L'ecografia da stress è ancora la vincente?

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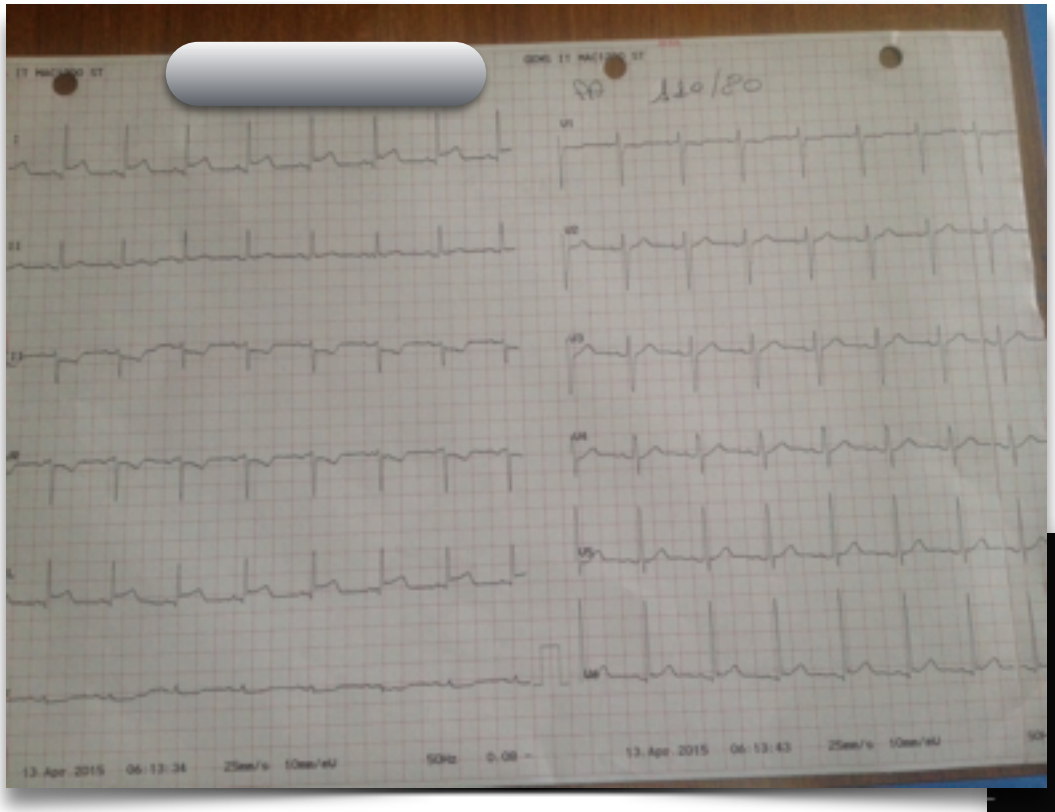
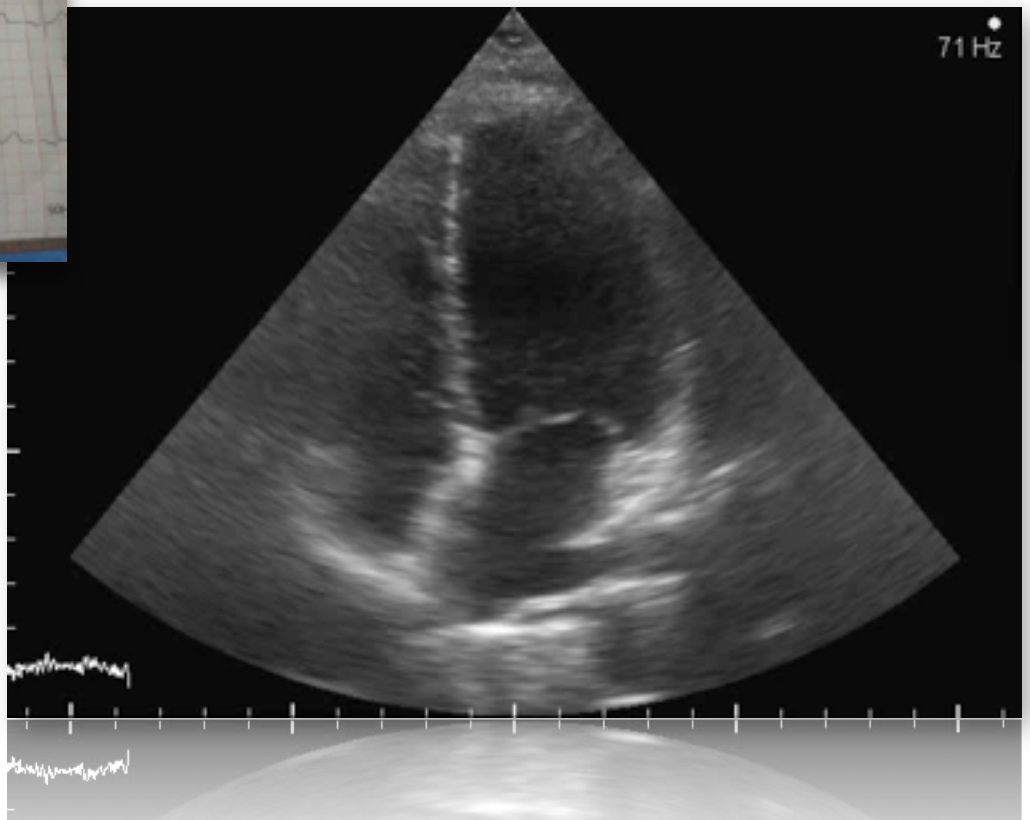
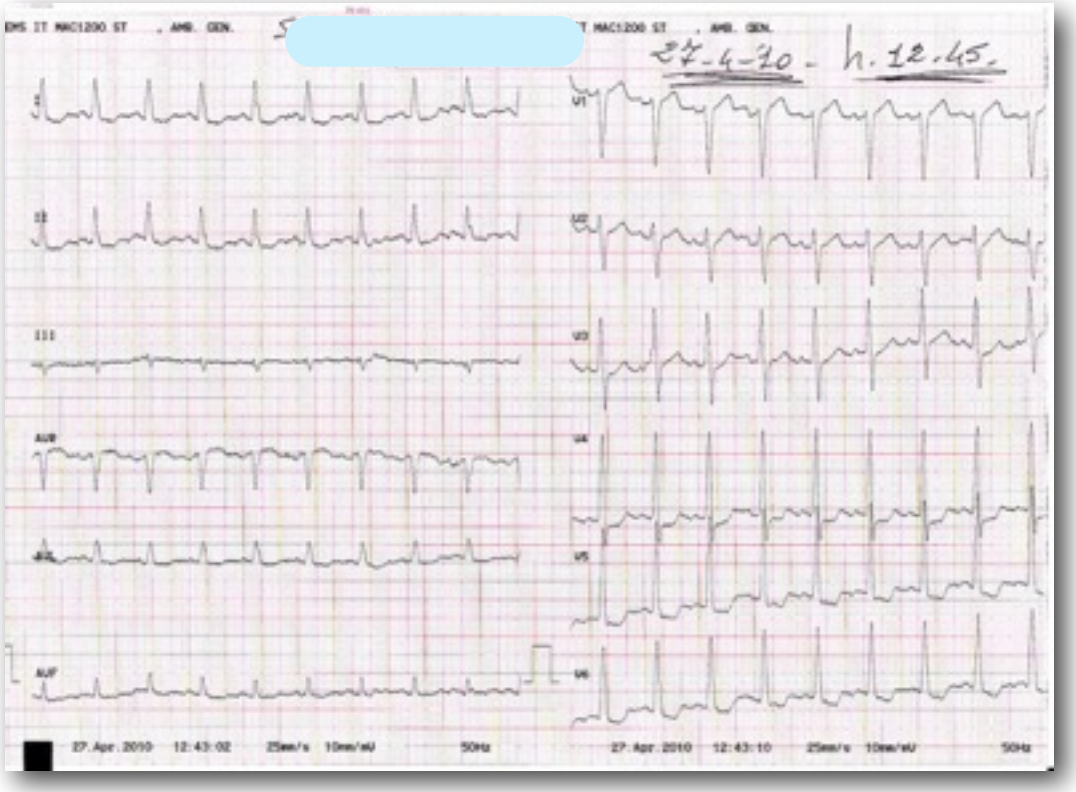
Unità Operativa Complessa di Cardiologia

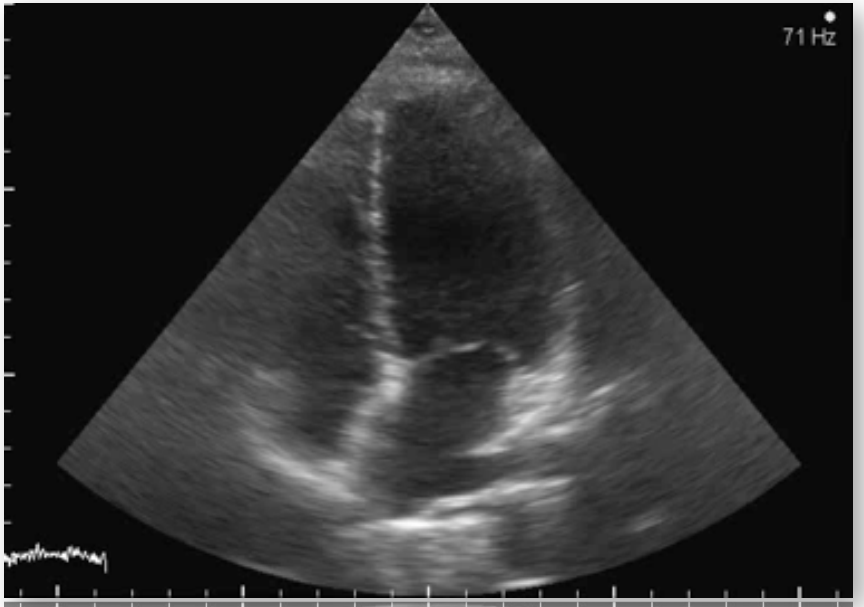
QUALE IMAGING SCELGO PER PRIMO NELLA SCA?

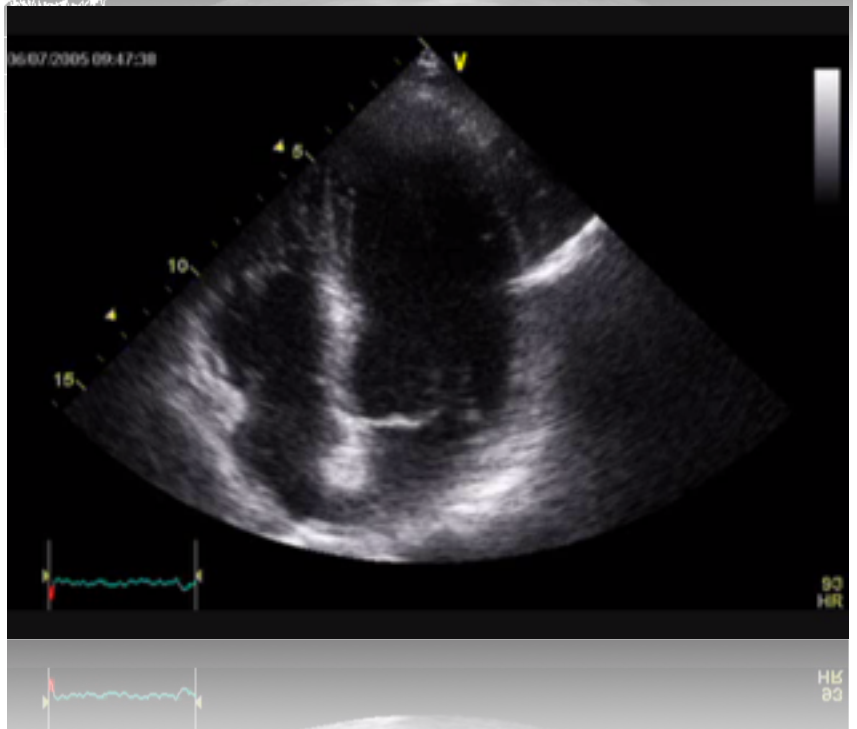




QUALE IMAGING SCELGO PER PRIMO NELLA SCA?



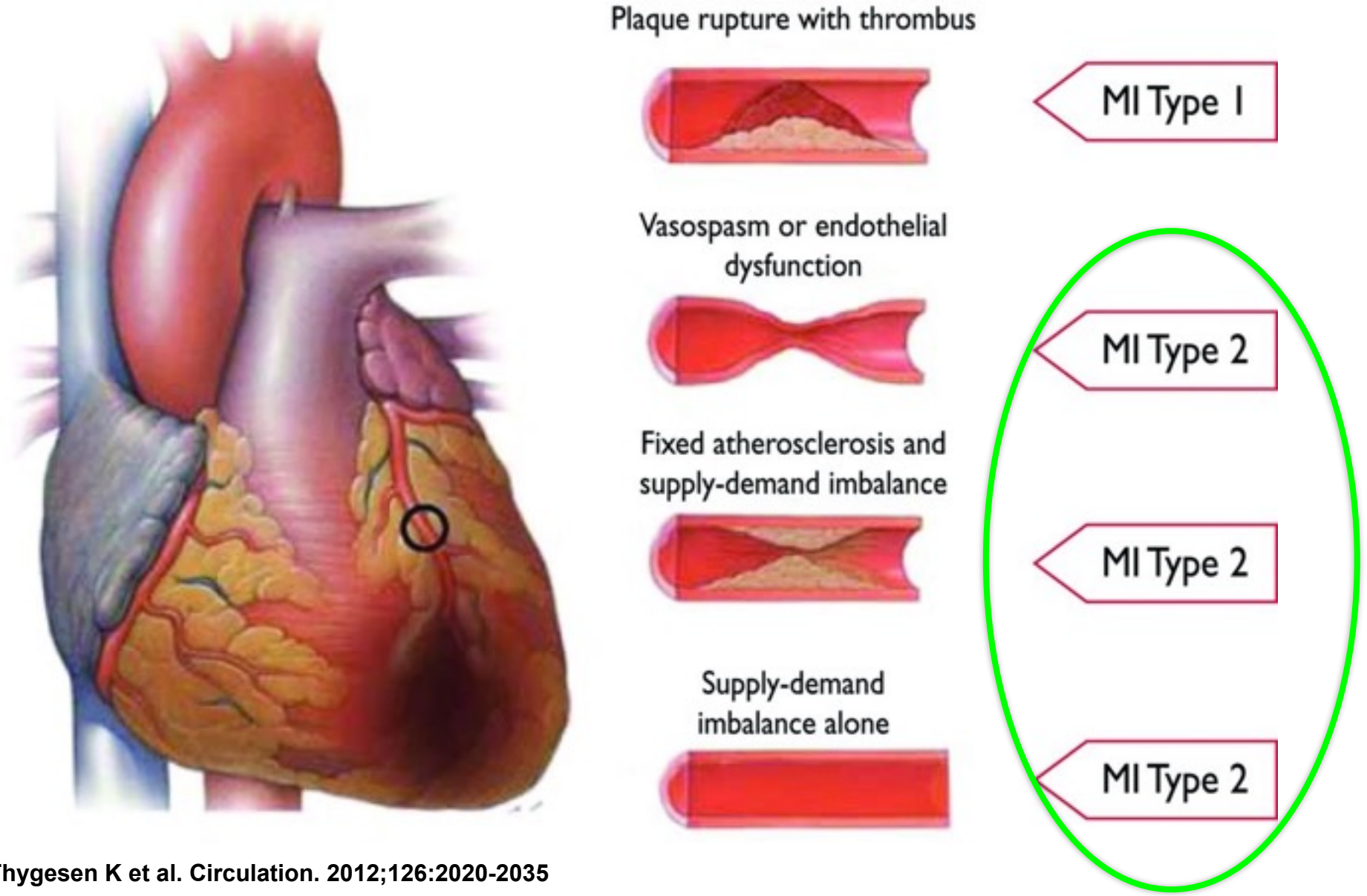




Goals

- Infarto pregresso/acuto
- Infarti di limitata estensione
- Reale estensione dell'infarto

Differentiation between myocardial infarction (MI) types 1 and 2 according to the condition of the coronary arteries.



Thygesen K et al. Circulation. 2012;126:2020-2035

American Heart Association.

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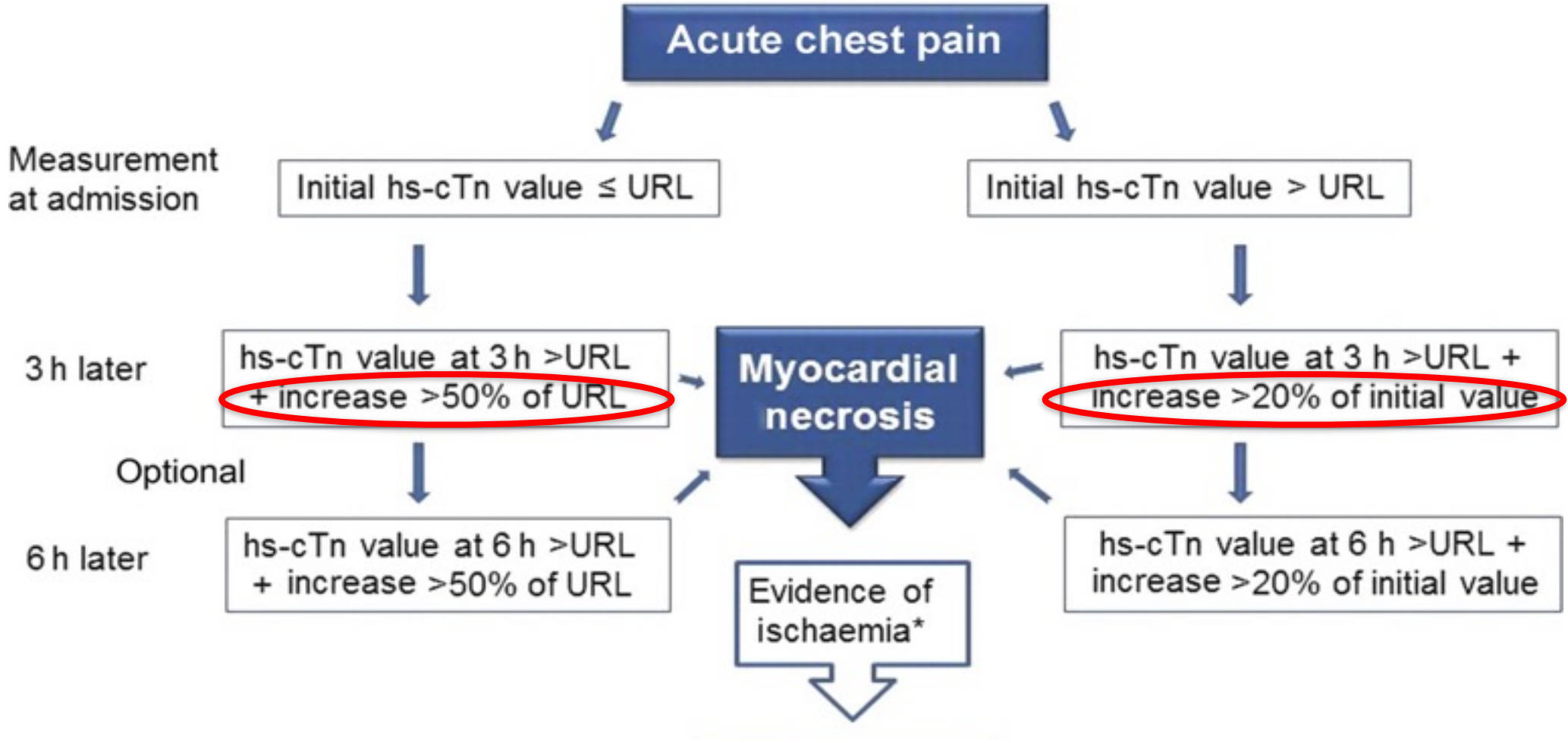
How to use high-sensitivity cardiac troponins in acute cardiac care†

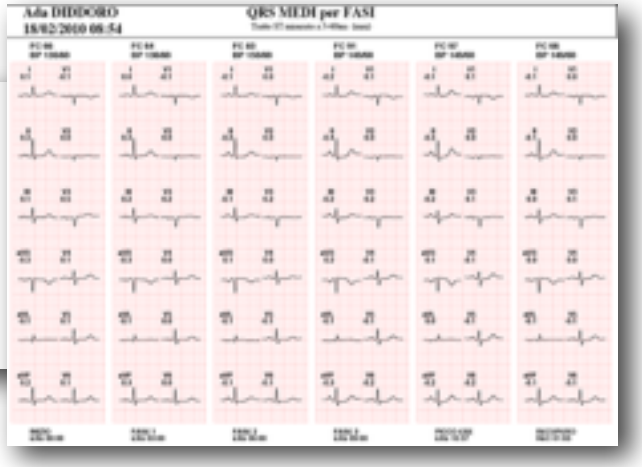
Kristian Thygesen*, Johannes Mair, Evangelos Giannitsis, Christian Mueller, Bertil Lindahl, Stefan Blankenberg, Kurt Huber, Mario Plebani, Luigi M. Biasucci, Marco Tubaro, Paul Collinson, Per Venge, Yonathan Hasin, Marcello Galvani, Wolfgang Koenig, Christian Hamm, Joseph S. Alpert, Hugo Katus, and Allan S. Jaffe, the Study Group on Biomarkers in Cardiology of the ESC Working Group on Acute Cardiac Care



Thysesen K, Eur Heart J 2012

L'ecografia da stress è ancora la vincente?

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation

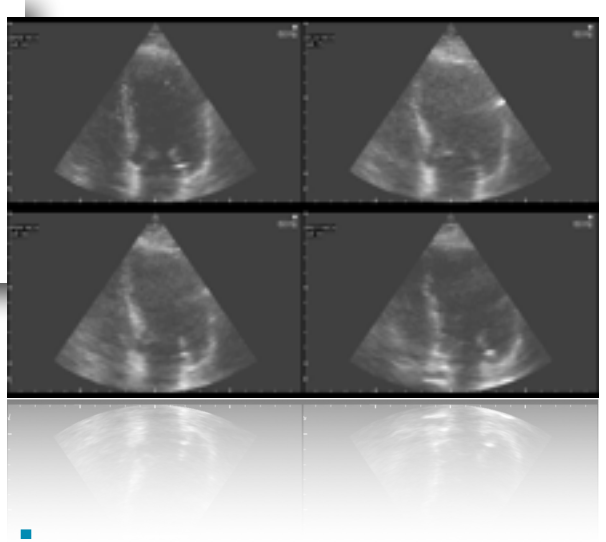


In patients with non-diagnostic 12-lead ECGs and negative cardiac biomarkers but suspected ACS, stress imaging may be performed, provided the patient is free of chest pain.

Various studies have used **stress echocardiography**, showing **high negative predictive values and/or excellent outcome in the presence of a normal stress echocardiogram.**

L'ecografia da stress è ancora la vincente?

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation



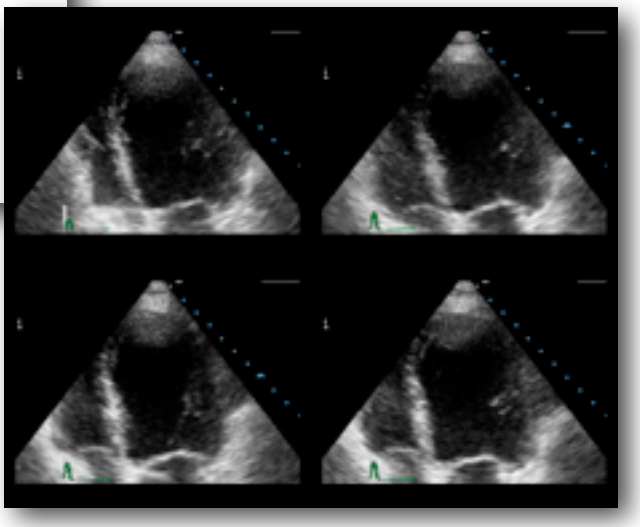
Stress testing for ischaemia

In patients who continue to have typical ischaemic rest pain, no stress test should be performed.

However, **a stress test for inducible ischaemia has predictive value and is therefore useful before hospital discharge in patients with a non-diagnostic ECG provided there is no pain, no signs of heart failure, and normal biomarkers** (repeat testing).

L'ecografia da stress è ancora la vincente?

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation

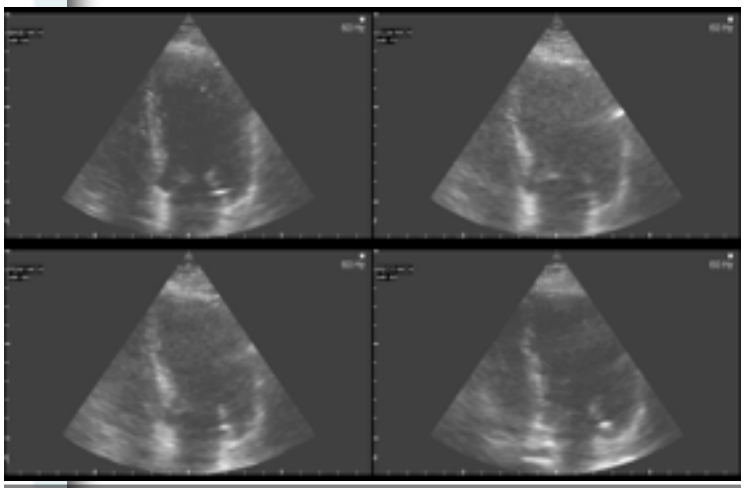


- **Early exercise testing** has a **high negative predictive value**
- Parameters reflecting **myocardial contractile performance** provide at least as much prognostic information as those reflecting **ischaemia**, while the combination of these parameters gives the best prognostic information.

L'ecografia da stress è ancora la vincente?

Table 12 **Characteristics of tests commonly used to diagnose the presence of coronary artery disease**

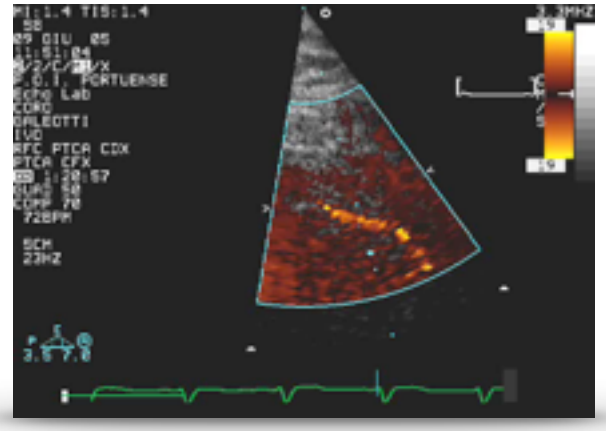
	Diagnosis of CAD	
	Sensitivity (%)	Specificity (%)
Exercise ECG [a,91,94,95]	45–50	85–90
Exercise stress echocardiography[96]	80–85	80–88
Exercise stress SPECT[96-99]	73–92	63–87
Dobutamine stress echocardiography[96]	79–83	82–86
Dobutamine stress MRI[b,100]	79–88	81–91
Vasodilator stress echocardiography[96]	72–79	92–95
Vasodilator stress SPECT[96,99]	90–91	75–84
Vasodilator stress MRI[b,98,100-102]	67–94	61–85
Coronary CTA[c,103-105]	95–99	64–83
Vasodilator stress PET[97,99,106]	81–97	74–91



Eur Heart J, 2013, 34: 2949-3003

Dipyridamole coronary flow reserve stratifies prognosis in acute coronary syndrome patients without left anterior descending disease

Luigi Ascione[1*], Guido Carlomagno[2], Chiara Sordelli[3], Raffaele Iengo[4], Vittorio Monda[1], Sergio Severino[1], Raffaele Merenda[1], Antonello D'Andrea[3], and Pio Caso[1]



- 152 patients with unstable angina, inferior or lateral STEMI
- free from LAD disease (LAD stenosis < 50% at coronary angiogram)
- patients with non-STEMI and subjects with apical wall motion abnormalities at rest not included
- High-dose dipyridamole stress echocardiography after they had been asymptomatic for at least 72 h.

European Heart Journal – Cardiovascular Imaging 2013; 14, 858–864

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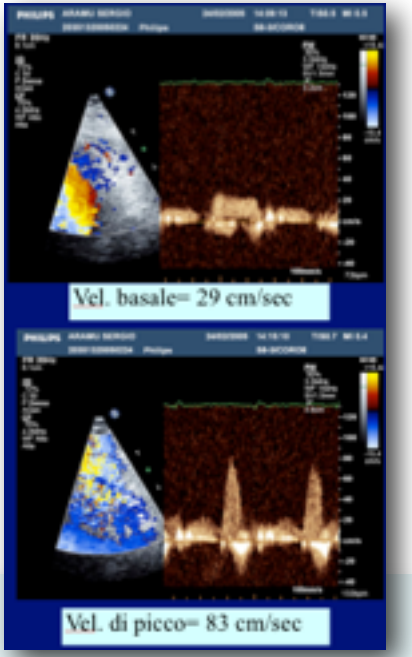

Table 2. Comparison of patients who did or did not develop major cardiovascular events

	MACE+ ($n = 22$)			MACE− ($n = 130$)			*P*
Age	65 ± 11			58 ± 10			0.005
Sex (M/F)	16 (73%)/6 (27%)			95 (73%)/35 (27%)			0.820
Diabetes	8 (37%)			17 (13%)			0.016
Smoke	14 (64%)			59 (45%)			0.069
Dyslipidemia	4 (19%)			23 (18%)			0.806
Hypertension	13 (59%)			63 (48%)			0.489
LVEF (%)	56.2 ± 5.3			56.2 ± 7.3			0.847
WMSI at rest	1.27 ± 0.18			1.17 ± 0.28			0.880
WMSI at peak	1.43 ± 0.32			1.31 ± 0.41			0.812
0/1/2 vessel CAD	1(4%)	14(64%)	7(32%)	40(31%)	81(62%)	9(7%)	<0.001
CFR	2.11 ± 0.33			2.58 ± 0.44			<0.001
CFR <2.25	19 (86%)			26 (20%)			<0.001

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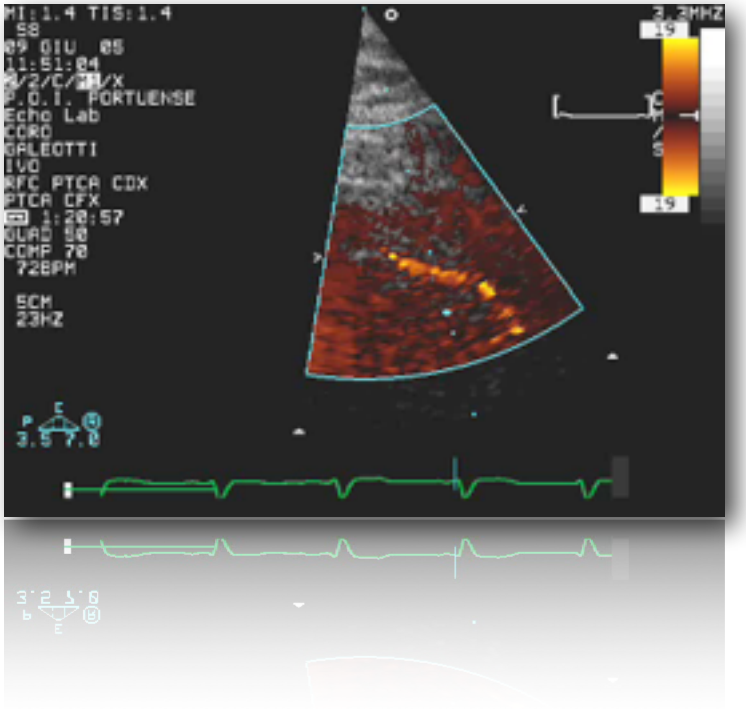
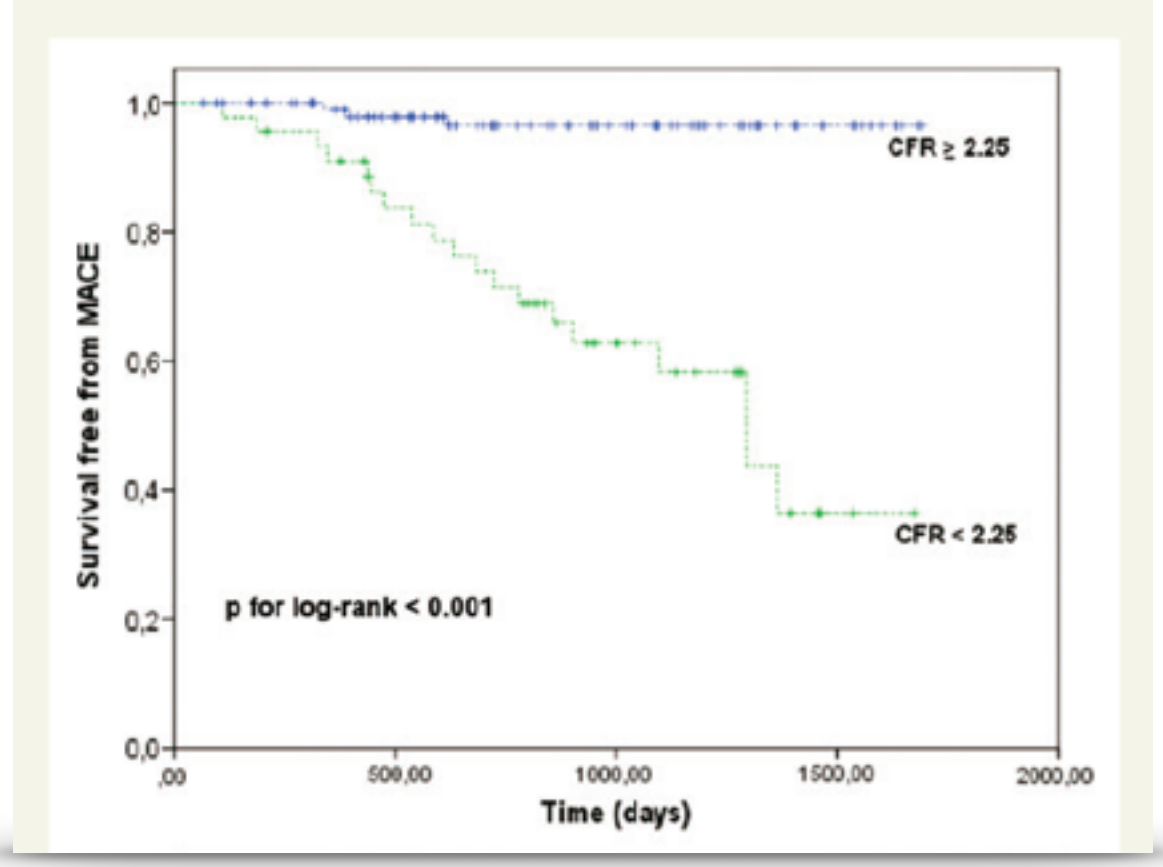




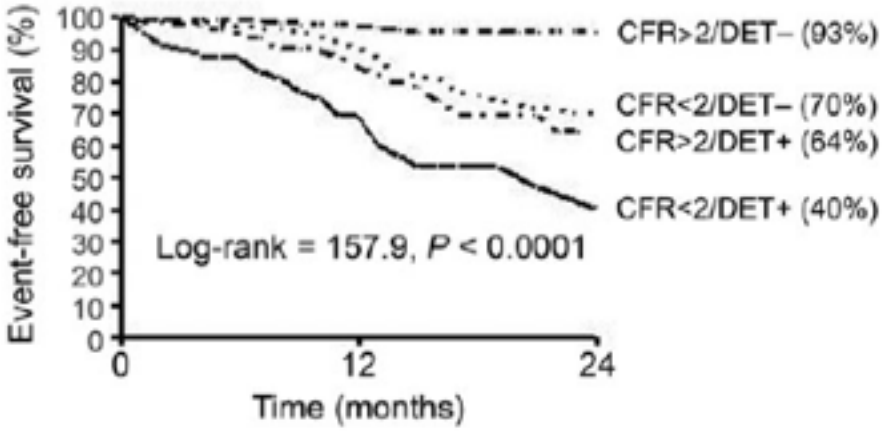
European Heart Journal – Cardiovascular Imaging 2013; 14, 858–864

European Heart Journal (2008) 29, 79–88
doi:10.1093/eurheartj/ehm527

CLINICAL RESEARCH
Imaging

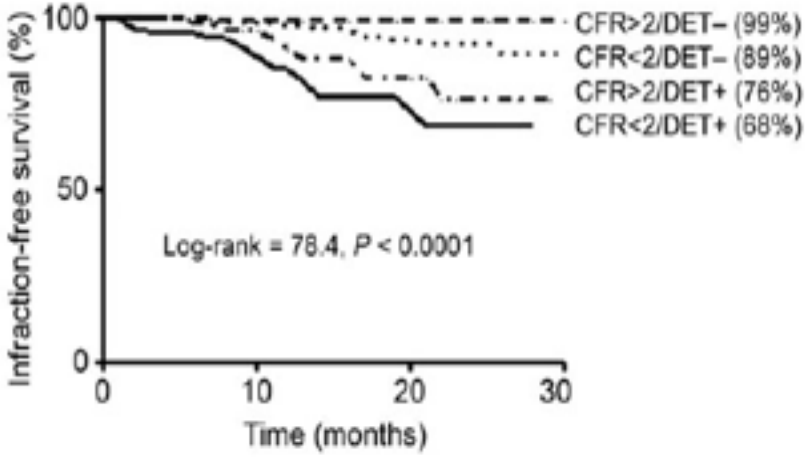
The additive prognostic value of wall motion abnormalities and coronary flow reserve during dipyridamole stress echo

Fausto Rigo[1], Rosa Sicari[2]*, Sonia Gherardi[3], Ana Djordjevic-Dikic[4], Lauro Cortigiani[5], and Eugenio Picano[2]



Subjects at risk

CFR>2/DET–	598	313	135
CFR<2/DET–	256	114	42
CFR>2/DET+	104	34	40
CFR<2/DET+	187	24	7



Subjects at risk

CFR>2/DET–	598	371	168	79
CFR<2/DET–	256	140	57	19
CFR>2/DET+	104	40	15	5
CFR<2/DET+	187	33	11	2

CONCLUSIONS: In patients with known or suspected CAD, DET result by wall motion criteria and CFR are additive and complementary for the identification of patients at risk of experiencing hard events

Table 6 Stress echo risk titration of a negative test

1-year risk (hard events)	Very low (<0.5% year)	Low (1–3% year)
Stress	Maximal	Submaximal
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
CFR	>2.0	<2.0

CFR, coronary flow reserve.

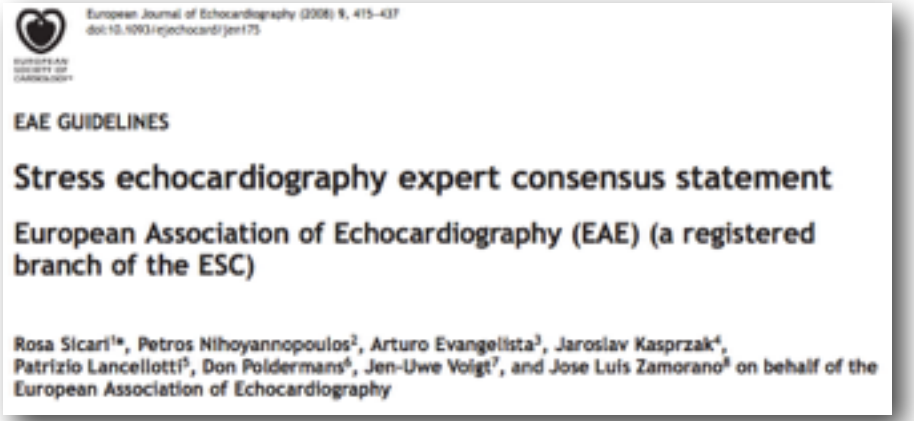
negative test

Table 5 Stress echo risk titration of a positive test

1-year risk (hard events)	Intermediate (1–3% year)	High (>10% year)
Dose/workload	High	Low
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
Coronary territory	LCx/RCA	LAD
Peak WMSI	Low	High
Recovery	Fast	Slow
Positivity or baseline dyssynergy	Homozonal	Heterozonal
CFR	>2.0	<2.0

LAD, left anterior descending artery; LCx, left circumflex; RCA, right coronary artery.

positive test



BUSINESS AND ADVOCACY

Cost-Effectiveness of Coronary Computed Tomography and Cardiac Stress Imaging in the Emergency Department

A Decision Analytic Model Comparing Diagnostic Strategies for Chest Pain in Patients at Low Risk of Acute Coronary Syndromes

Virginia L. Priest, BS,* Paul A. Scuffham, PhD,* Rory Hachamovitch, MS, MD,‡
Thomas H. Marwick, MD, PhD†‡

Table 4. Results of SPECT and Echo Pharmacological Stress (CAD Prevalence 5%)

Diagnostic Strategy	Costs, $	QALYs	No. of Events in Negative Patients
Echo			
Exercise	7,539	0.8579	8
Adenosine	6,430	0.8596	9
Dipyridamole	5,988	0.8606	9
Dobutamine	7,576	0.8579	8
SPECT			
Exercise	10,799	0.8548	4
Adenosine	8,321	0.8581	4
Dipyridamole	9,449	0.8566	4
Dobutamine	9,449	0.8566	4
Technetium	13,577	0.8505	3

J Am Coll Cardiol Img 2011; 4: 549–56

Table 5. Correct Diagnosis Model: Expected Diagnostic Accuracy in a Population of 1,000 Patients at Different Levels of Prevalence

Diagnostic Accuracy	Average Cost, $ per Patient Diagnosed	True Positive	False Positive	True Negative	False Negative	Overall Accuracy, %
Prevalence = 2% (20 patients with CAD)						
CTA + SPECT	1,508	20	16	964	0	98.43
CTA	3,064	20	196	784	0	80.40
Ex Echo	5,900	17	192	788	3	80.46
Ex ECG	8,502	15	414	565	5	57.99
Ex SPECT	9,202	18	347	633	2	65.03
Prevalence = 5% (50 patients with CAD)						
CTA + SPECT	1,952	50	15	935	0	98.47
CTA	3,363	50	190	760	0	81.00
Ex Echo	6,202	42	191	759	8	80.07
Ex ECG	8,719	37	410	540	13	57.69
Ex SPECT	9,407	44	340	610	6	65.41
Prevalence = 10% (100 patients with CAD)						
CTA + SPECT	2,693	100	14	886	0	98.55
CTA	3,861	100	180	720	0	81.99
Ex Echo	6,704	84	189	711	16	78.87
Ex ECG	9,082	75	401	498	25	57.30
Ex SPECT	9,750	89	328	572	11	66.76
Prevalence = 20% (200 patients with CAD)						
CTA + SPECT	4,173	200	13	787	0	98.70
CTA	4,857	200	160	640	0	83.98
Ex Echo	7,710	185	615	31	0	77.46
Ex ECG	9,806	152	382	418	48	56.98
Ex SPECT	10,436	178	303	497	22	69.02
Prevalence = 30% (300 patients with CAD)						
CTA + SPECT	5,654	300	11	689	0	98.85
CTA	5,853	300	140	560	0	85.97
Ex Echo	8,715	255	180	520	45	77.46
Ex ECG	10,531	233	359	341	67	57.34
Ex SPECT	11,122	268	278	422	31	69.02

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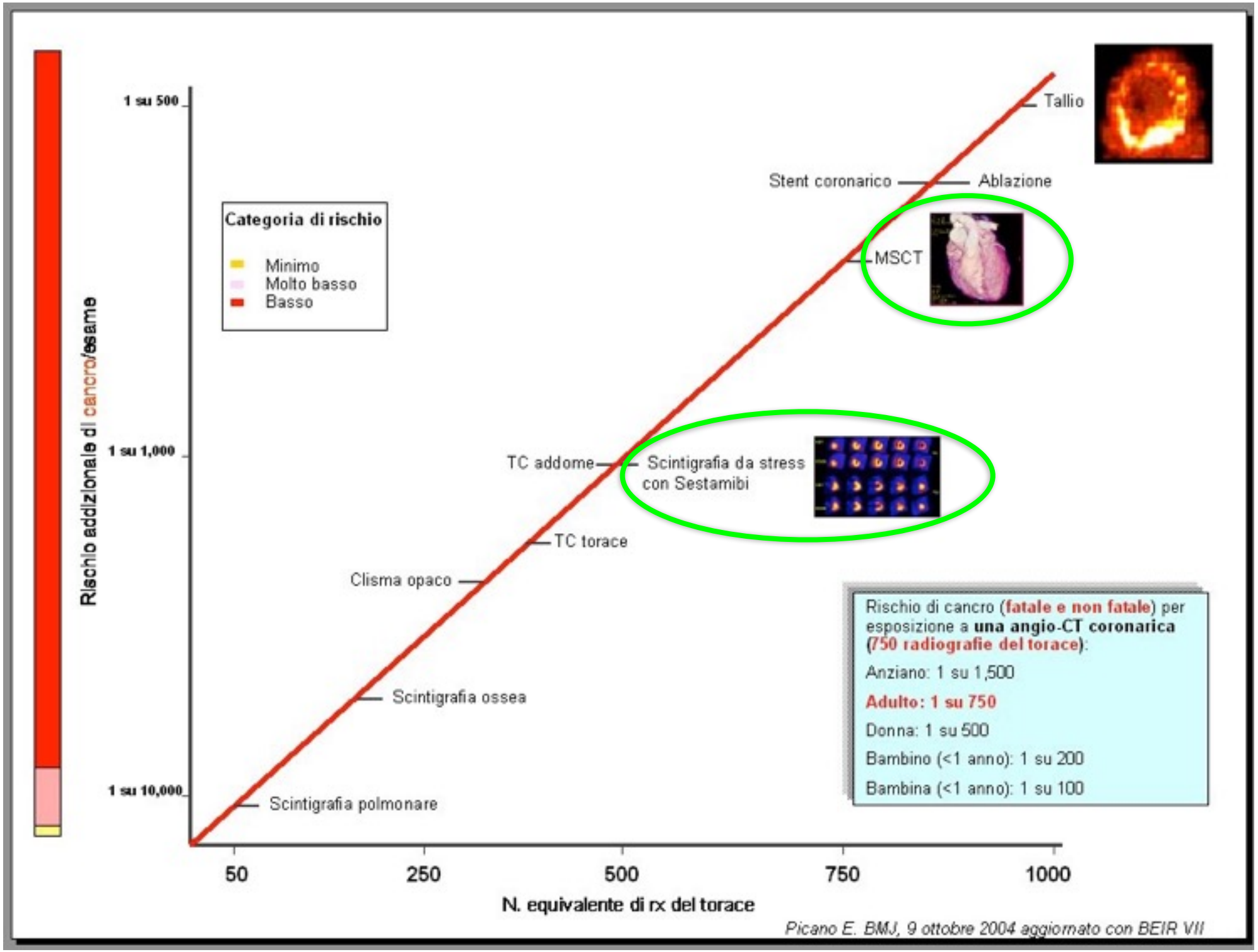
In these models of a patient group at low risk of CAD and prevalence 2% to 30%, CTA with confirmatory SPECT was cost saving (lower costs, higher QALYs) compared with a CTA-only strategy, stress ECG, Echo, and SPECT. However, CTA may be associated with a higher event rate in negative patients than SPECT, and the diagnostic and prognostic information for the use of CTA in the emergency department is scarce and still emerging.

J Am Coll Cardiol Img 2011; 4: 549–56


Rischio addizionale di cancro/esame
1 su 500
1 su 1,000
1 su 10,000
Categoria di rischio
Minimo
Molto basso
Basso
Tallio
Stent coronarico
Ablazione
MSCT
TC addome
Scintigrafia da stress con Sestamibi
TC torace
Clisma opaco
Scintigrafia ossea
Scintigrafia polmonare
Rischio di cancro (fatale e non fatale) per esposizione a una angio-CT coronarica (750 radiografie del torace):
Anziano: 1 su 1,500
Adulto: 1 su 750
Donna: 1 su 500
Bambino (<1 anno): 1 su 200
Bambina (<1 anno): 1 su 100
50
250
500
750
1000
N. equivalente di rx del torace
Picano E. BMJ, 9 ottobre 2004 aggiornato con BEIR VII

Stress CMR Reduces Revascularization, Hospital Readmission, and Recurrent Cardiac Testing in Intermediate-Risk Patients With Acute Chest Pain

Chadwick D. Miller, MD, MS,* L. Douglas Case, PhD,† William C. Little, MD,‡ Simon A. Mahler, MD,*§ Gregory L. Burke, MD, MSc,‖ Erin N. Harper, BS,* Cedric Lefebvre, MD,* Brian Hiestand, MD, MPH,* James W. Hoekstra, MD,* Craig A. Hamilton, PhD,¶ W. Gregory Hundley, MD‡#

105 pts with with symptoms of ACS but without definite ACS on the basis of the first electrocardiogram and troponin

Table 5. Study Outcomes and Safety Events Through 90 Days

	Usual Care (n = 53)	OU CMR (n = 52)	p Value
Primary outcome			
Composite*	20 (38)	7 (13)	0.004
Revascularization†	8 (15)	1 (2)	0.031
Hospital readmission*	12 (23)	4 (8)	0.033
Recurrent cardiac testing*	9 (17)	2 (4)	0.028
Secondary outcome			
Index visit length of stay, h‡	26.3 (22.7–44.8)	21.1 (14.8–25.2)	<0.001
Safety events†			
Death (all cause)	0 (0)	0 (0)	—
ACS after discharge	3 (6)	0 (0)	0.24
Stress testing adverse events	0 (0)	0 (0)	—

J Am Coll Cardiol Img 2013; 6: 785–94

Stress CMR Reduces Revascularization, Hospital Readmission, and Recurrent Cardiac Testing in Intermediate-Risk Patients With Acute Chest Pain

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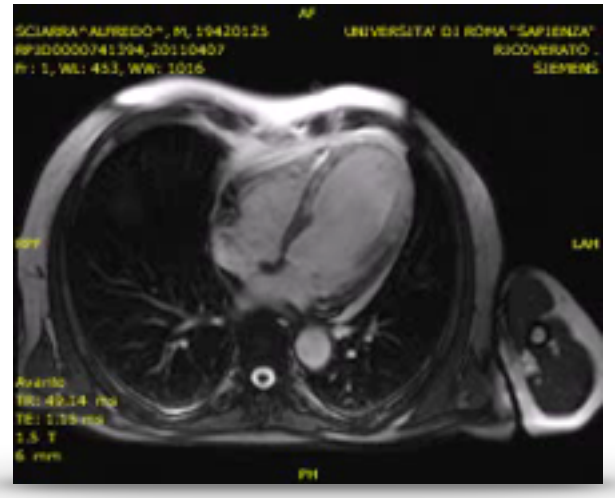


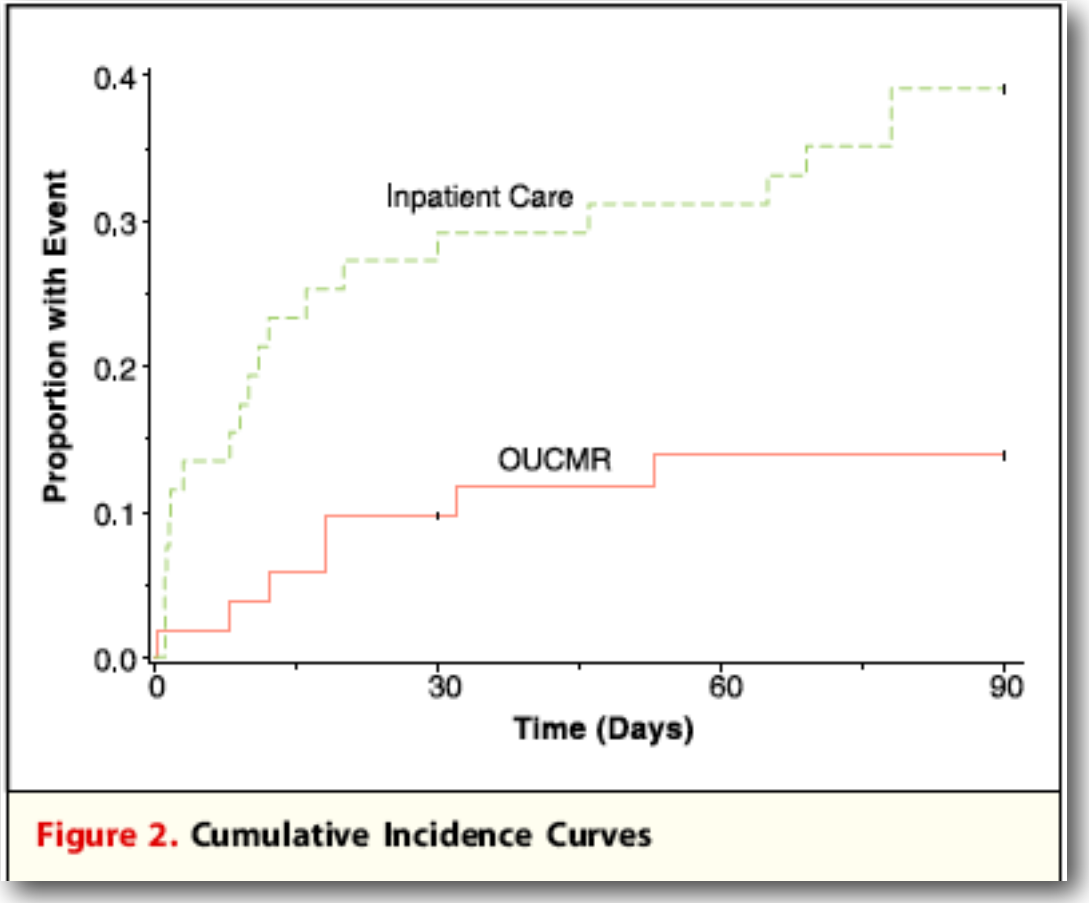


Figure 2. Cumulative Incidence Curves

In this single-center trial, management of intermediate-risk patients with possible ACS in an OU with stress CMR reduced coronary artery revascularization, hospital readmissions, and recurrent cardiac testing, without an increase in post discharge ACS at 90 days.

J Am Coll Cardiol Img 2013; 6: 785–94

Contrast Stress-Echocardiography Predicts Cardiac Events in Patients with Suspected Acute Coronary Syndrome but Nondiagnostic Electrocardiogram and Normal 12-Hour Troponin

Nicola Gaibazzi, MD, PhD, Angelo Squeri, MD, Claudio Reverberi, MD, Sabrina Molinaro, PhD, Valentina Lorenzoni, MSc, Daniele Sartorio, MD, and Roxy Senior, MD, FRCP, FESC, FACC, *Parma and Pisa, Italy; and London, United Kingdom*

545 pts with with suspected ACS but non diagnostic ECG findings and normal troponin levels at 12 hours

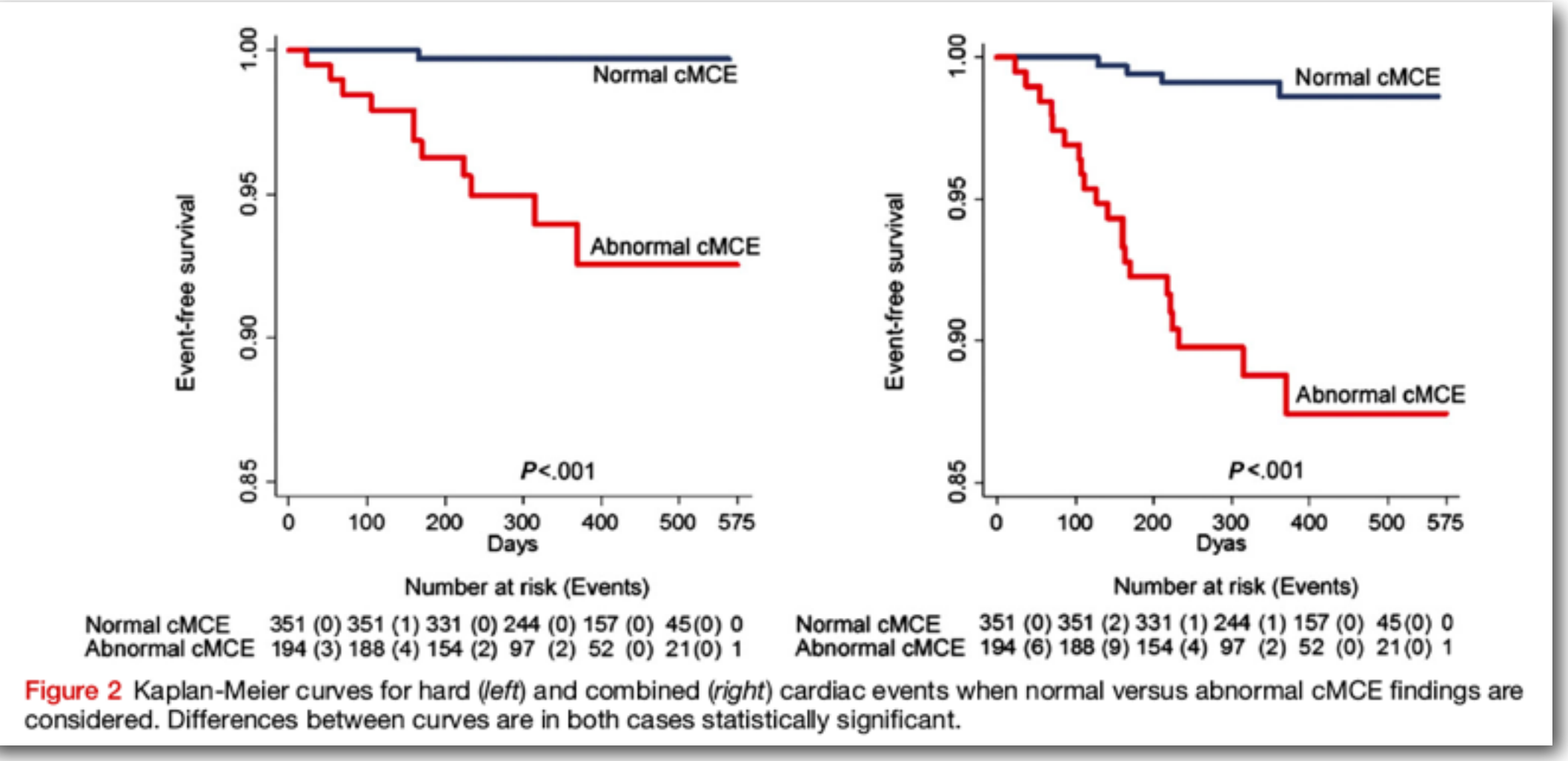
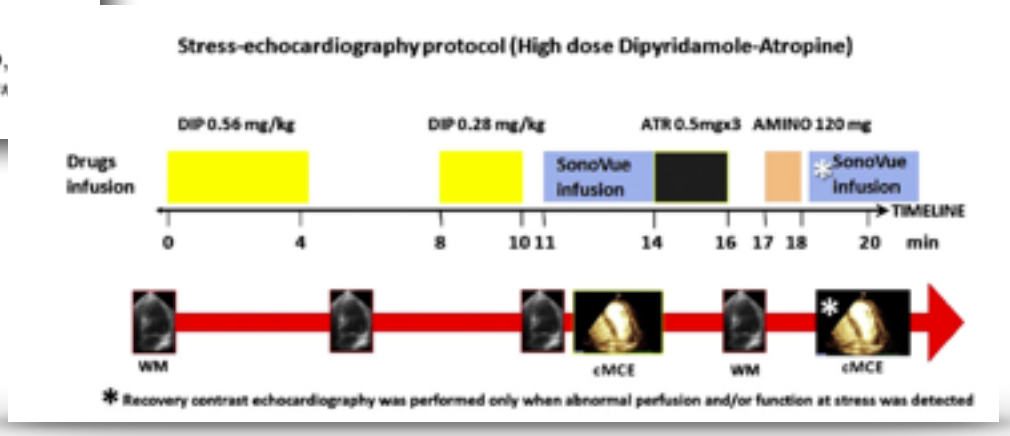


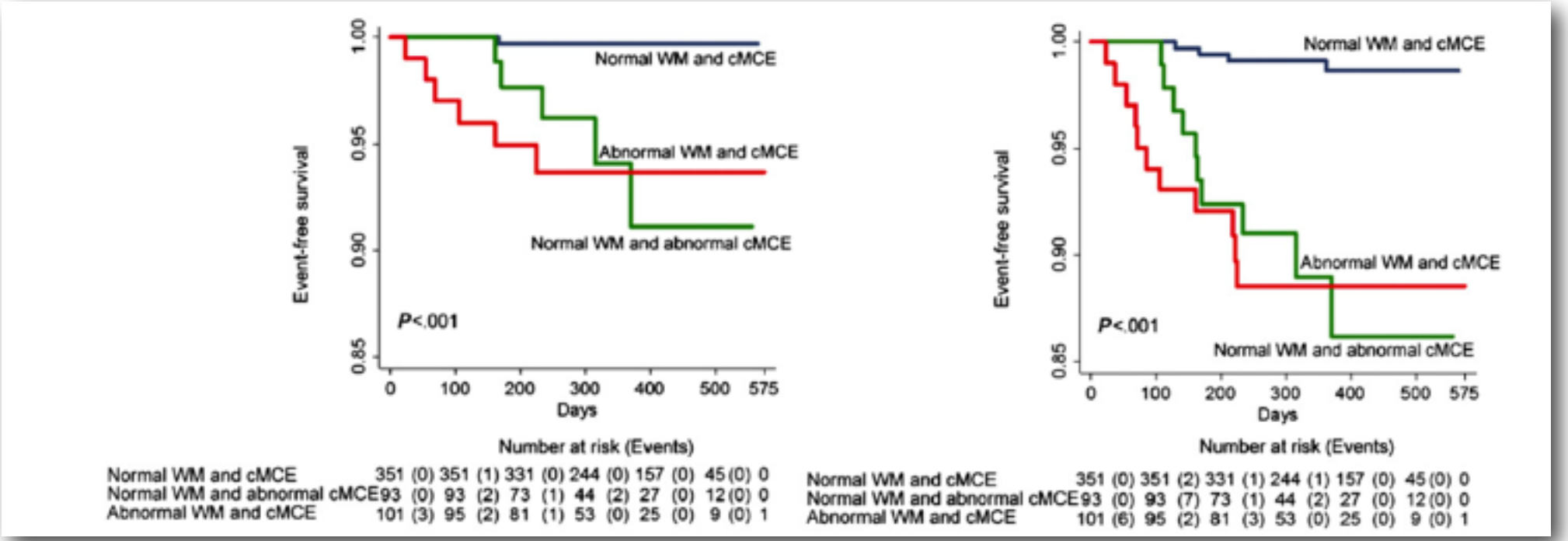
Figure 2 Kaplan-Meier curves for hard (*left*) and combined (*right*) cardiac events when normal versus abnormal cMCE findings are considered. Differences between curves are in both cases statistically significant.

J Am Soc Echocardiogr 2011; 24: 1333-41

Contrast Stress-Echocardiography Predicts Cardiac Events in Patients with Suspected Acute Coronary Syndrome but Nondiagnostic Electrocardiogram and Normal 12-Hour Troponin

Nicola Gaibazzi, MD, PhD, Angelo Squeri, MD, Claudio Reverberi, MD, Sabrina Molinaro, PhD, Valentina Lorenzoni, MSc, Daniele Sartorio, MD, and Roxy Senior, MD, FRCP, FESC, FACC, *Parma and Italy; and London, United Kingdom*





J Am Soc Echocardiogr 2011; 24: 1333-41

Incremental Diagnostic and Prognostic Value of Contemporary Stress Echocardiography in a Chest Pain Unit

Mortality and Morbidity Outcomes From a Real-World Setting

Benoy N. Shah, BSc, MBBS, MRCP*; Gothandaraman Balaji, MBBS, MRCP*;
Abdalla Alhajiri, MB, MRCP, MSc; Ihab S. Ramzy, MD, PhD; Shahram Ahmadvazir, MD, MRCP;
Roxy Senior, MD, DM, FRCP, FESC

849 pts with suspected ACS

Table 2. Cumulative Kaplan-Meier Estimates of Mortality and All Hard Events (Mortality and Acute Myocardial Infarction) in the Normal and Abnormal Stress Echocardiography Groups at Various Points of Follow-up

	Normal SE (n=618)	Abnormal SE (n=184)	Total (n=802)
Follow-up Period	Estimate (95% CI), %	Estimate (95% CI), %	Estimate (95% CI), %
Death			
12 mo	0.3 (0.0–1.3)	4.5 (2.2–8.7)	1.3 (0.7–2.3)
24 mo	1.7 (0.9–3.5)	6.6 (3.7–11.8)	2.8 (1.8–4.5)
36 mo	4.5 (2.2–9.0)	15.8 (7.3–32.2)	6.9 (4.2–11.2)
Death+and nonfatal MI			
12 mo	0.5 (0.2–1.5)	6.6 (3.8–11.3)	1.9 (1.1–3.1)
24 mo	2.3 (1.3–4.2)	9.6 (5.9–15.3)	4.0 (2.7–5.8)
36 mo	5.1 (2.7–9.4)	21.1 (11.5–36.9)	8.6 (5.6–13.1)

AMI indicates acute myocardial infarction; CI, confidence interval; MI, myocardial infarction; and SE, stress echocardiography.

Circ Cardiovasc Imaging. 2013; 6: 202-209

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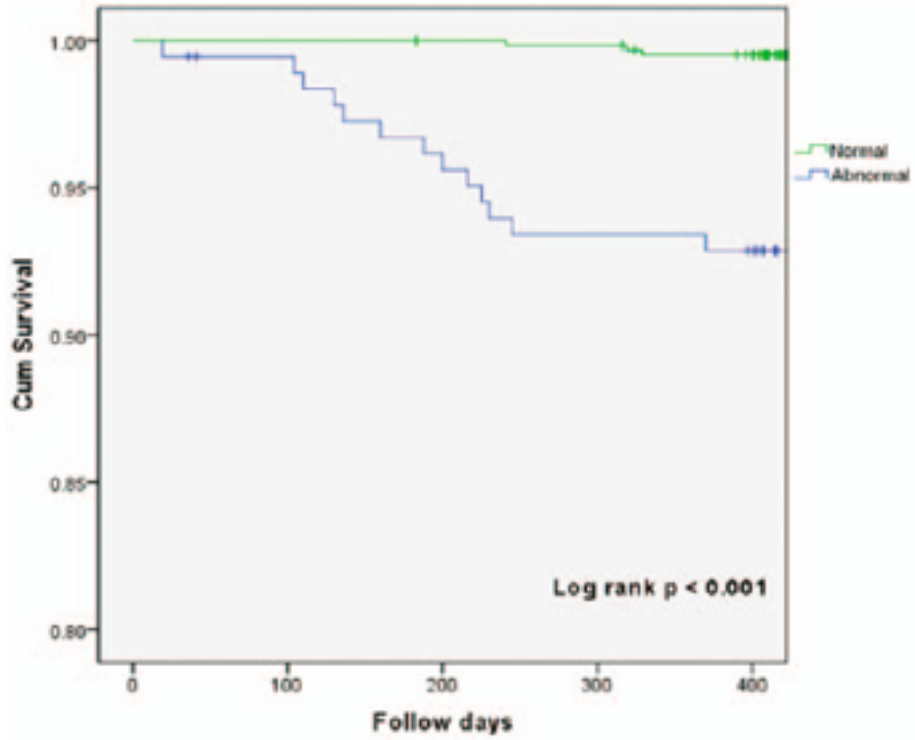

Figure 2. Kaplan-Meier survival estimate of time to any hard event in the first 365 days for patients with normal and abnormal stress echocardiography results.

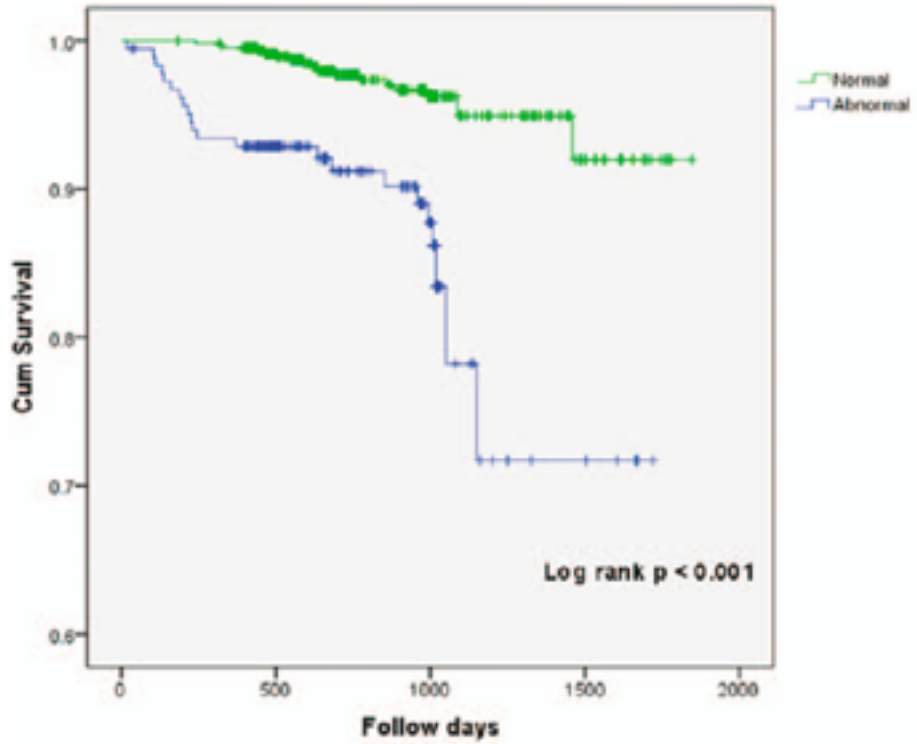

Figure 3. Kaplan-Meier survival estimate of time to any hard event for patients with normal and abnormal stress echocardiography results over a 27±11-month period.

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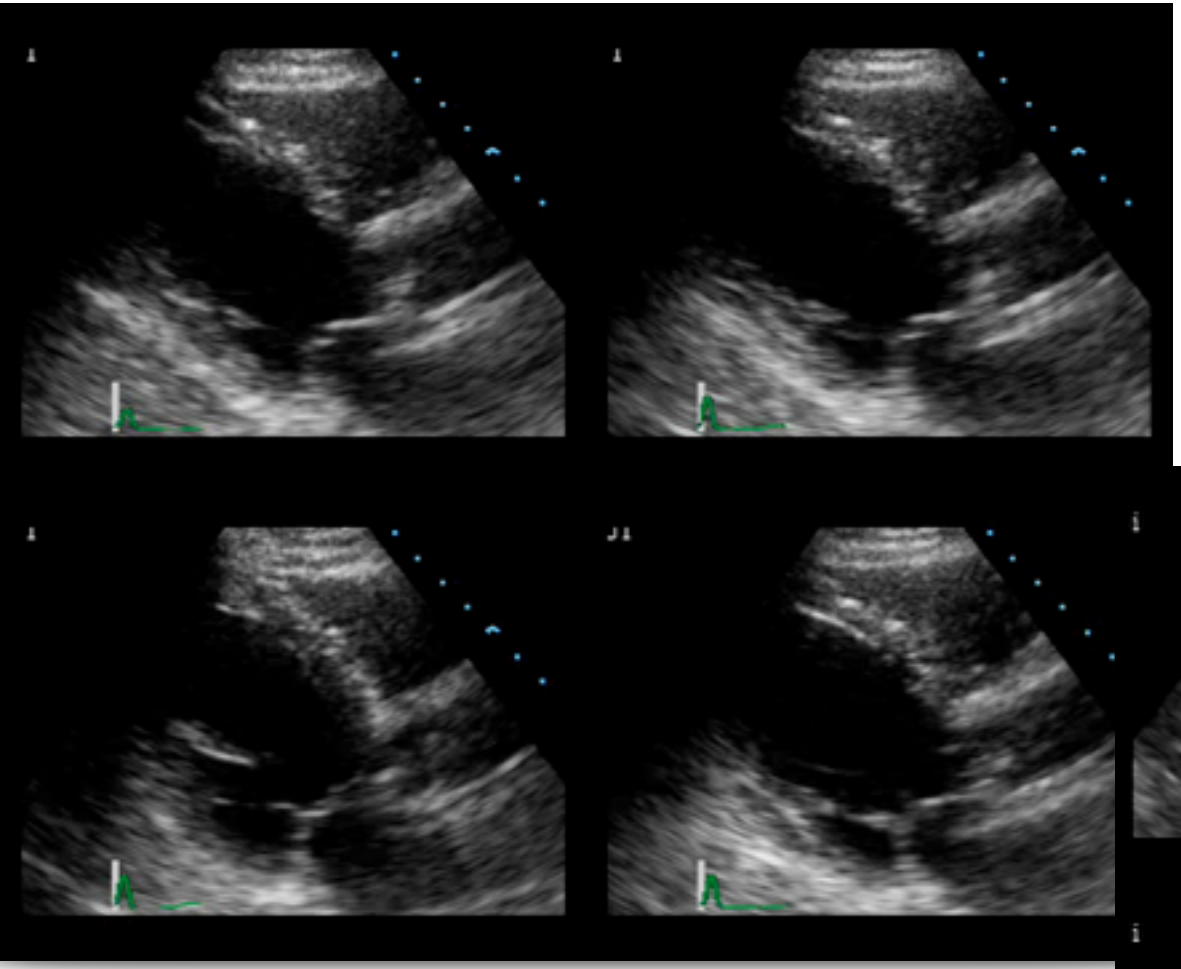

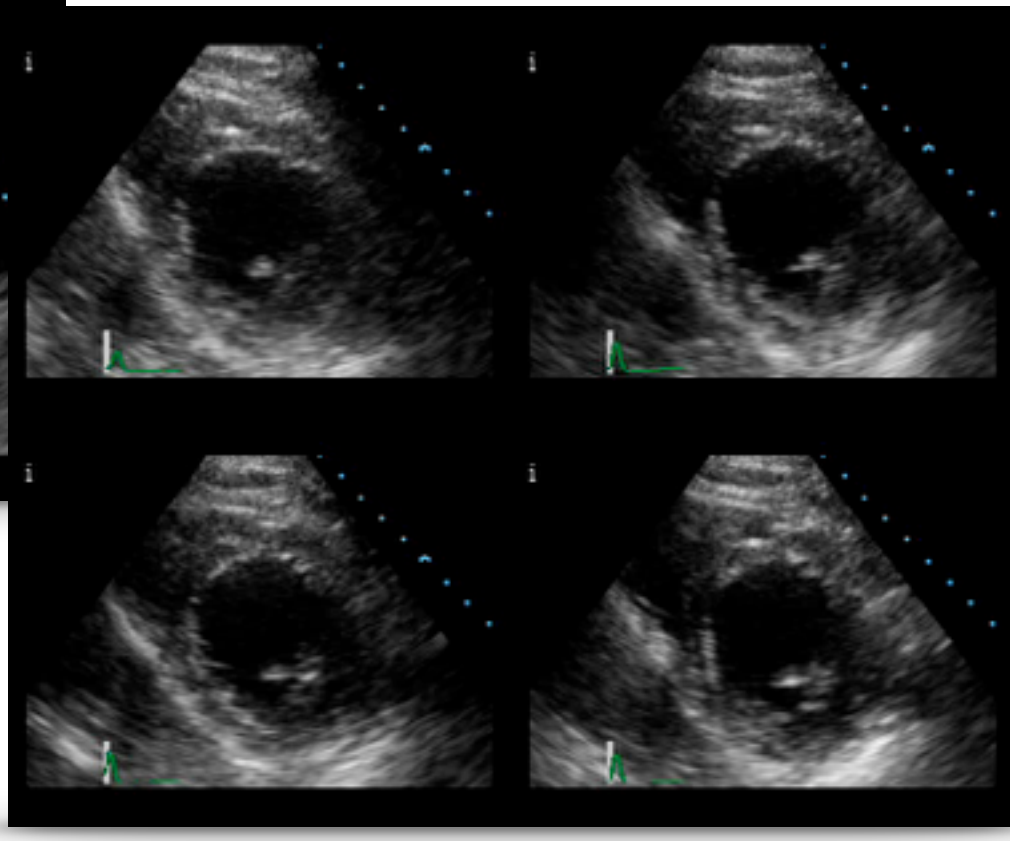

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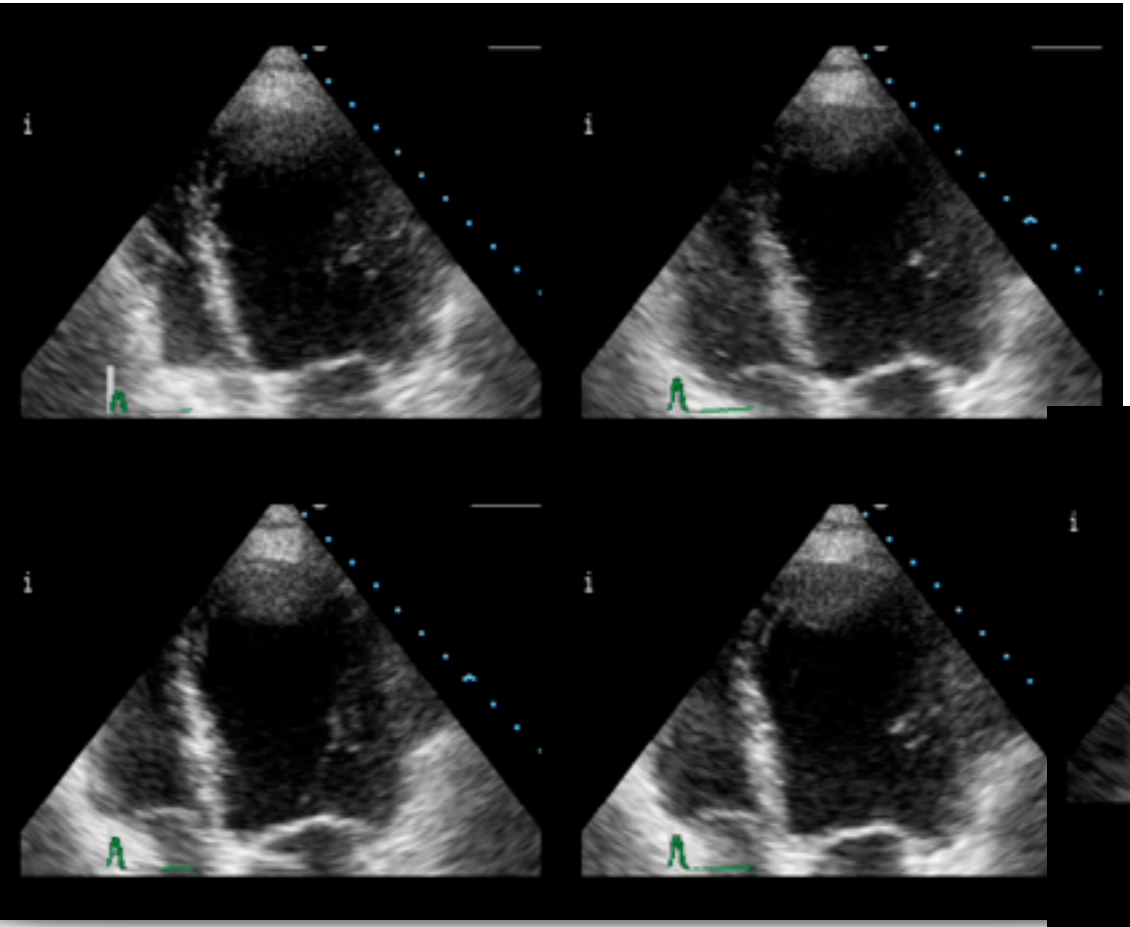
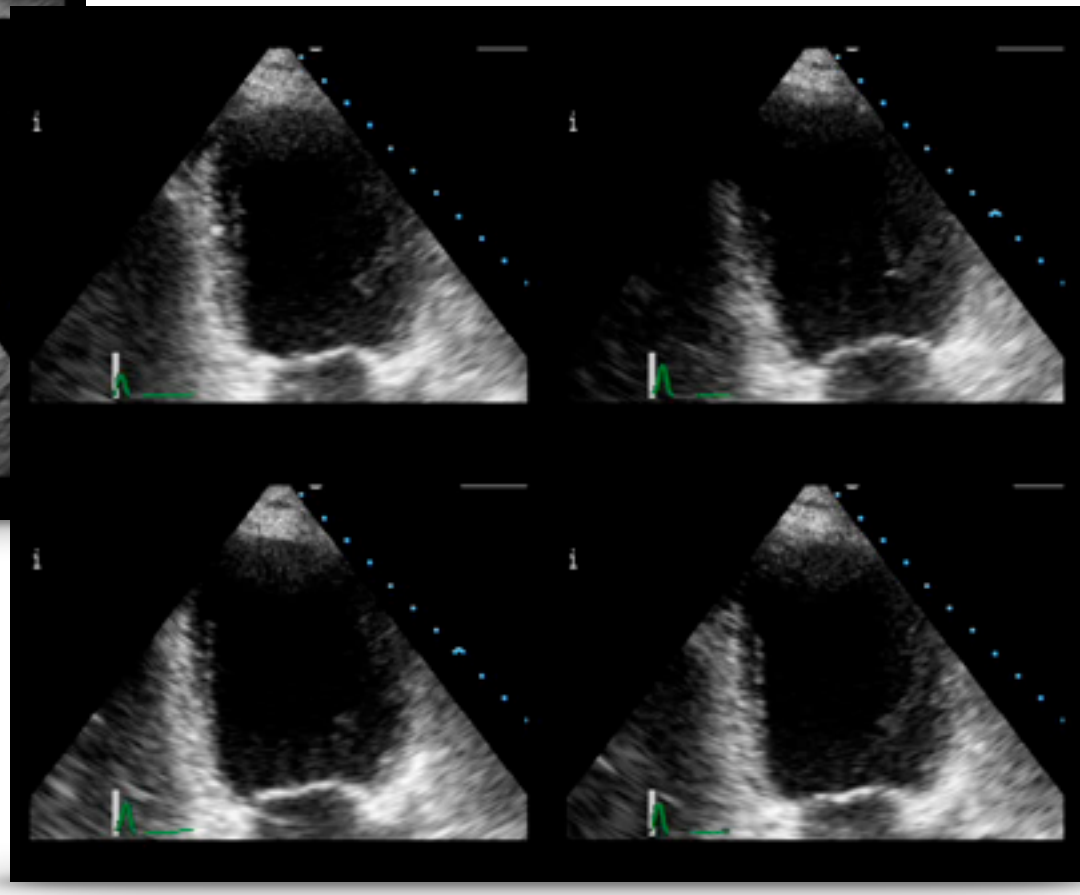
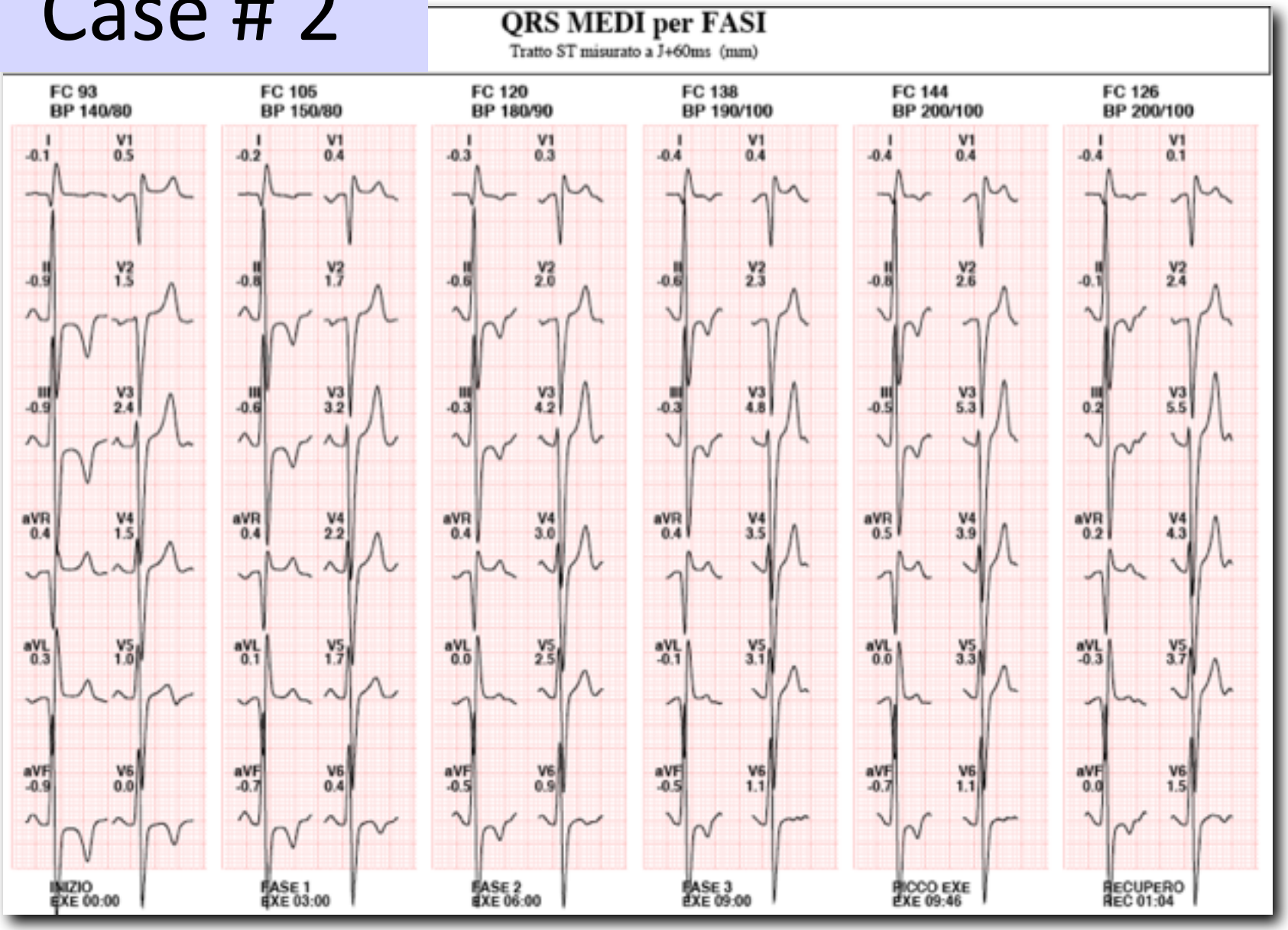




Case # 1

Case # 2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FC 105
BP 150/80
FC 120
BP 180/90
FC 138
BP 190/100
FC 144
BP 200/100
FC 126
BP 200/100
I -0.1
V1 0.5
II -0.9
V2 1.5
III -0.9
V3 2.4
aVR 0.4
V4 1.5
aVL 0.3
V5 1.0
aVF -0.9
V6 0.0
I -0.2
V1 0.4
II -0.8
V2 1.7
III -0.6
V3 3.2
aVR 0.4
V4 2.2
aVL 0.1
V5 1.7
aVF -0.7
V6 0.4
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V1 0.3
II -0.6
V2 2.0
III -0.3
V3 4.2
aVR 0.4
V4 3.0
aVL 0.0
V5 2.5
aVF -0.5
V6 0.9
I -0.4
V1 0.4
II -0.6
V2 2.3
III -0.3
V3 4.8
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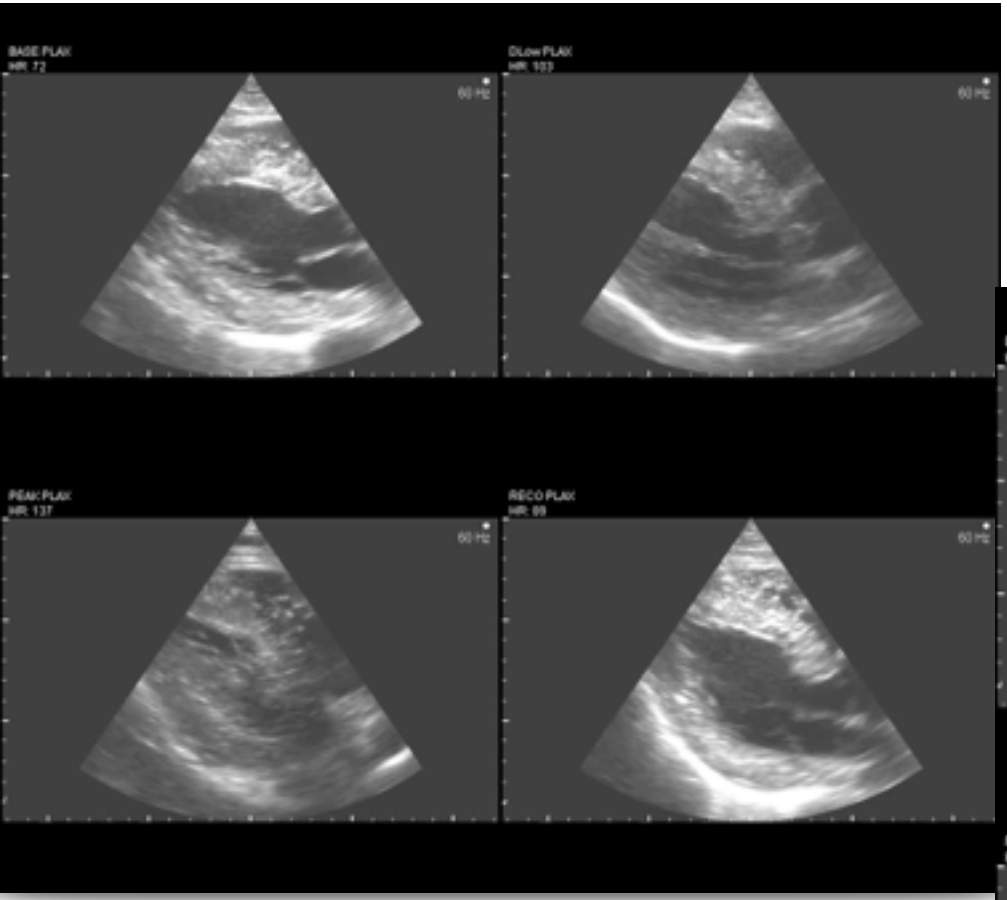
V4 3.5
aVL -0.1
V5 3.1
aVF -0.5
V6 1.1
I -0.4
V1 0.4
II -0.8
V2 2.6
III -0.5
V3 5.3
aVR 0.5
V4 3.9
aVL 0.0
V5 3.3
aVF -0.7
V6 1.1
I -0.4
V1 0.1
II -0.1
V2 2.4
III 0.2
V3 5.5
aVR 0.2
V4 4.3
aVL -0.3
V5 3.7
aVF 0.0
V6 1.5
INIZIO
EXE 00:00
FASE 1
EXE 03:00
FASE 2
EXE 06:00
FASE 3
EXE 09:00
PICCO EXE
EXE 09:46
RECUPERO
REC 01:04

Case # 2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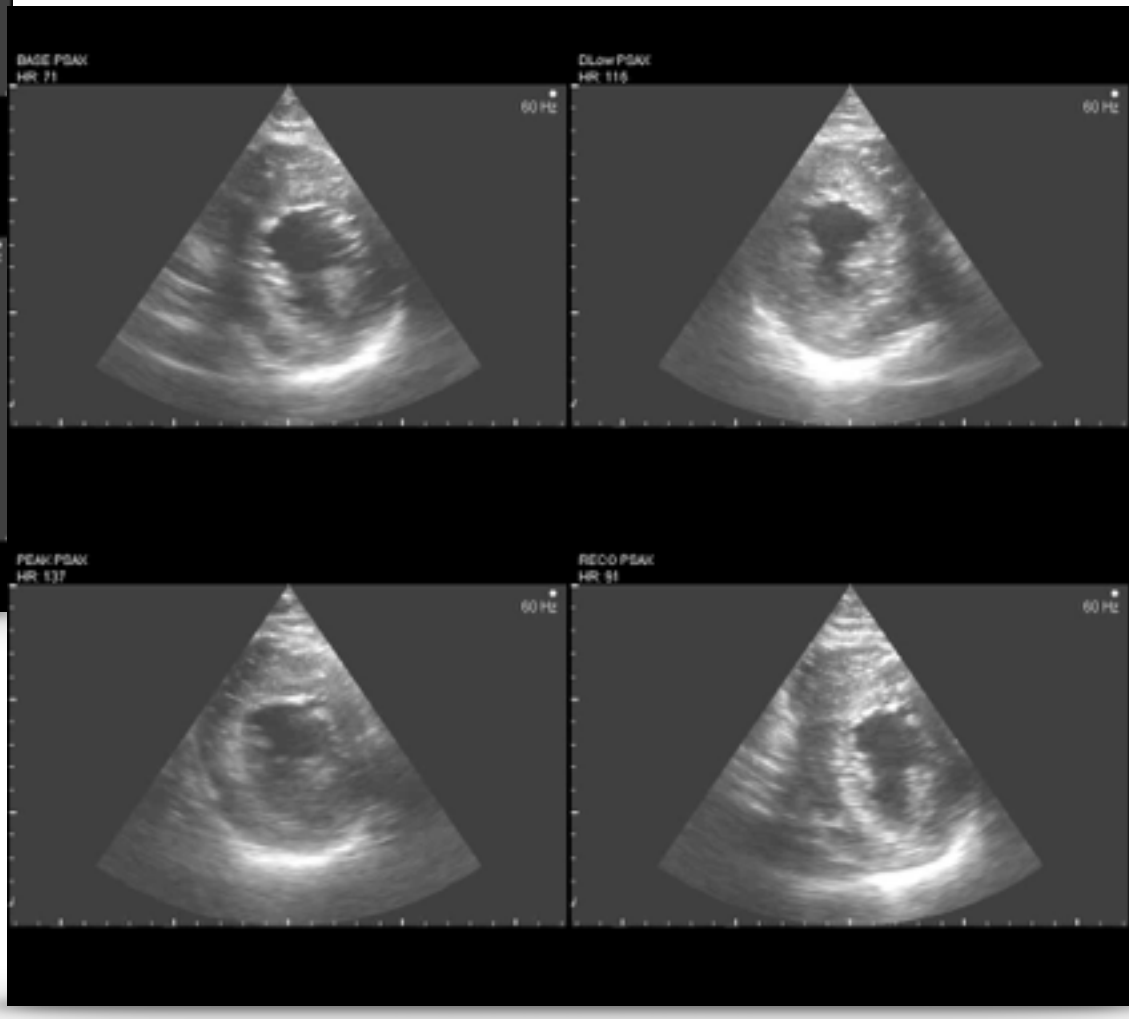
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RECO PSAX
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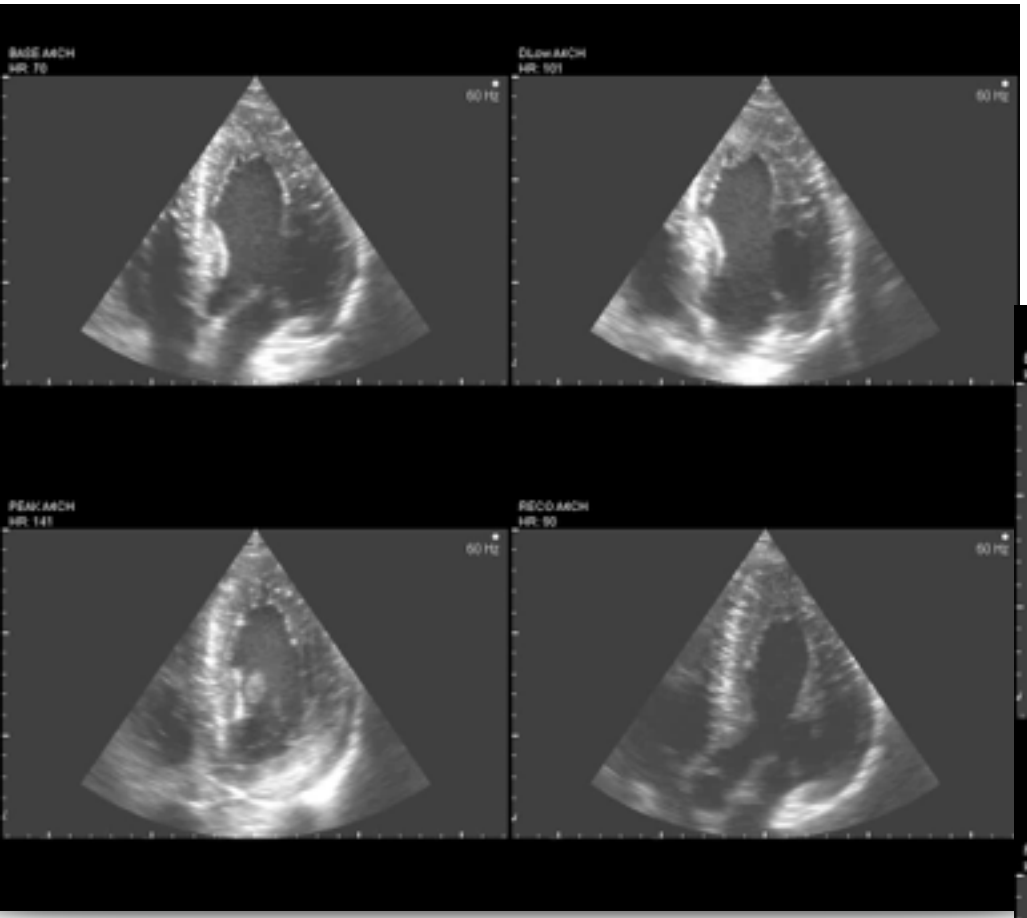
60 Hz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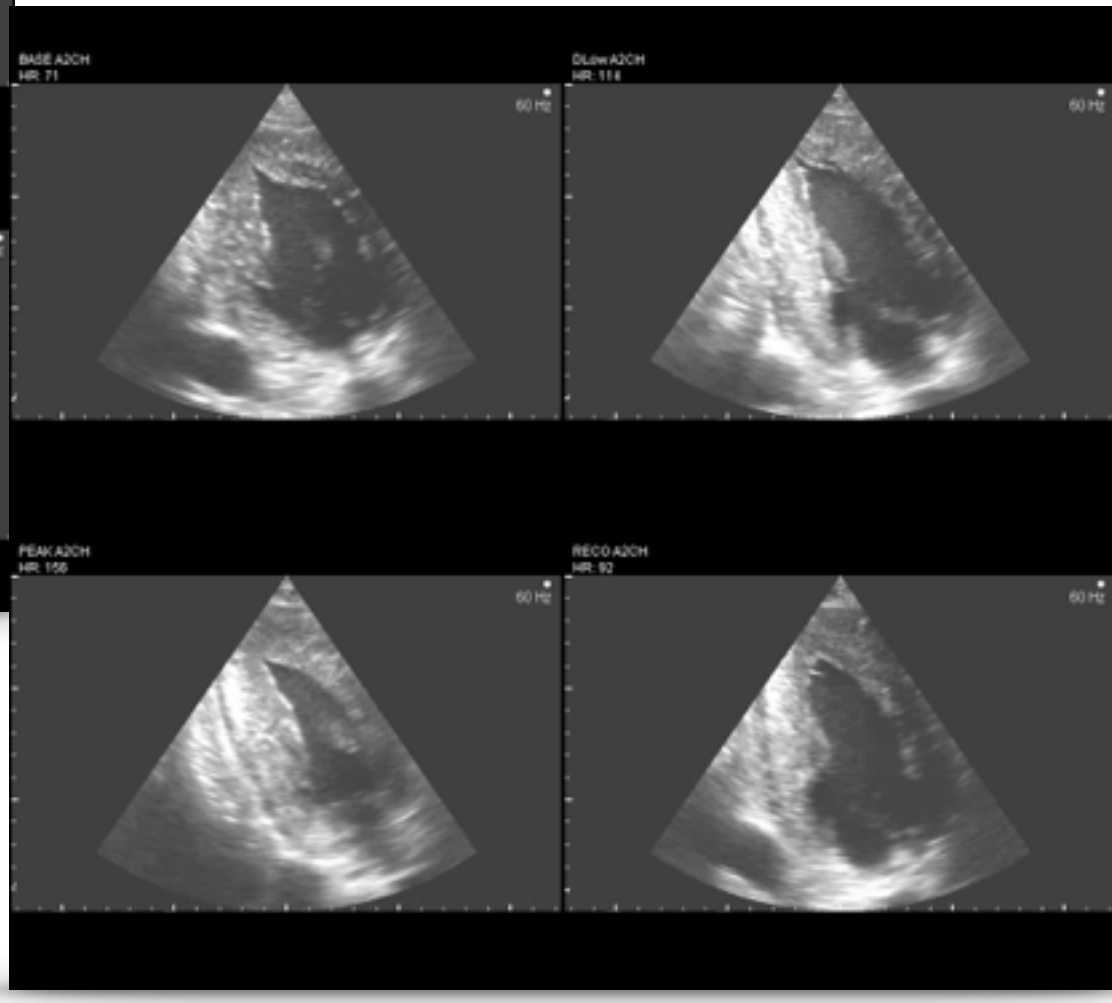
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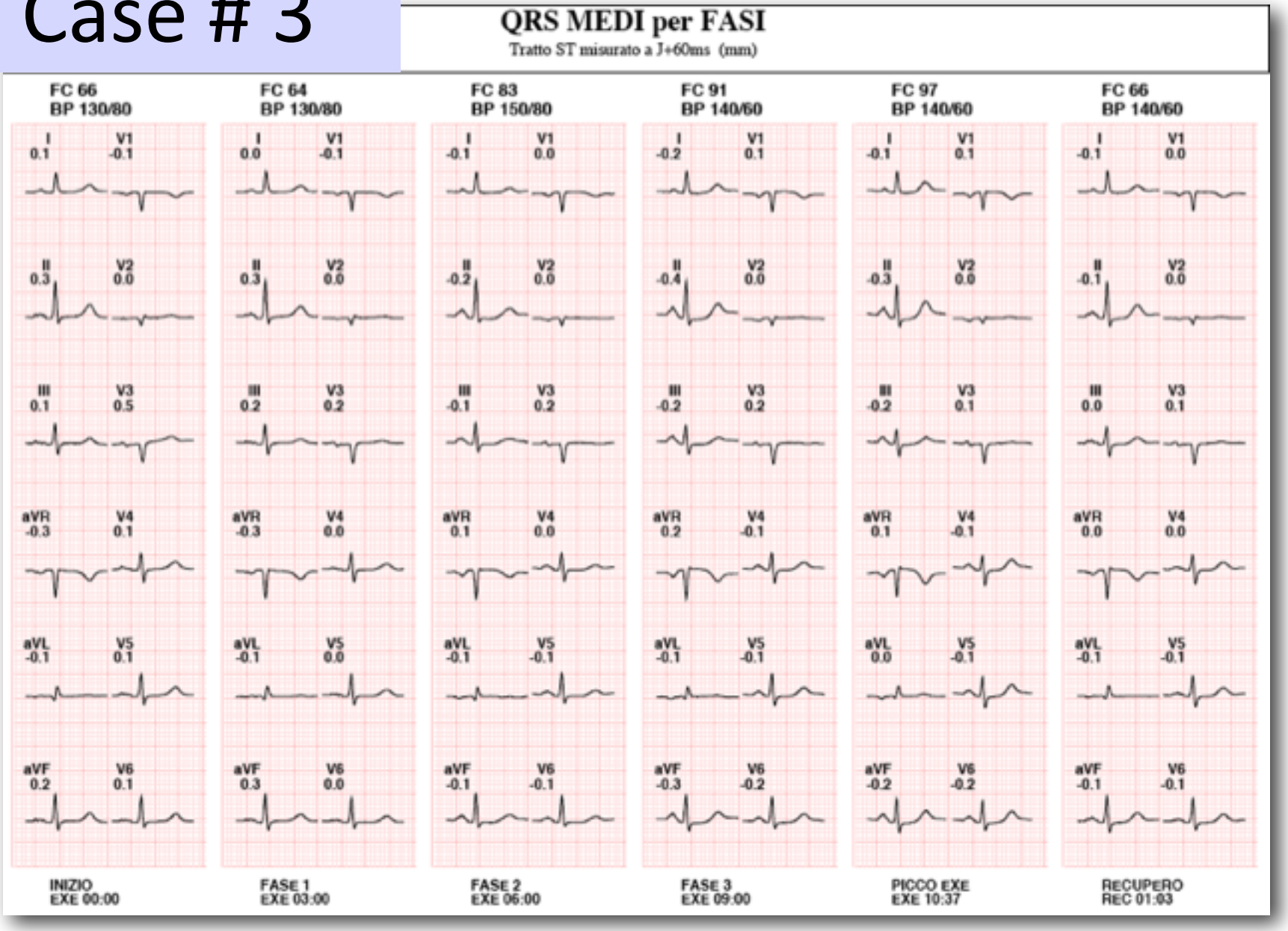
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Tratto ST misurato a J+60ms (mm)
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II 0.3
V2 0.0
III 0.1
V3 0.5
aVR -0.3
V4 0.1
aVL -0.1
V5 0.1
aVF 0.2
V6 0.1
INIZIO
EXE 00:00
FC 64
BP 130/80
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V1 -0.1
II 0.3
V2 0.0
III 0.2
V3 0.2
aVR -0.3
V4 0.0
aVL -0.1
V5 0.0
aVF 0.3
V6 0.0
FASE 1
EXE 03:00
FC 83
BP 150/80
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V1 0.0
II -0.2
V2 0.0
III -0.1
V3 0.2
aVR 0.1
V4 0.0
aVL -0.1
V5 -0.1
aVF -0.1
V6 -0.1
FASE 2
EXE 06:00
FC 91
BP 140/60
I -0.2
V1 0.1
II -0.4
V2 0.0
III -0.2
V3 0.2
aVR 0.2
V4 -0.1
aVL -0.1
V5 -0.1
aVF -0.3
V6 -0.2
FASE 3
EXE 09:00
FC 97
BP 140/60
I -0.1
V1 0.1
II -0.3
V2 0.0
III -0.2
V3 0.1
aVR 0.1
V4 -0.1
aVL 0.0
V5 -0.1
aVF -0.2
V6 -0.2
PICCO EXE
EXE 10:37
FC 66
BP 140/60
I -0.1
V1 0.0
II -0.1
V2 0.0
III 0.0
V3 0.1
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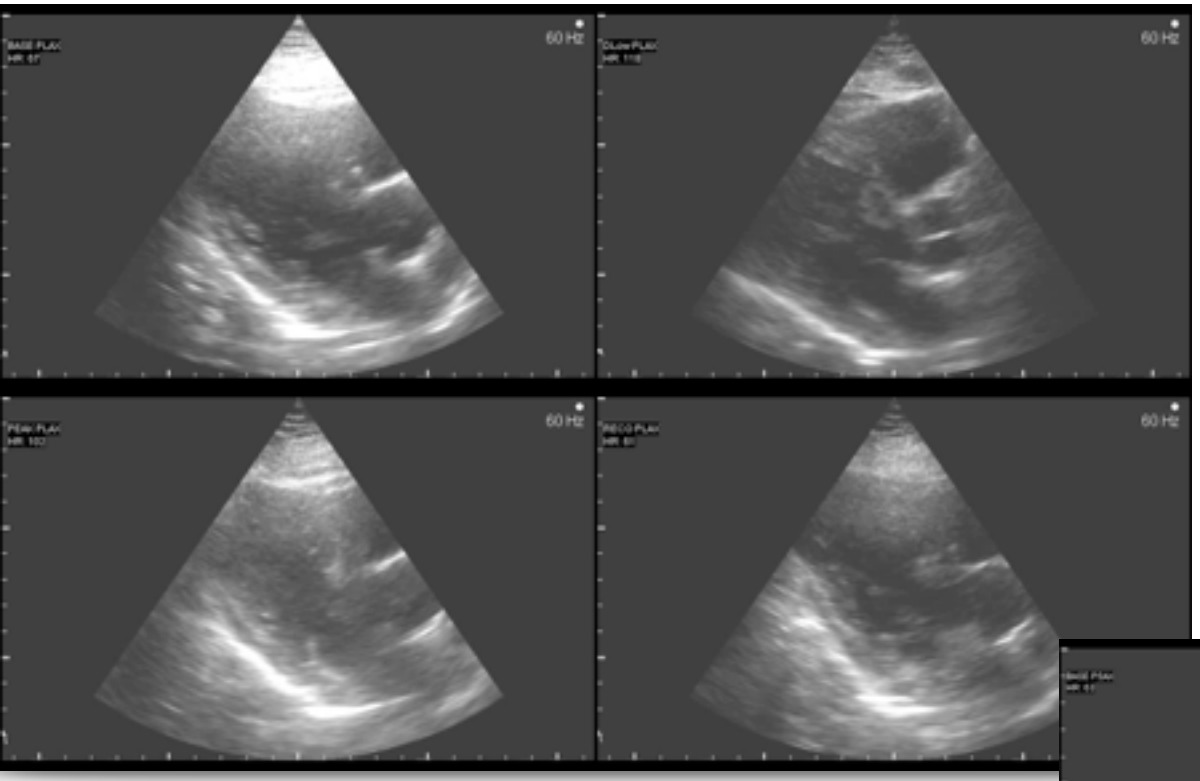
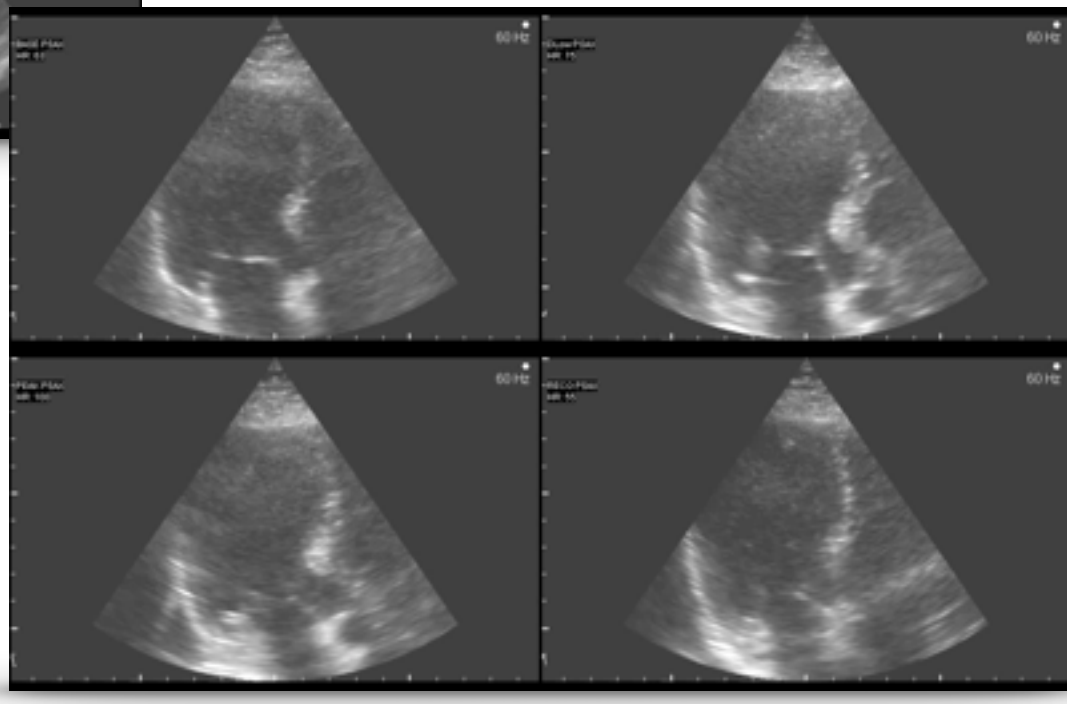
RECUPERO
REC 01:03





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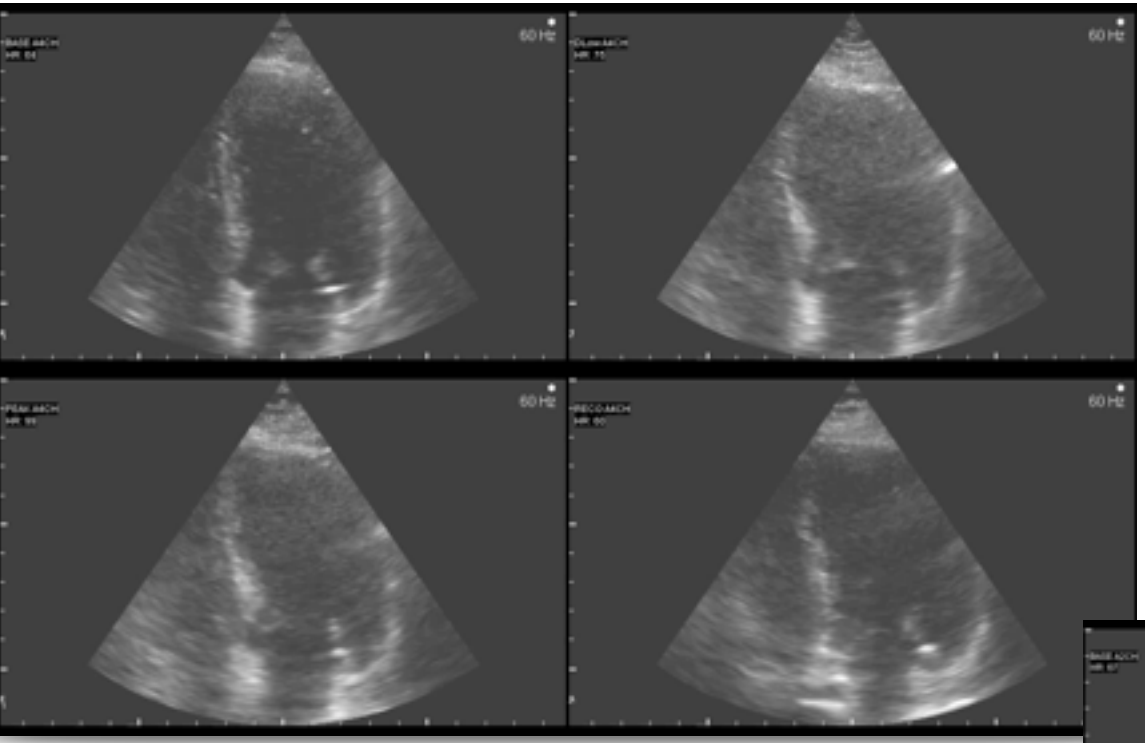
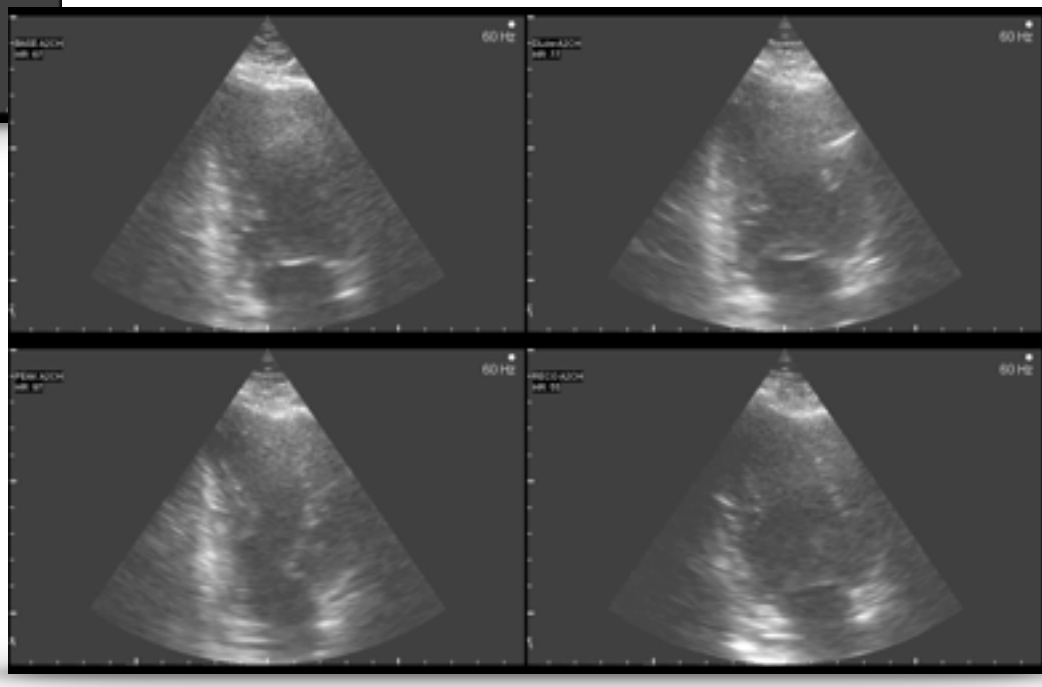
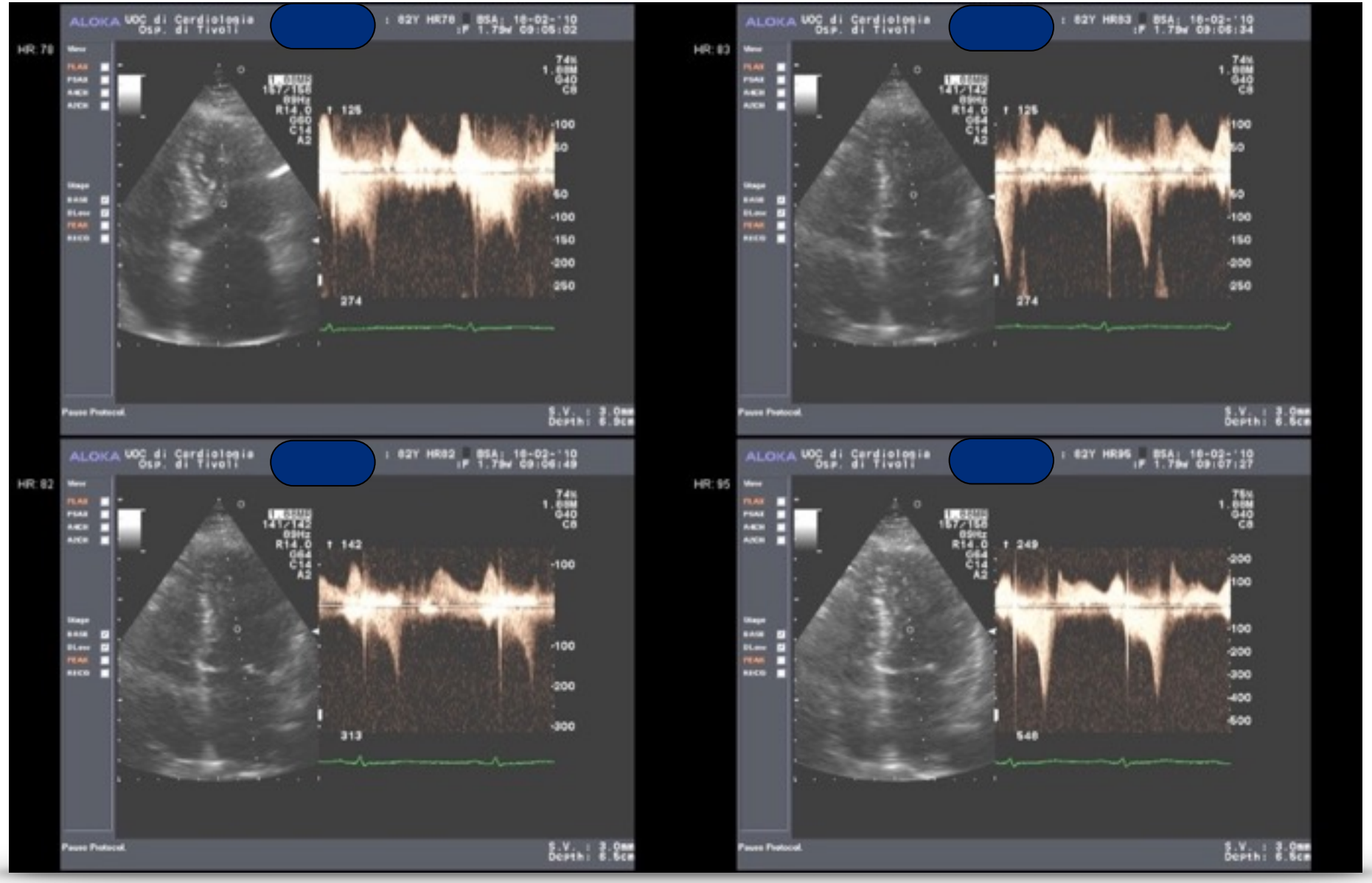




Case # 3

Case # 3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HR: 78
274
ALOKA UOC di Cardiologia Osp. di Tivoli
HR: 83
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HR: 82
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HR: 95
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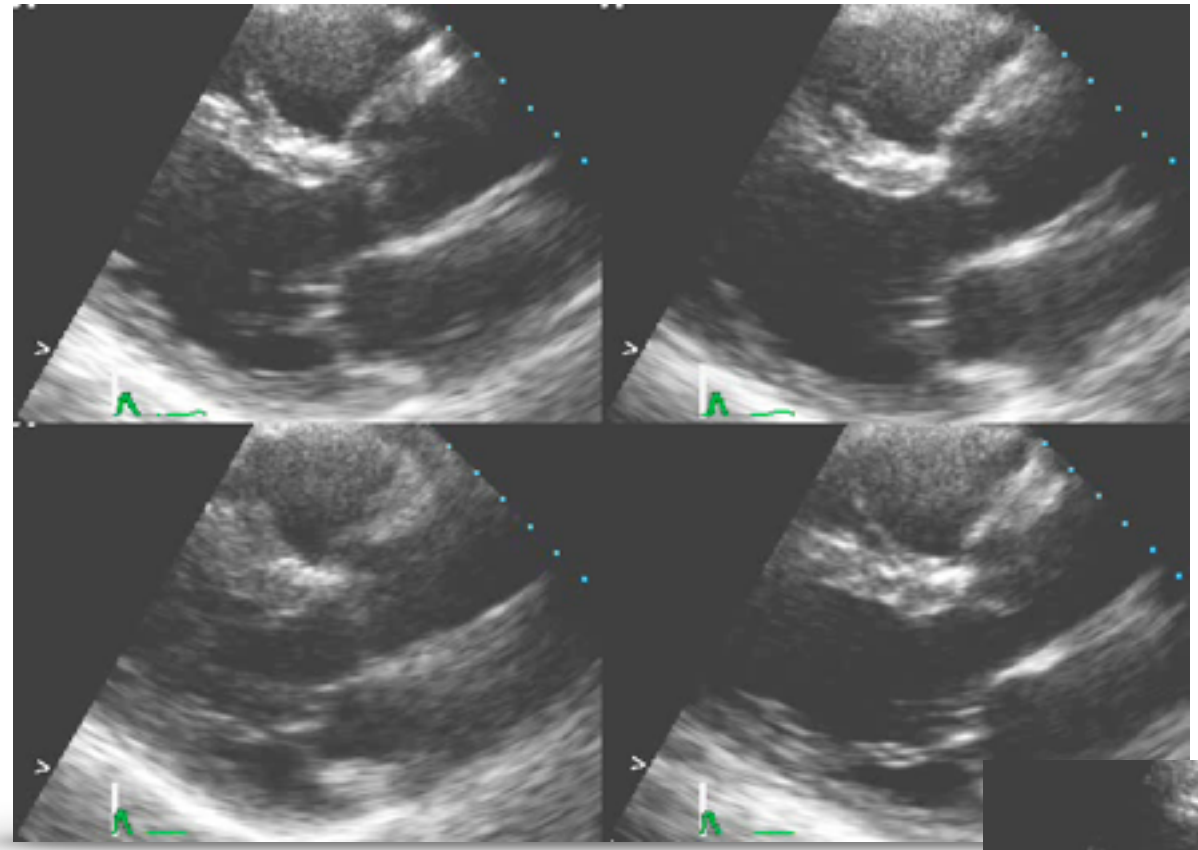

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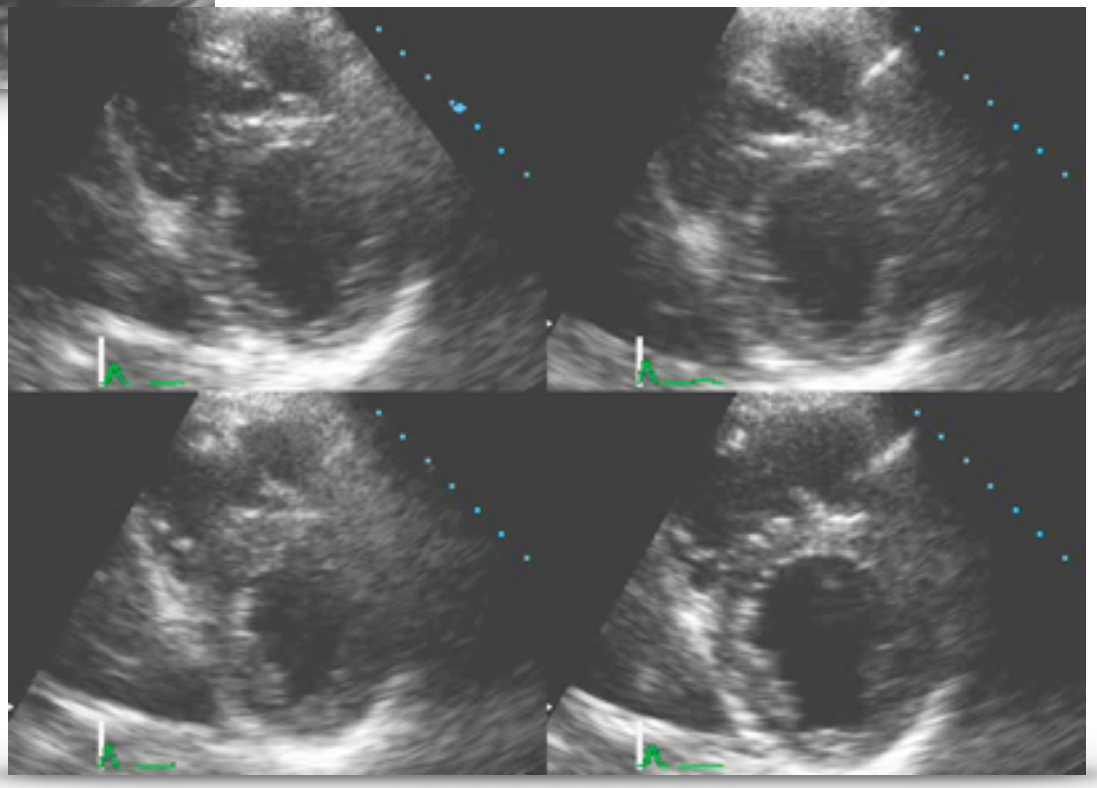

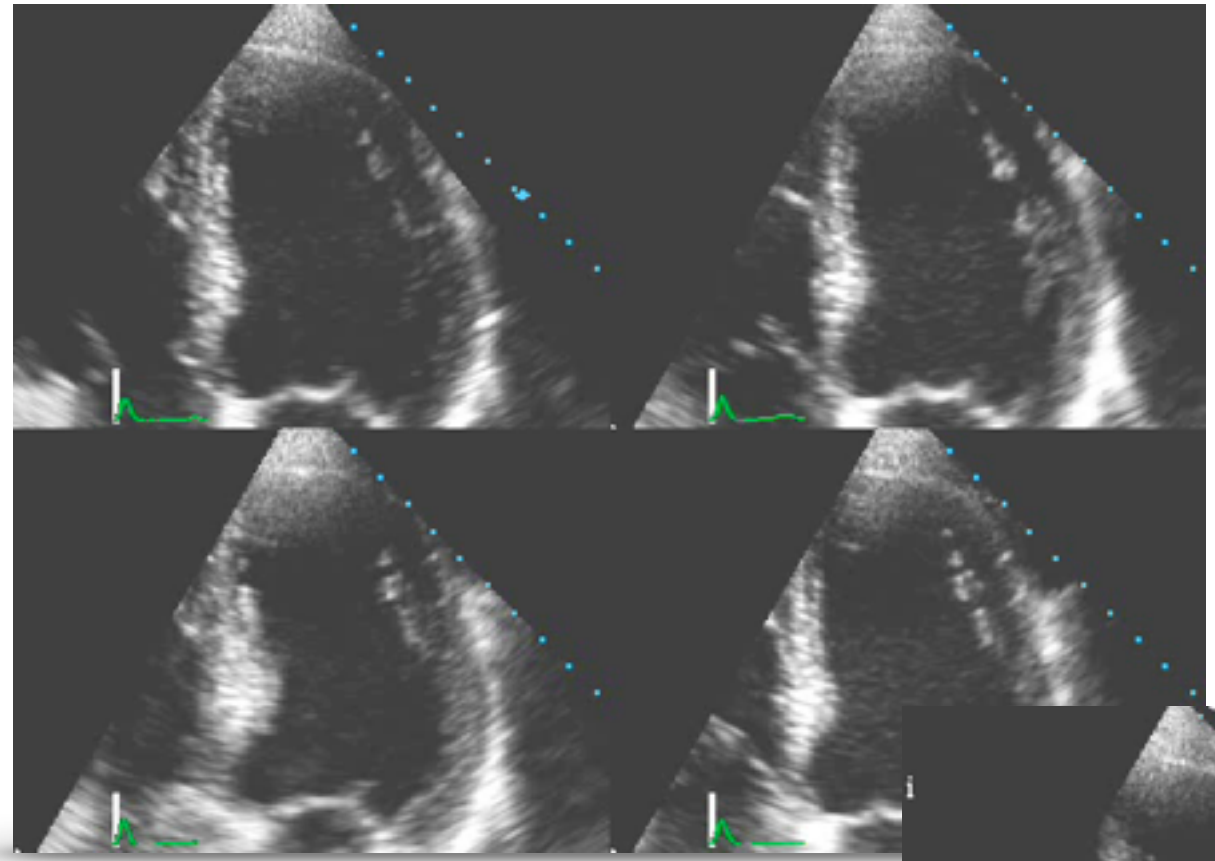

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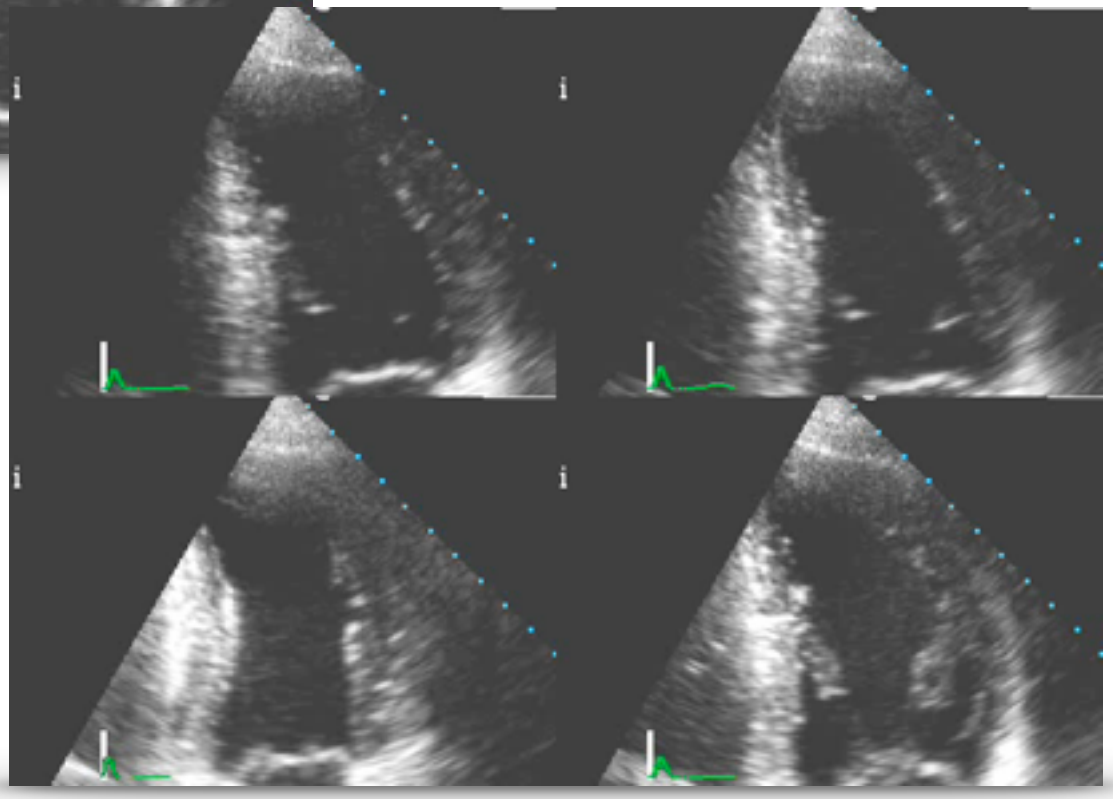
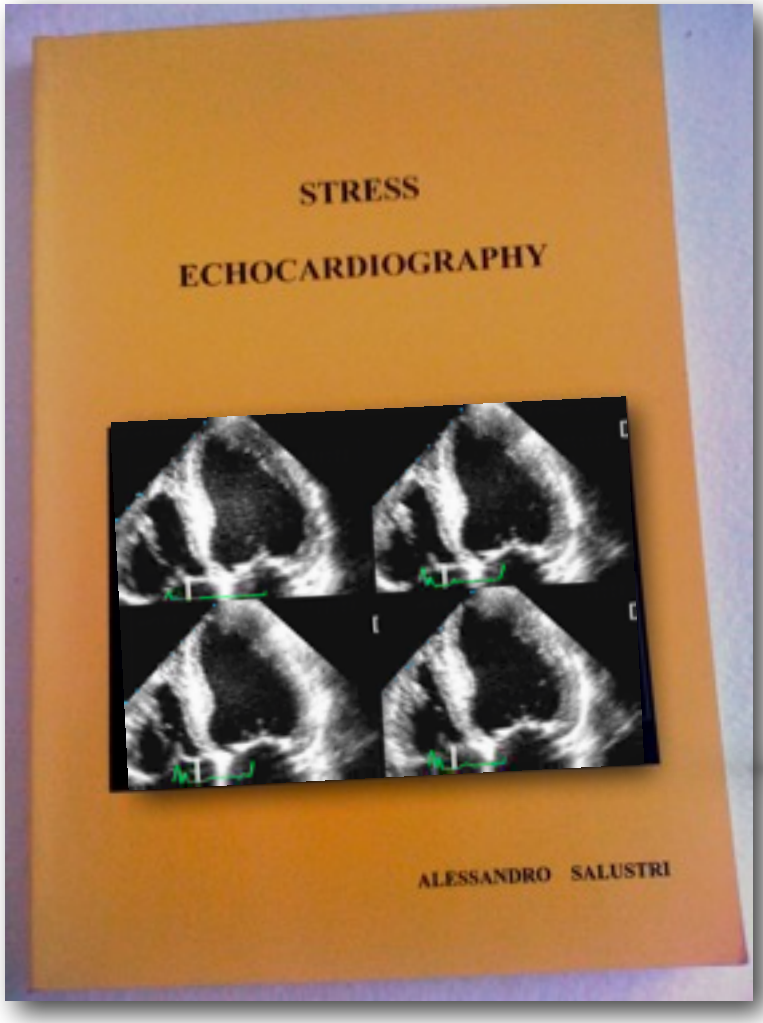
L'ecografia da stress è ancora la vincente?