involvement in regular smokers by Pocket Size Imaging Device

Vincenzo Schiano-Lomoriello[1,2], Roberta Esposito[1,2], Ciro Santoro[1,2], Giovanni de Simone[1,2] and Maurizio Galderisi[1,3*]



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… Where eagles dare