Ressonància Magnètica en Cardiologia

Estudi de la perfussió miocàrdica a la cardiopatia isquèmica: una alternativa al SPECT?

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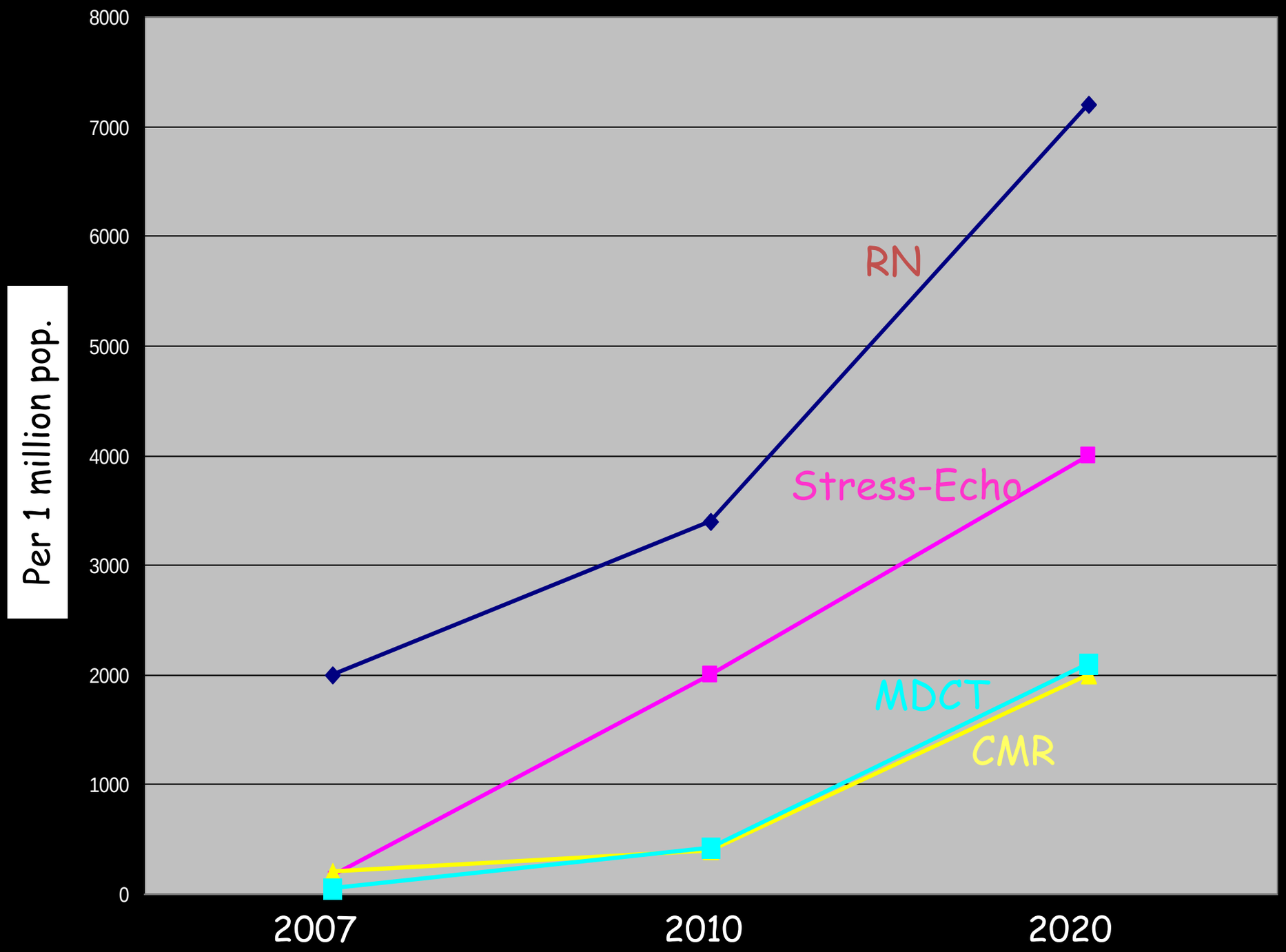
Barcelona

Societat Catalana de Cardiologia, Barcelona 2010

Heart ONLINE

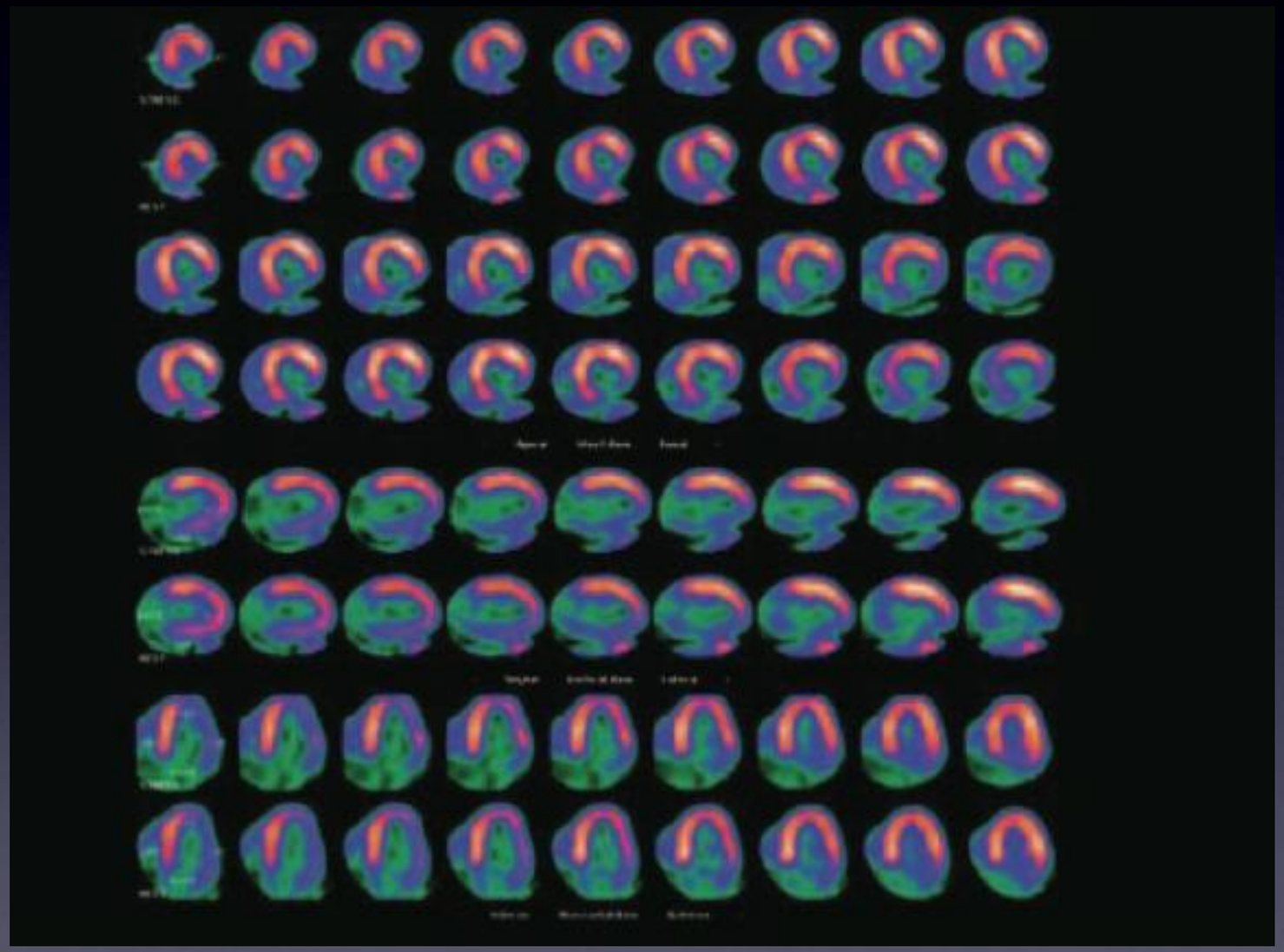
Role of non-invasive imaging in the management of coronary artery disease: an assessment of likely change over the next 10 years. A report from the British Cardiovascular Society Working Group

A H Gershlick, M de Belder, J Chambers, D Hackett, R Keal, A Kelion, S Neubauer, D J Pennell, M Rothman, M Signy and P Wilde



Gershlick et al. Heart 2007;93:423

ECG-gated SPECT



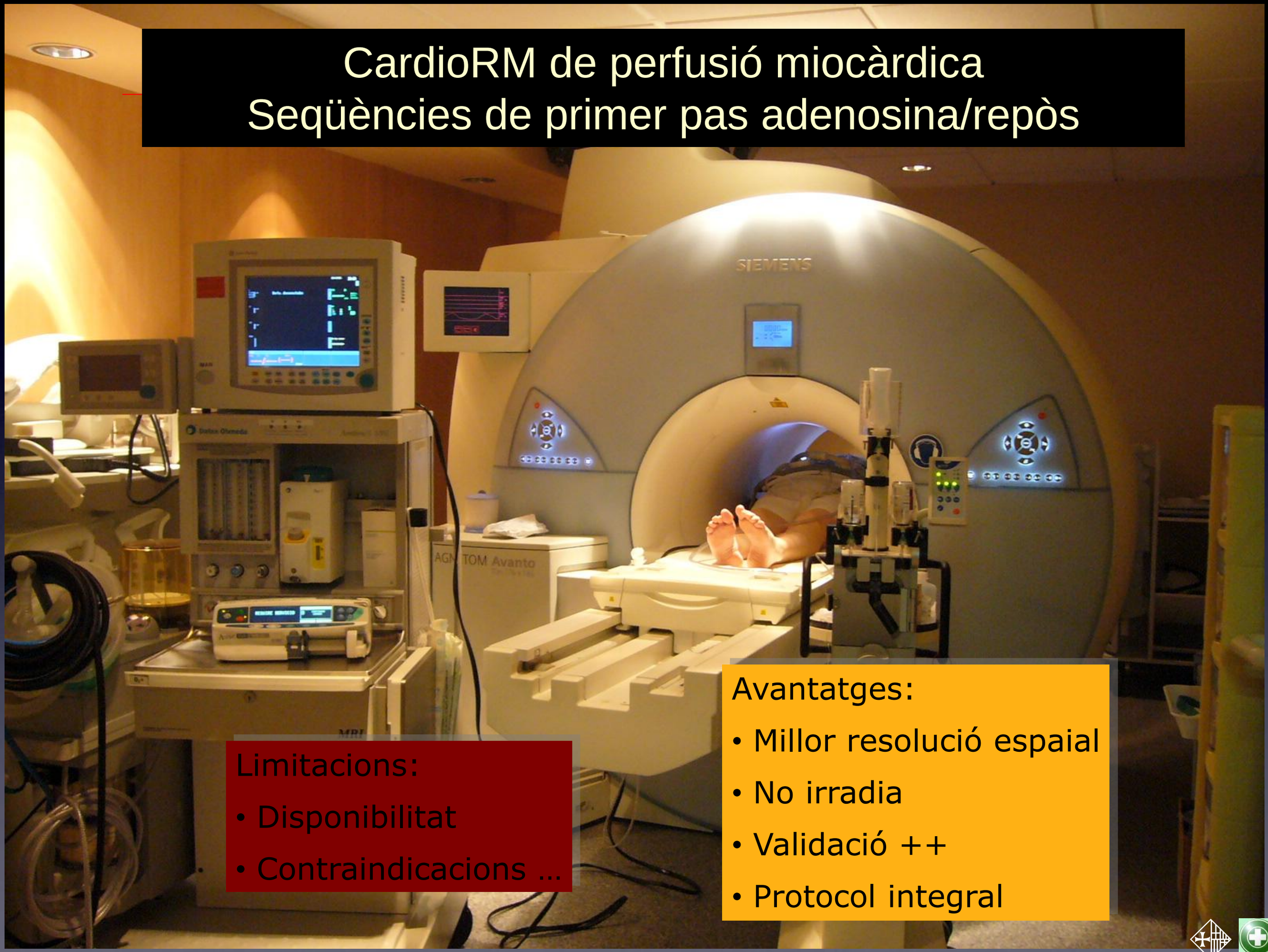
Avantatges:

- Disponibilitat
- Validació +++
- Exercici/Vasodilatadors

Limitacions:

- Baixa resolució espaial
- Atenuació
- Radiació

CardioRM de perfusió miocàrdica
Seqüències de primer pas adenosina/repòs



Limitacions:

- Disponibilitat
- Contraindicacions ...

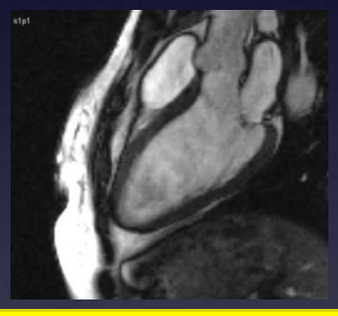
Avantatges:

- Millor resolució espaial
- No irradia
- Validació ++
- Protocol integral

Comprehensive CMR study

Gadolinio
0.1 mmol/Kg

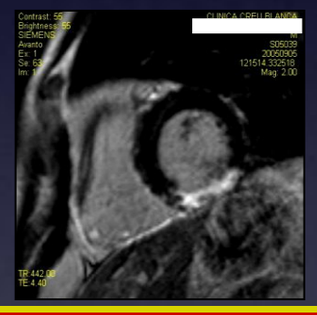
Stress **Perfusion** Study (Adenosine)



LV **Function**
Wall thickness
Contractile Reserve

Gadolinio
0.1 mmol/Kg

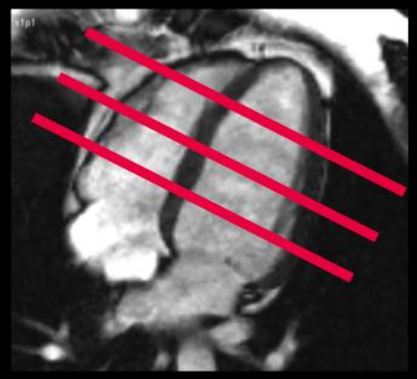
Rest **Perfusion** Study



Contrast-enhancement

40-45 minutes

Estudio de Perfusión Miocárdica por CRM

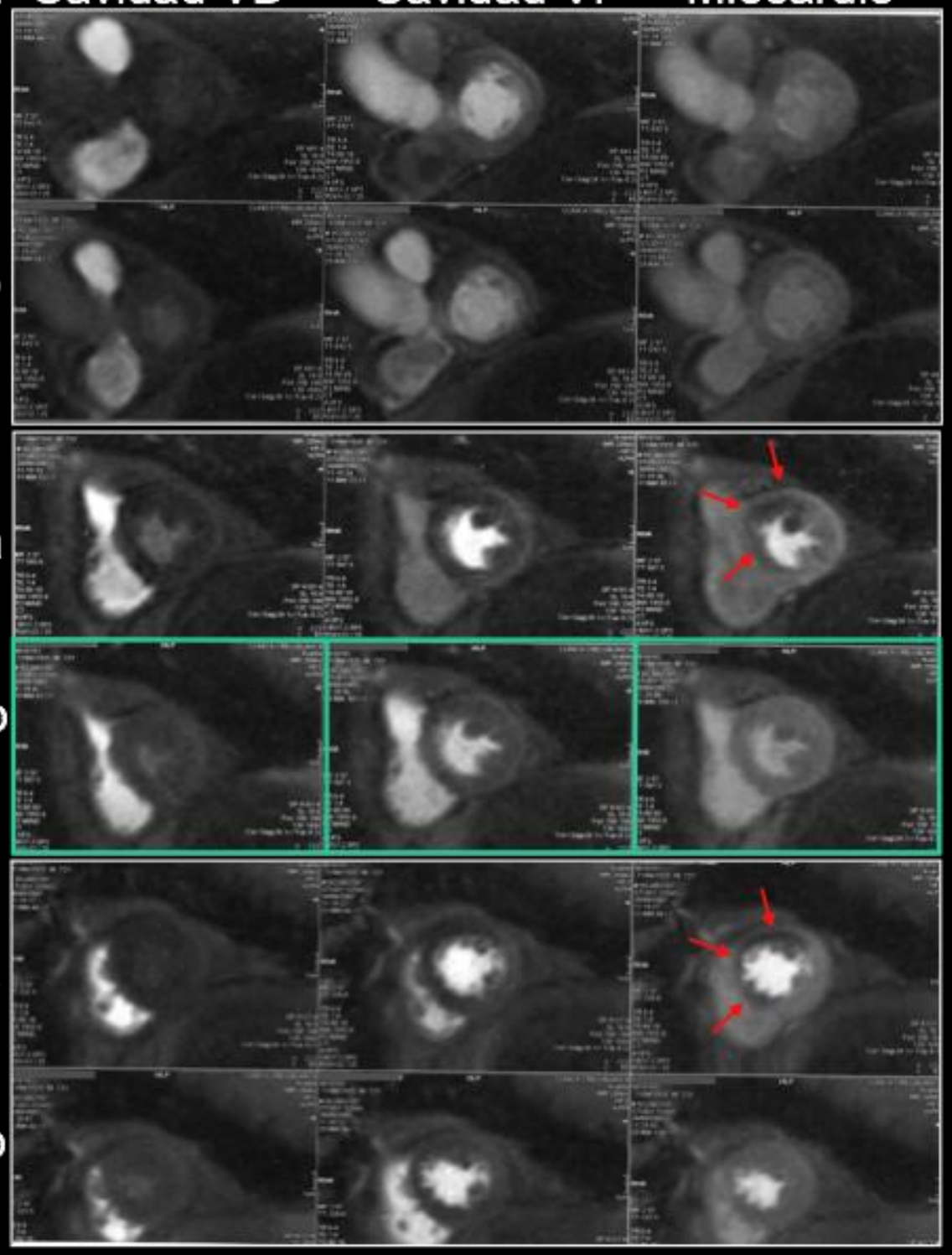


Primer Paso de Gadolinio: Cavidad VD → Cavidad VI → Miocardio

Basal
- Adenosina
- Reposo

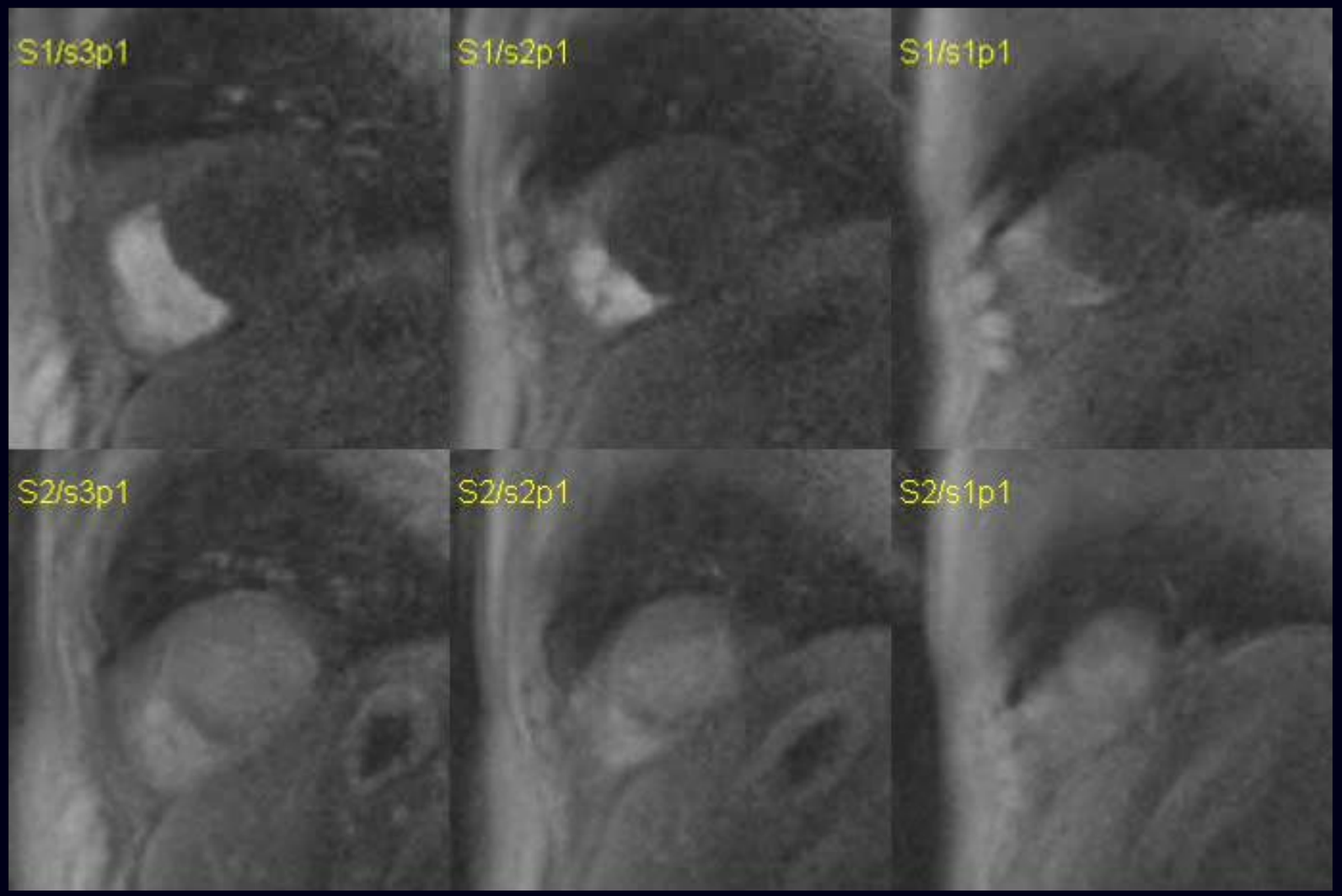
Medial
- Adenosina
- Reposo

Apical
- Adenosina
- Reposo



Estudio de Perfusión Miocárdica por CRM

Perfusión Adenosina



Perfusión Reposo

Assessment of Myocardial Perfusion in Coronary Artery Disease by Magnetic Resonance

A Comparison With Positron Emission Tomography and Coronary Angiography

J. Schwitter, MD; D. Nanz, PhD; S. Kneifel, MD; K. Bertschinger, MD; M. Büchi, MD; P.R. Knüsel, MD; B. Marincek, MD; T.F. Lüscher, MD; G.K. von Schulthess, MD, PhD

Circulation. 2001;103:2230-2235.

S:87% E:85%

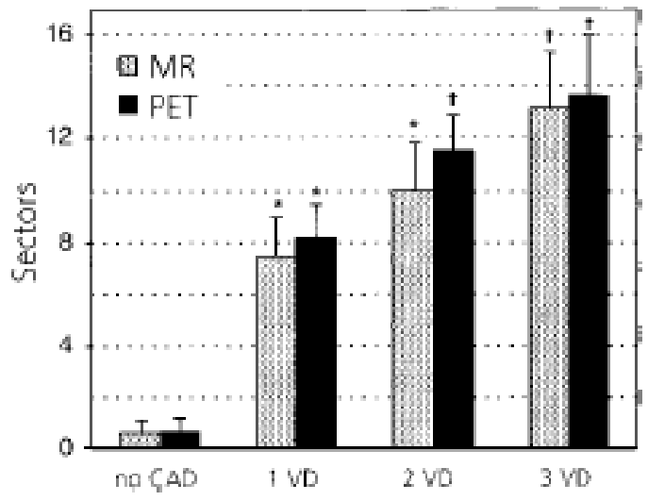


Figure 4. Comparison of pathological sectors, as defined by MR and PET, in patients with 1-, 2-, and 3-vessel disease (VD) and no disease (for details, see Results). There was a trend toward underestimation of the extent of disease by MR ($P=0.22$ vs PET). *$P<0.05$ vs no disease, †$P<0.01$ vs no disease (2-way ANOVA for repeated measures, Bonferroni-corrected; error bars represent SEM).

CMR vs PET

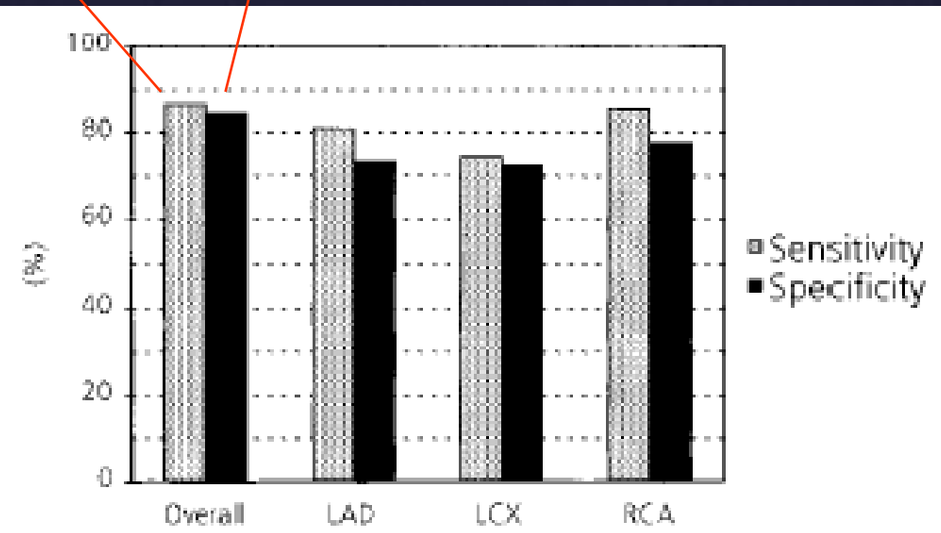


Figure 6. For all 3 coronary arteries, the sensitivities and specificities of subendocardial MR data to detect ≥50% stenoses, as defined by QCA, were similar, indicating that the quality of MR data was similar throughout the left ventricular myocardium.

CMR vs QCA

Noninvasive Assessment of Myocardial Perfusion

Michael Salerno, MD, PhD; George A. Beller, MD

Table 2. Pooled Diagnostic Performance of Perfusion Imaging Techniques

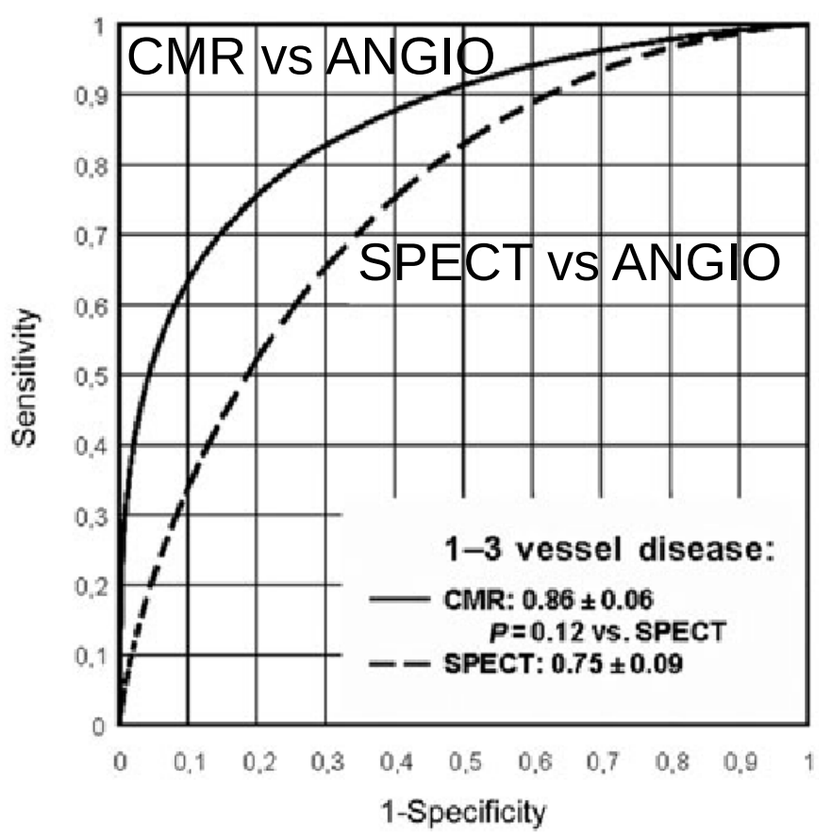
Modality	n	CAD Prevalence	Sensitivity	Specificity
SPECT[27]	4480	76%	0.87 (0.86–0.88)	0.73 (0.70–0.76)
PET[38]	1442	77%	0.85 (0.79–0.90)	0.87 (0.84–0.90)
CMR[75]	1516	57%	0.91 (0.88–0.94)	0.81 (0.77–0.85)
Echocardiography[46]	1088	69%	0.82 (0.76–0.88)	0.80 (0.73–0.87)

Circ Cardiovasc Imaging 2009;2;412-424;

European Heart Journal

MR-IMPACT: comparison of perfusion-cardiac magnetic resonance with single-photon emission computed tomography for the detection of coronary artery disease in a multicentre, multivendor, randomized trial

Juerg Schwitter[1]*, Christian M. Wacker[2], Albert C. van Rossum[3], Massimo Lombardi[4], Nidal Al-Saadi[5], Hakan Ahlstrom[6], Thorsten Dill[7], Henrik B.W. Larsson[8], Scott D. Flamm[9], Moritz Marquardt[10], and Lars Johansson[6]



European Heart Journal (2008) **29**, 480–489

European Heart Journal (2008) **29**, 480–489
doi:10.1093/eurheartj/ehm617

CLINICAL RESEARCH
Imaging

MR-IMPACT: comparison of perfusion-cardiac magnetic resonance with single-photon emission computed tomography for the detection of coronary artery disease in a multicentre, multivendor, randomized trial

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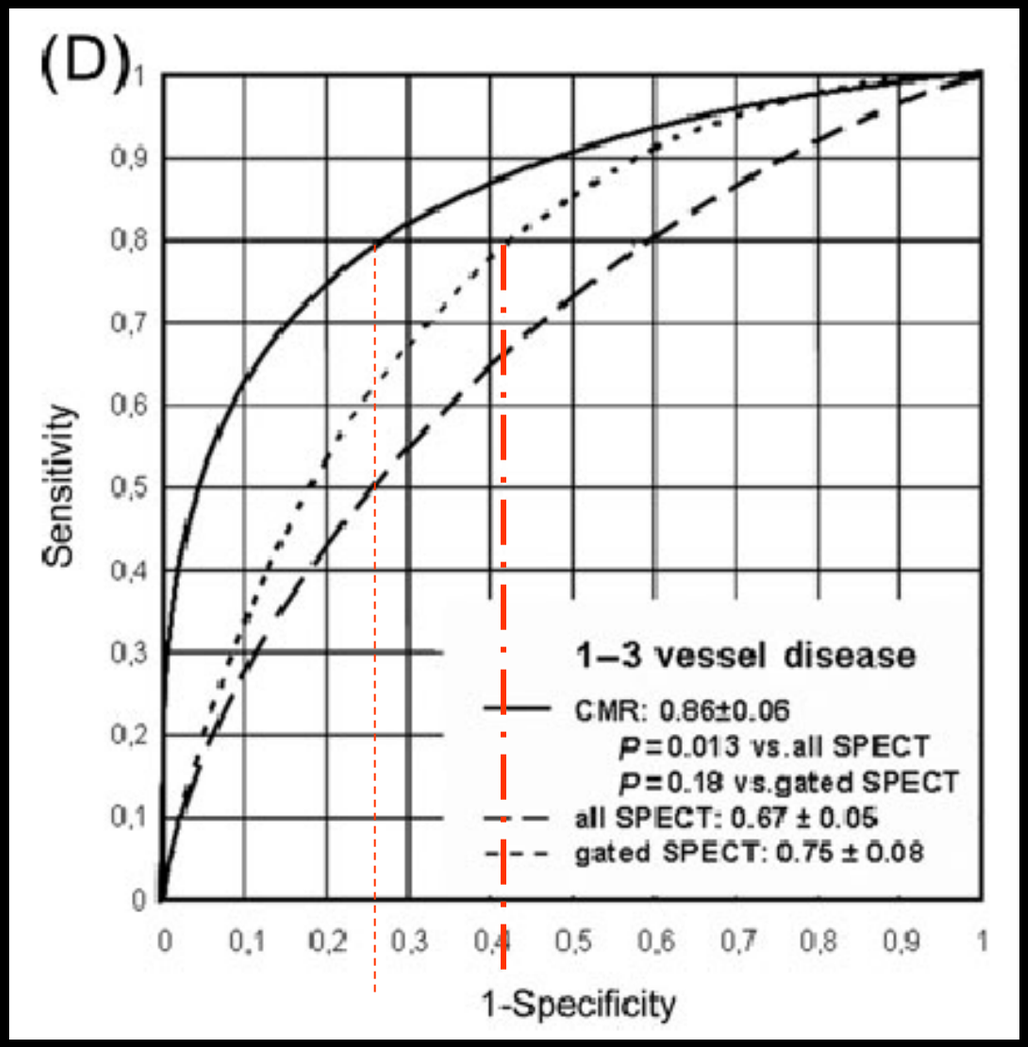


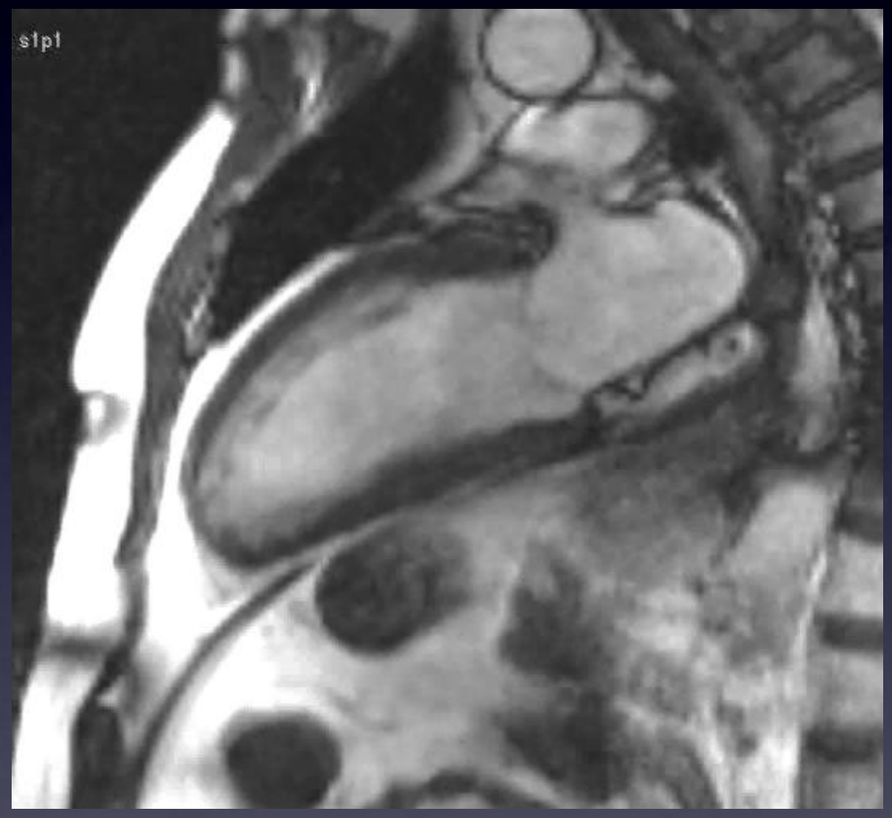
N= 241; CAD= stenosis > 50%
Non evaluable studies:
MRI: 4.8%, SPECT: 5.3%

Detection of CAD: MRI Sens: 80%, spec: 73%
SPECT gated Sens: 80%, spec: 58%

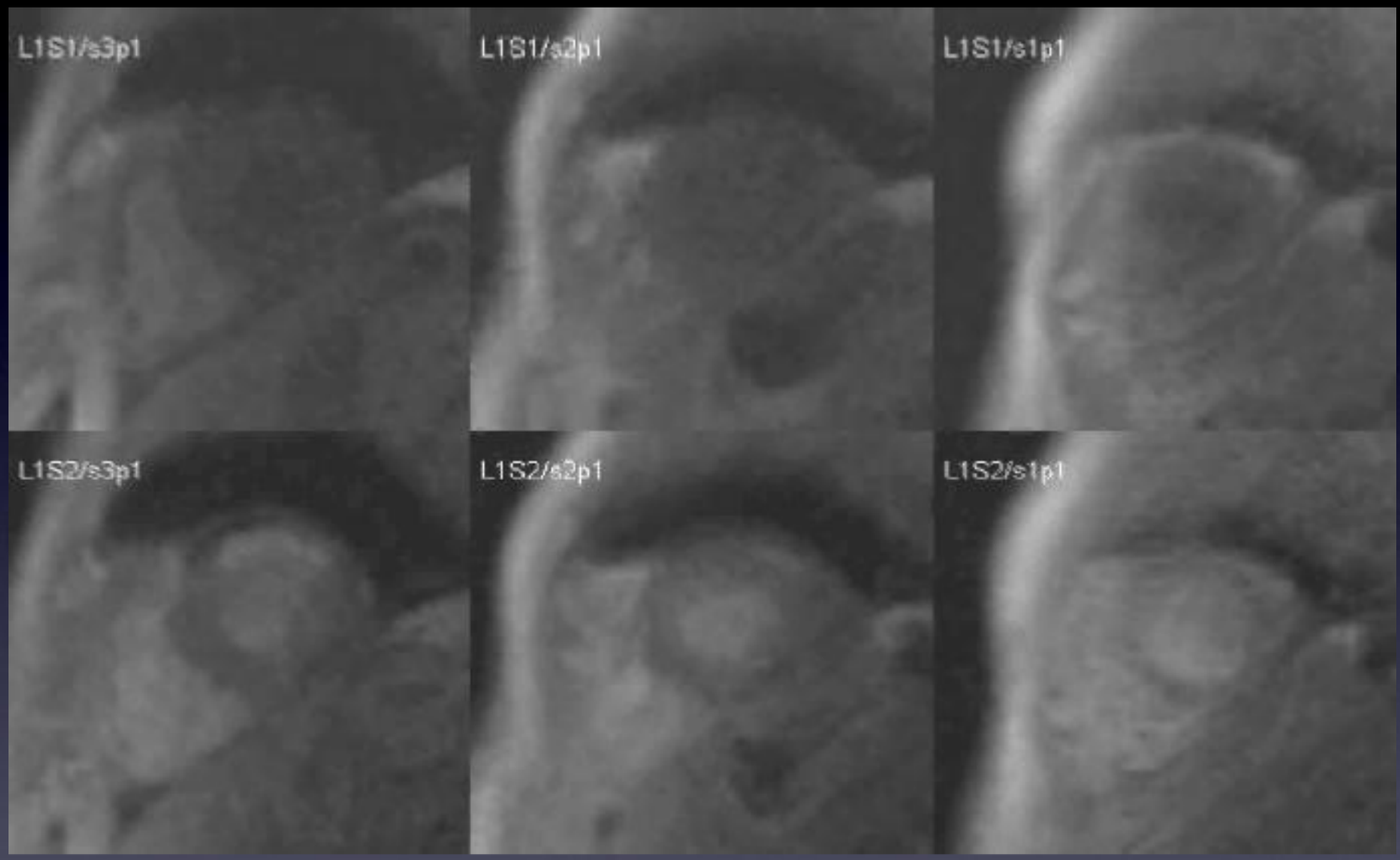
Diagnostic performance: MRI: 0.86±0.06
(area under ROC)

{ SPECT all 0.67±0.05
SPECT gated 0.75±0.08 }

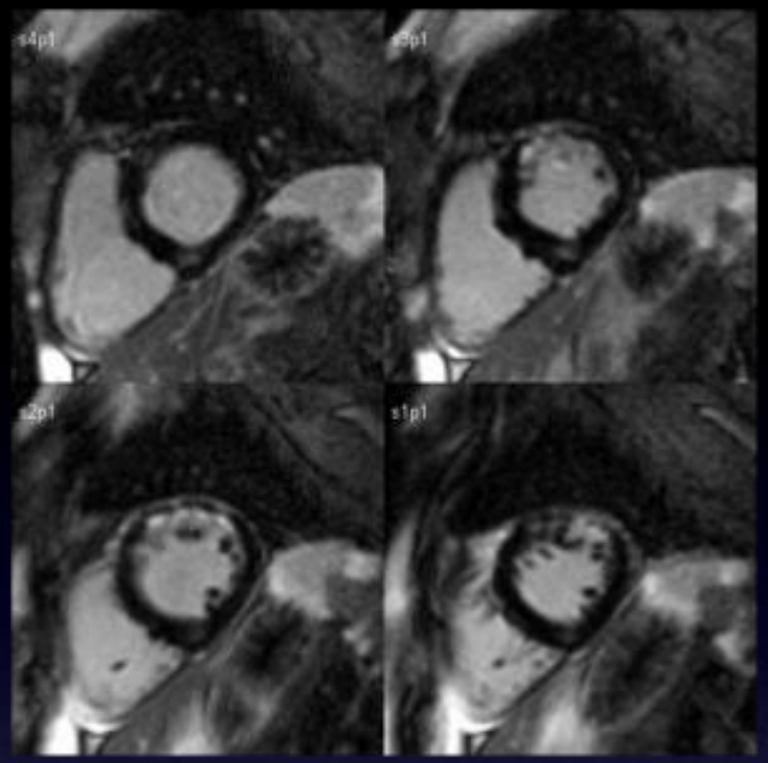
Varón 58 a, IAM no Q 2006 + stent D1 y bisectriz
Dolor torácico + marcadores (-) + PE no conluyente



Estrés



Basal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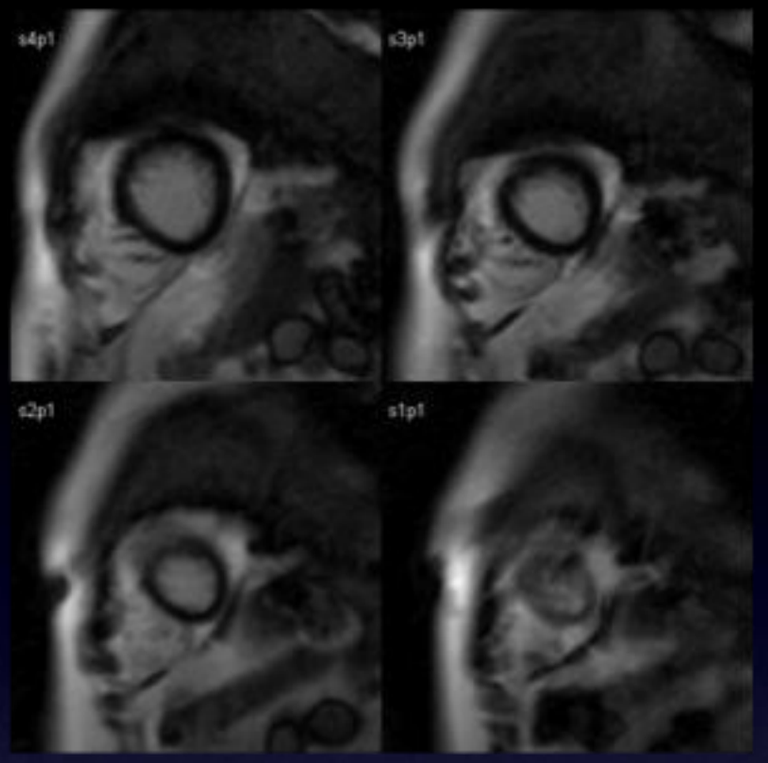
s3p1
s2p1
s1p1


s4p1
s3p1
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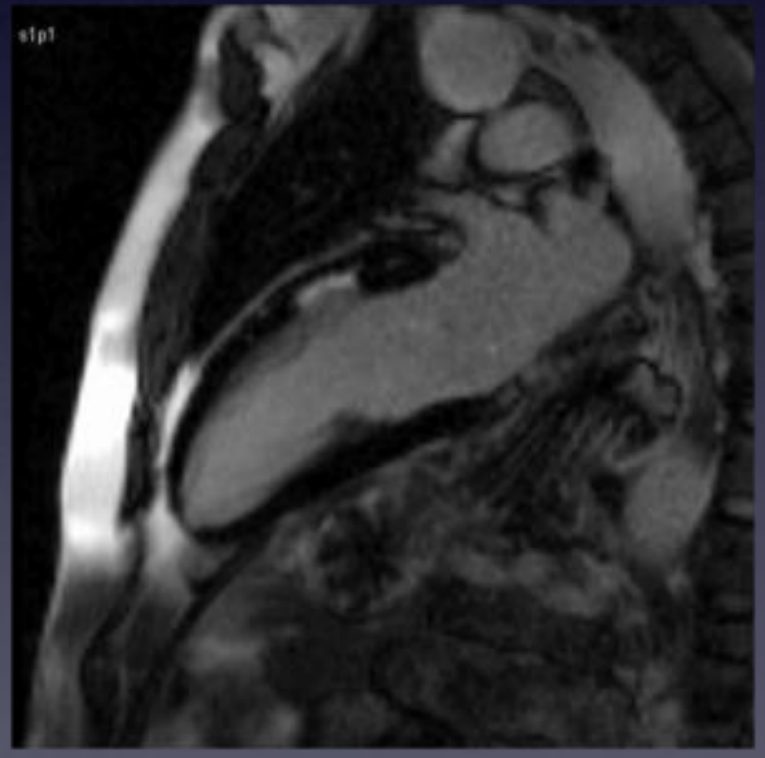
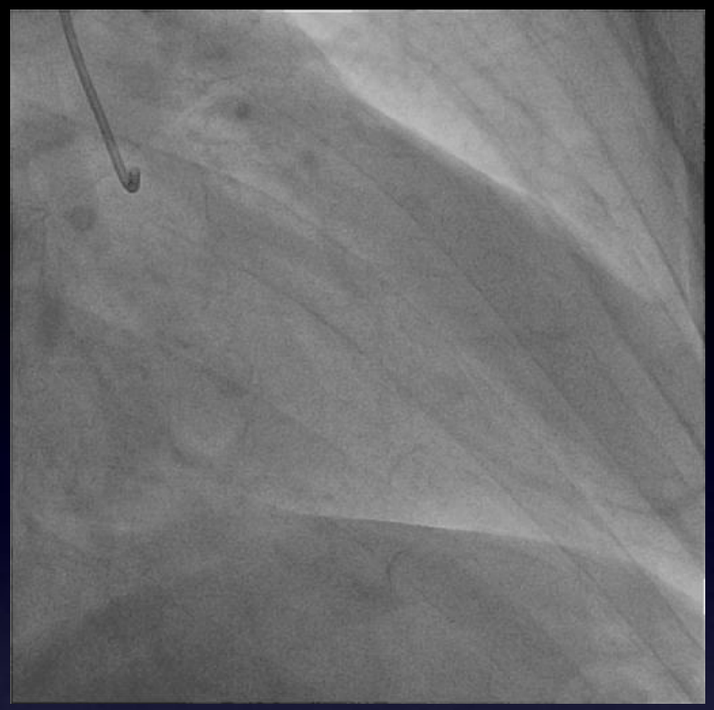

s1p1

s3p1



Edad: 80 a.

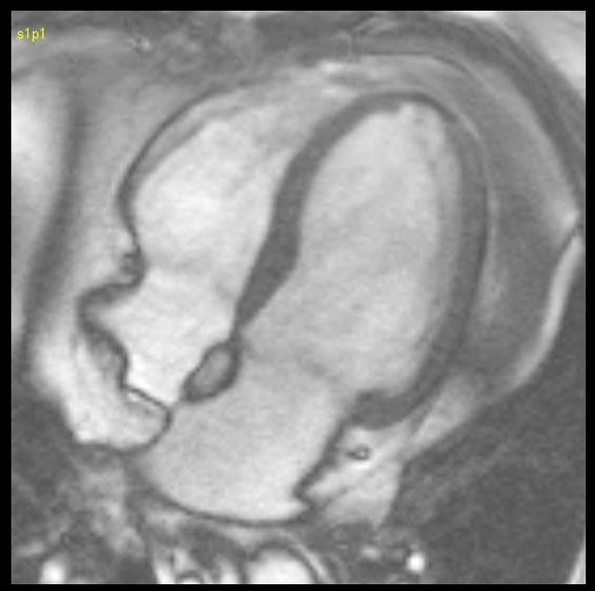
Fecha del Estudio: 10/02/2010

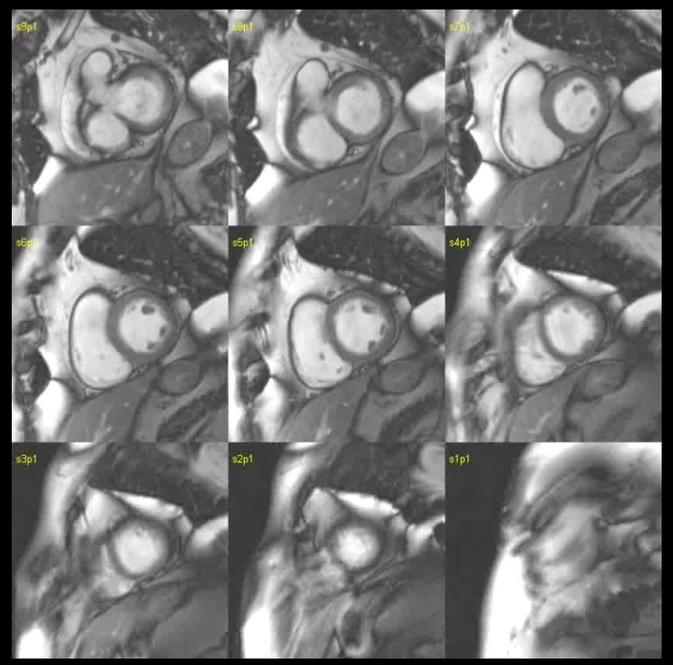
Centro de Procedencia: Hospital de Sant Pau - Sala

Solicitado por Dr/a. :

Información clínica

AEC 1997: DA, CD, OM. ACTP DA y CD. Angor actual con PE positiva precoz





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Adenosina

Basal

Edad: 80 a.

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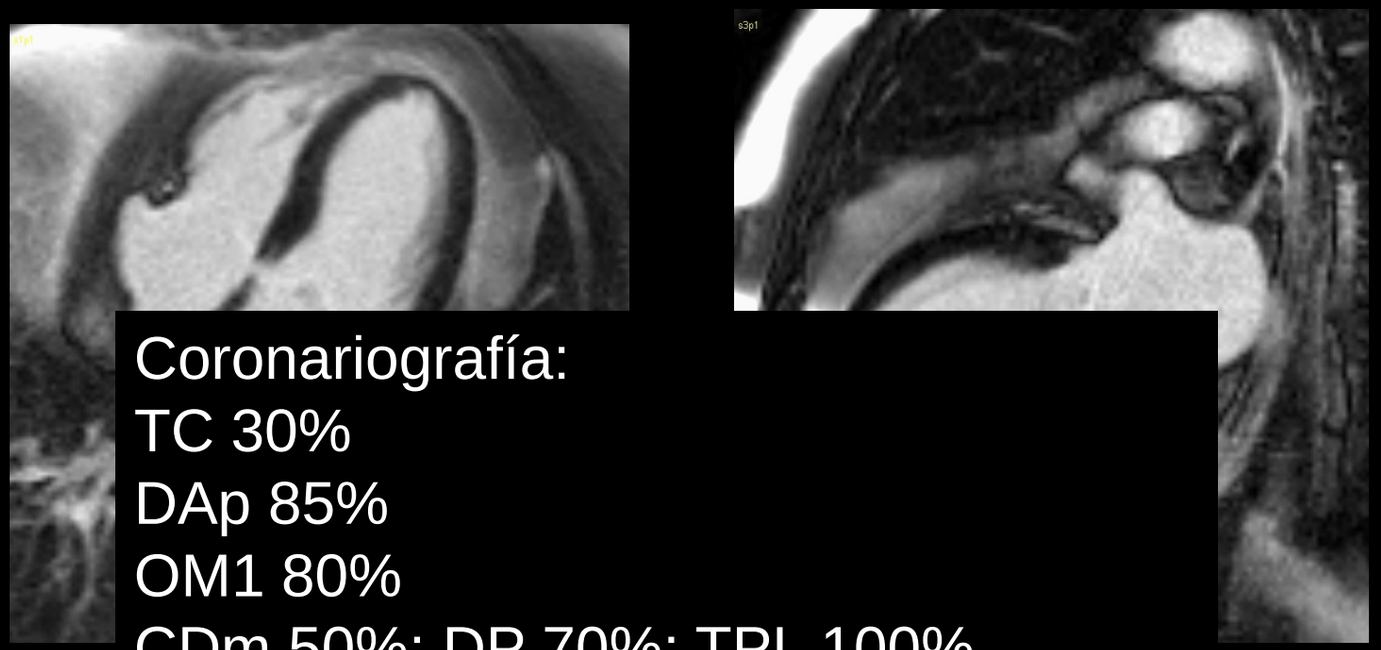
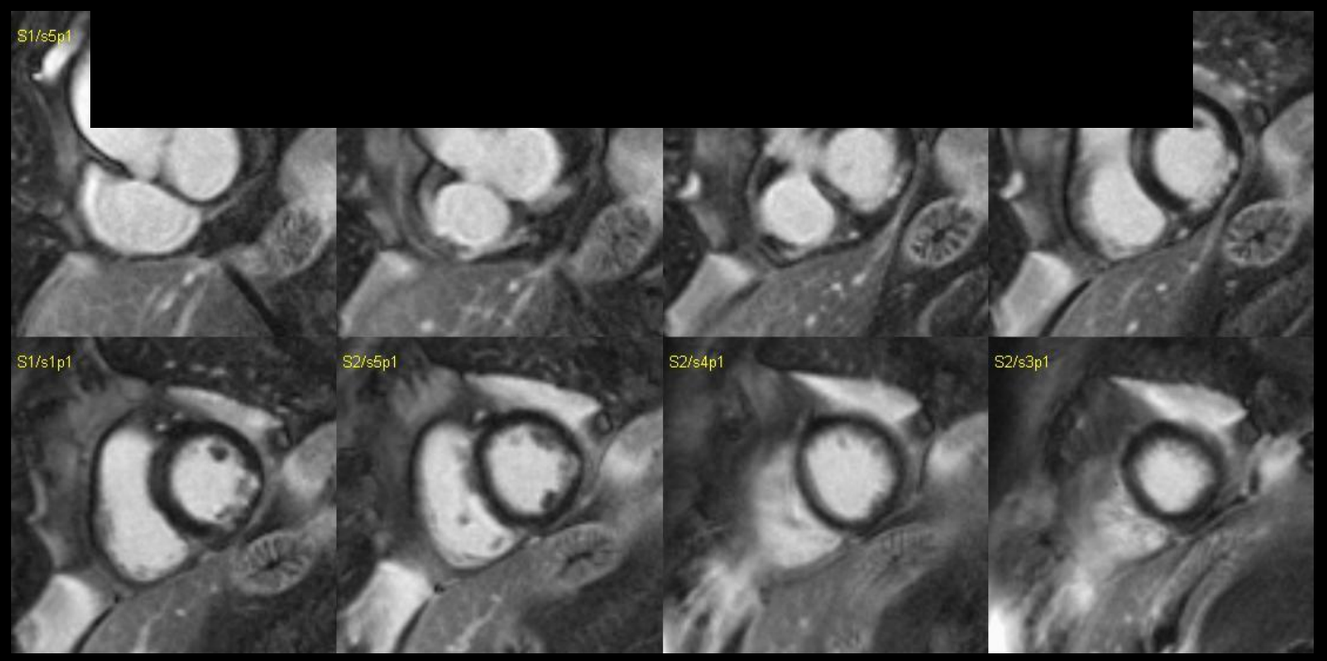


Coronariografía:
TC 30%
DAp 85%
OM1 80%
CDm 50%; DP 70%; TPL 100%



Valor pronóstico de la CRM en la evaluación de dolor torácico en UCIAs

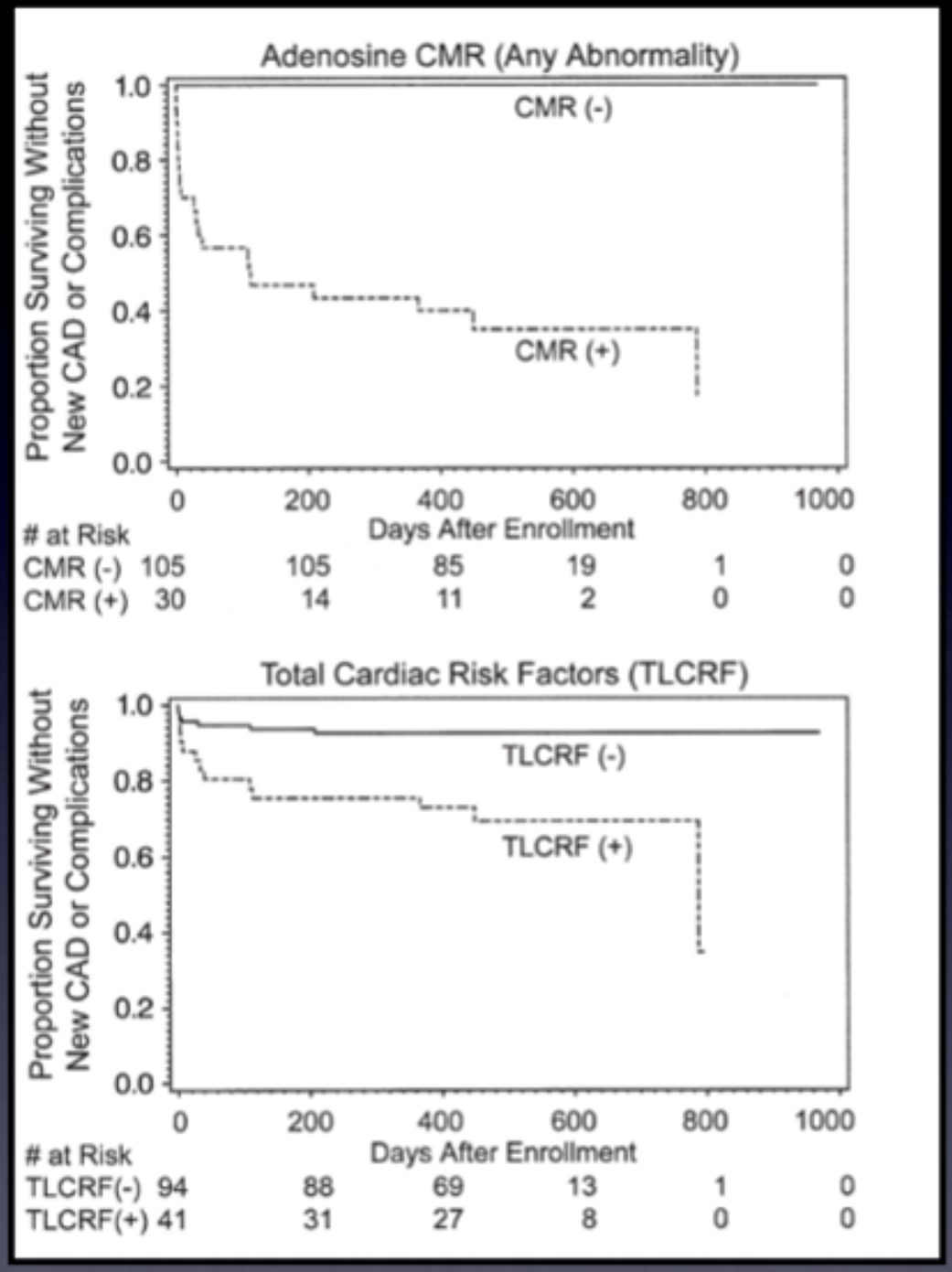
Prognosis of Negative Adenosine Stress Magnetic Resonance in Patients Presenting to an Emergency Department With Chest Pain

W. Patricia Ingkanisorn, MD,* Raymond Y. Kwong, MD,* Nicole S. Bohme, BA,† Nancy L. Geller, PHD,† Kenneth L. Rhoads, MD,* Christopher K. Dyke, MD,* D. Ian Paterson, MD,* Mushabbar A. Syed, MD,* Anthony H. Aletras, PHD,* Andrew E. Arai, MD*

- N = 135
- Dolor torácico + Tpn I negativa
- Seguimiento 14 meses (15% eventos)

	Resting RWM (n = 19)	Adenosine Perfusion (n = 28)	Delayed Enhancement (n = 14)	Any Abnormality (n = 30)
Sensitivity (%)	70	100	55	100
Specificity (%)	96	93	97	91
PPV (%)	74	71	79	67
NPV (%)	95	100	93	100

Ingkanisorn et al. JACC 2006;47:1427-32

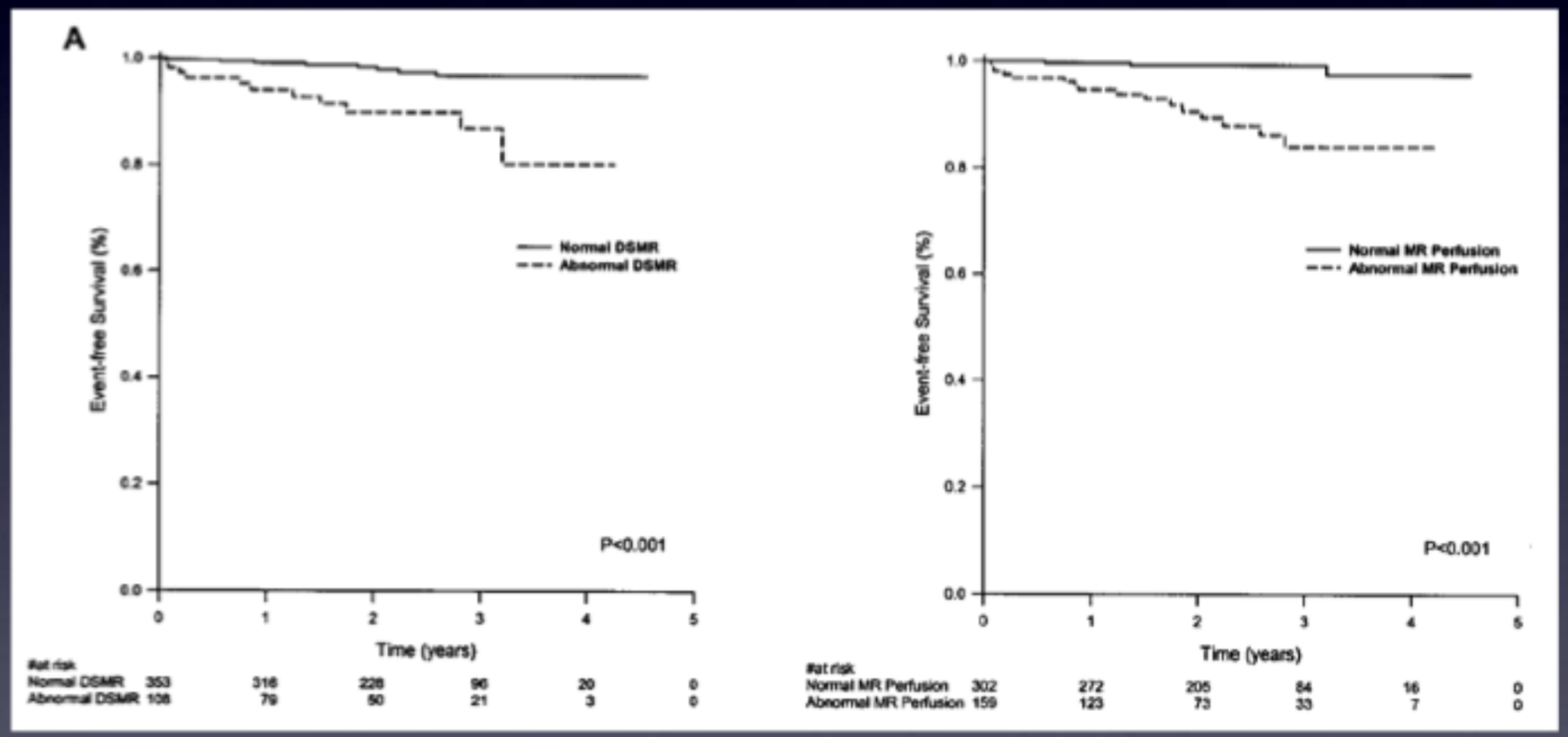


Ingkanisorn et al. JACC 2006;47:1427-32

Prognostic Value of Cardiac Magnetic Resonance Stress Tests

Adenosine Stress Perfusion and Dobutamine Stress Wall Motion Imaging

Cosima Jahnke, MD; Eike Nagel, MD; Rolf Gebker, MD; Thomas Kokocinski, MD; Sebastian Kelle, MD; Robert Manka, MD; Eckart Fleck, MD; Ingo Paetsch, MD

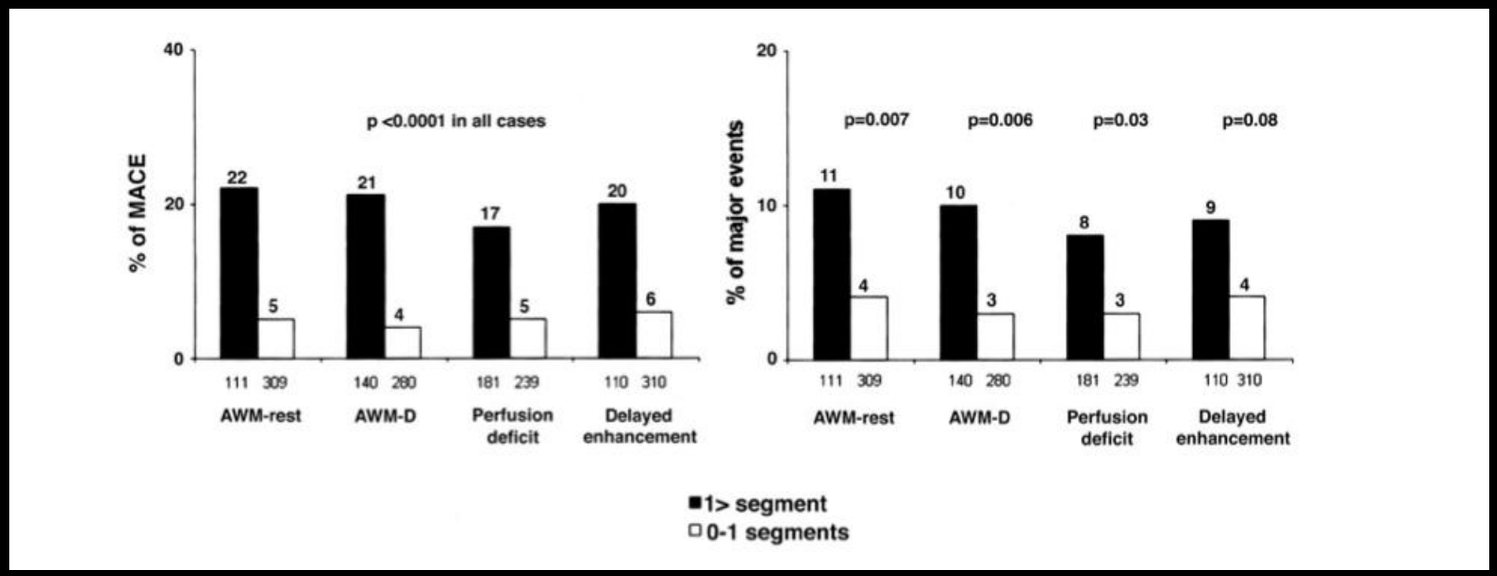


Circulation. 2007;115:1769-1776

Prognostic Value of Dipyridamole Stress Cardiovascular Magnetic Resonance Imaging in Patients With Known or Suspected Coronary Artery Disease

Vicente Bodi, MD, FESC,* Juan Sanchis, MD, FESC,* Maria P. Lopez-Lereu, MD,†
Julio Nunez, MD,* Luis Mainar, MD,* Jose V. Monmeneu, MD,† Oliver Husser, MD,*
Eloy Dominguez, MD,* Francisco J. Chorro, MD, FESC,* Angel Llacer, MD, FESC*
Valencia, Spain

N= 420 con dolor torácico
FU = 420 días: 41 MACE



J Am Coll Cardiol 2007;50:1174–9

JACC
Journal of the American College of Cardiology

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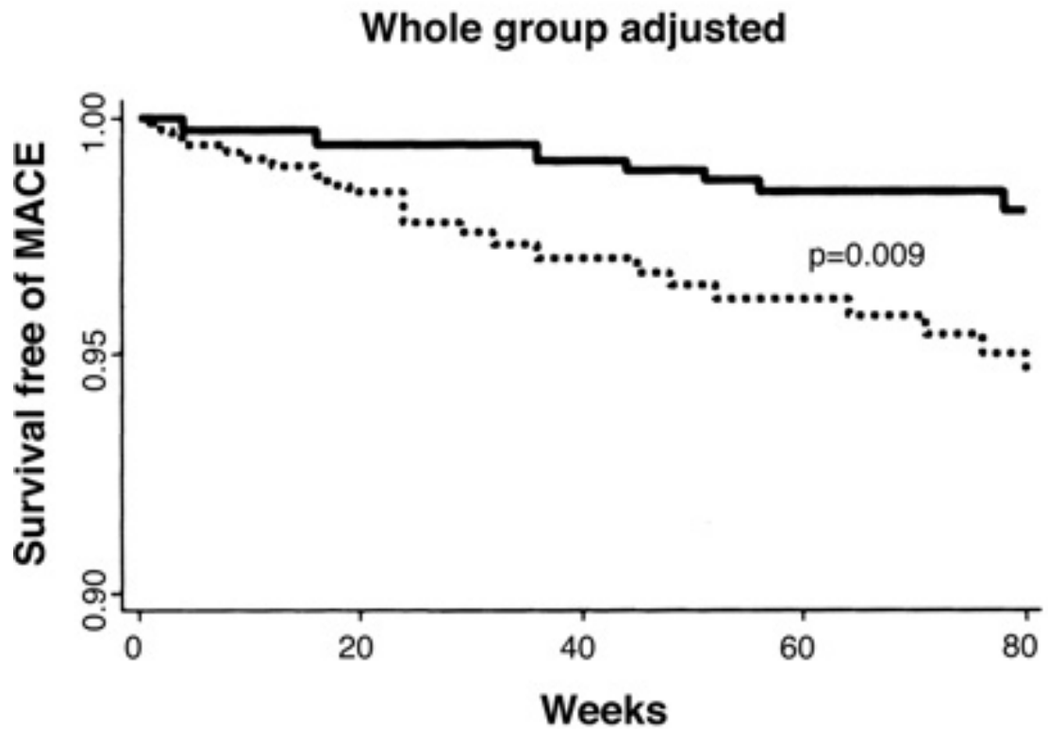
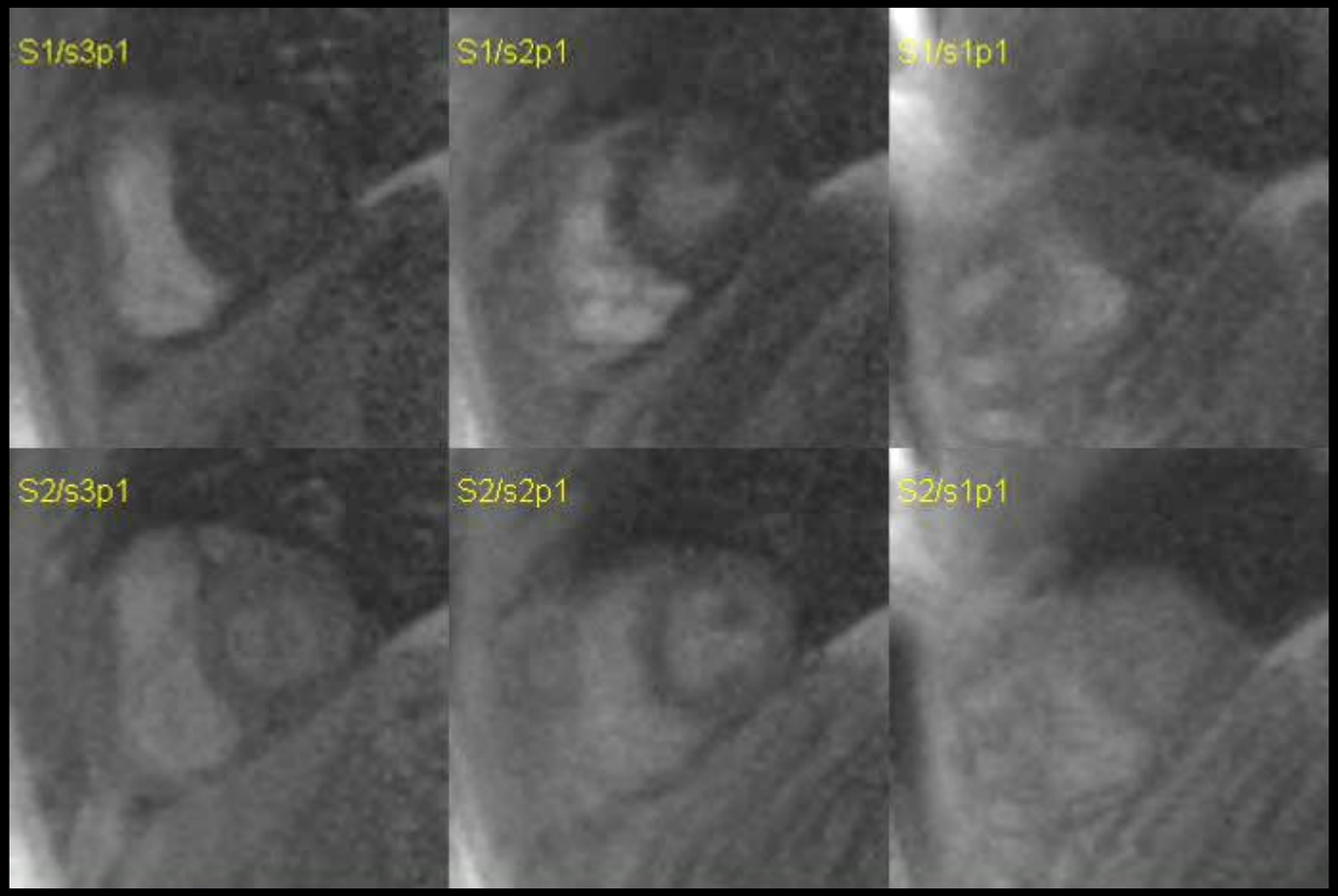


Kaplan-Meier Survival Distributions Without MACE Based on the Presence or Absence of Abnormal Wall Motion With Dipyridamole

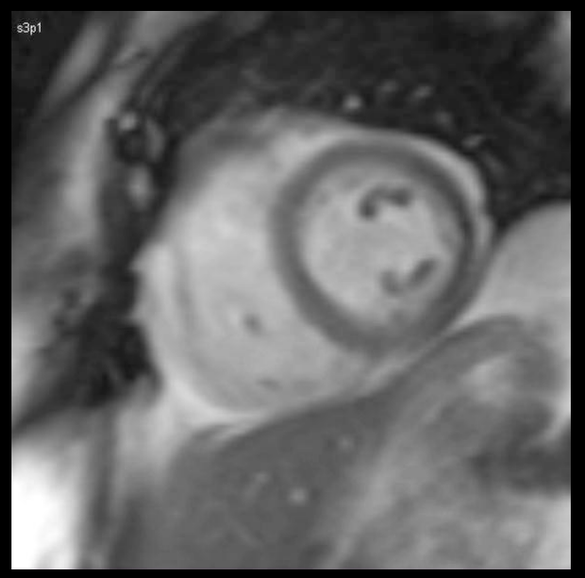
Bodí et al. J Am Coll Cardiol 2007; 50: 1174

Estrès



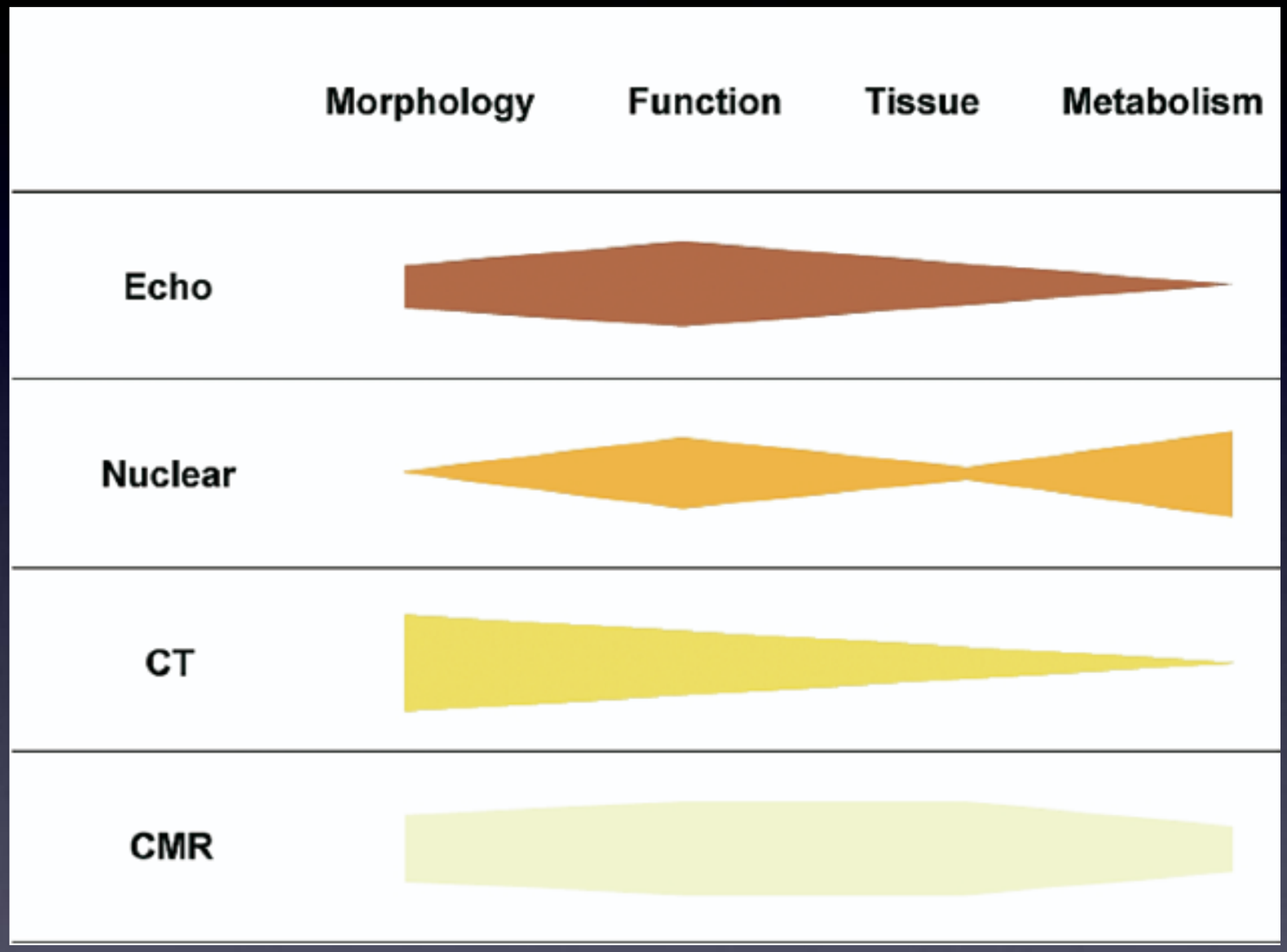
Basal

Basal



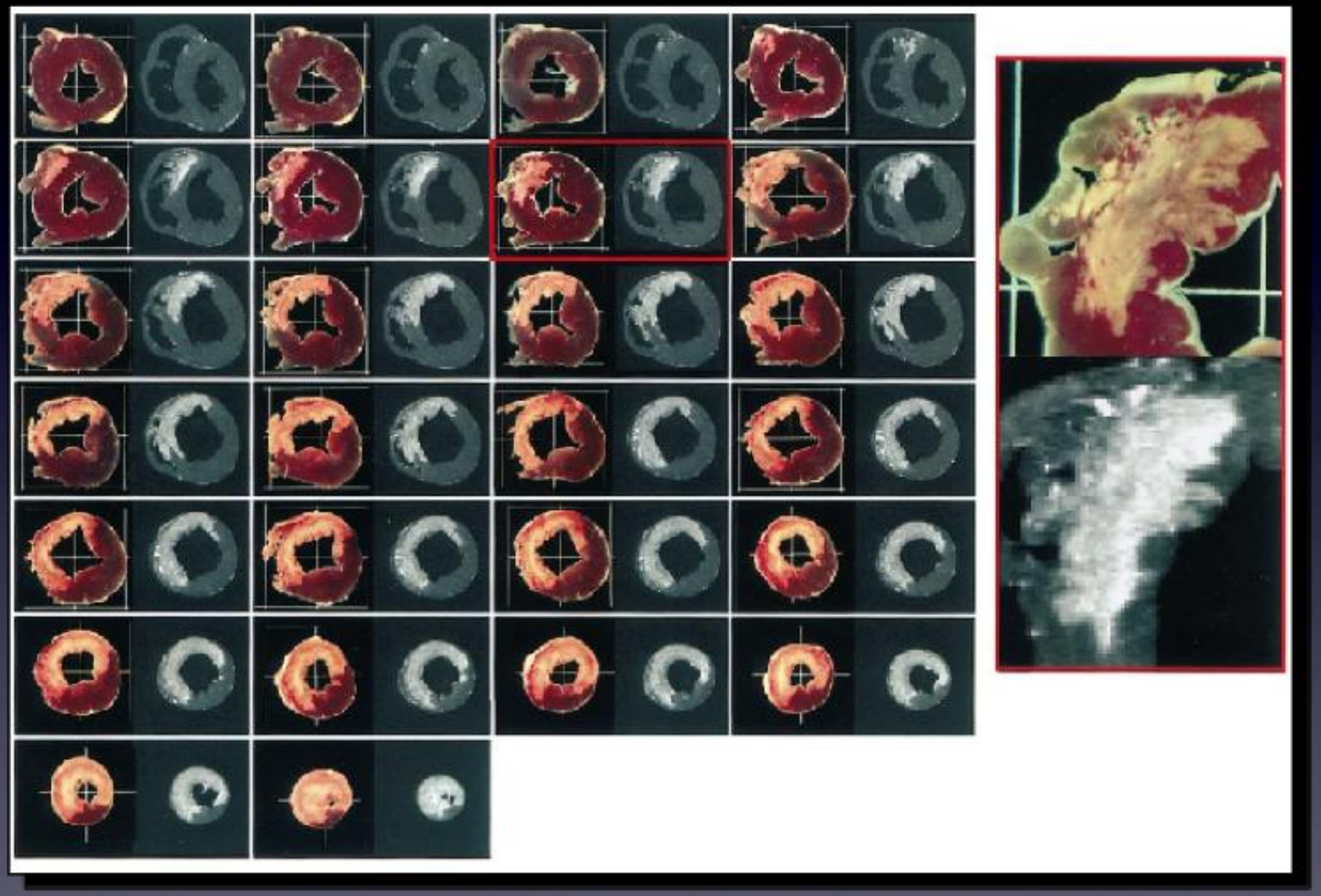
Estrès

Valor Relatiu de les Tècnicas de Diagnòstic No Invasiu en Cardiologia



Friedrich. JACC Imaging 2008; 1: 652

Estudio de Realce Tardío



Relationship of MRI delayed contrast enhancement to irreversible injury, infarct age and contractile function. Kim et al. Circ 1999;100:1992

Diagnostic Value of Contrast-Enhanced Magnetic Resonance Imaging and Single-Photon Emission Computed Tomography for Detection of Myocardial Necrosis Early After Acute Myocardial Infarction

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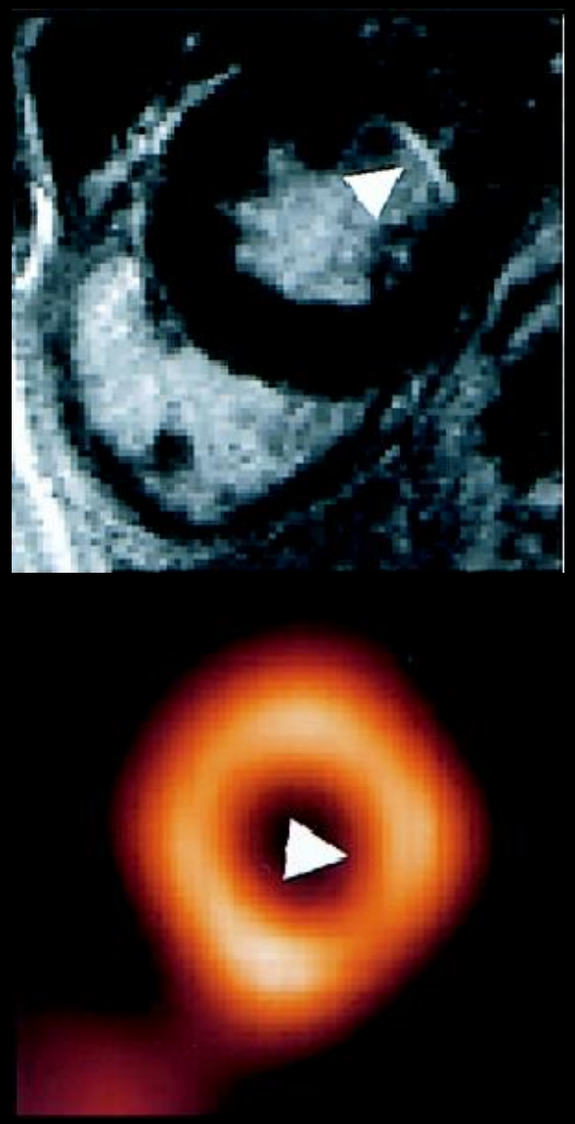

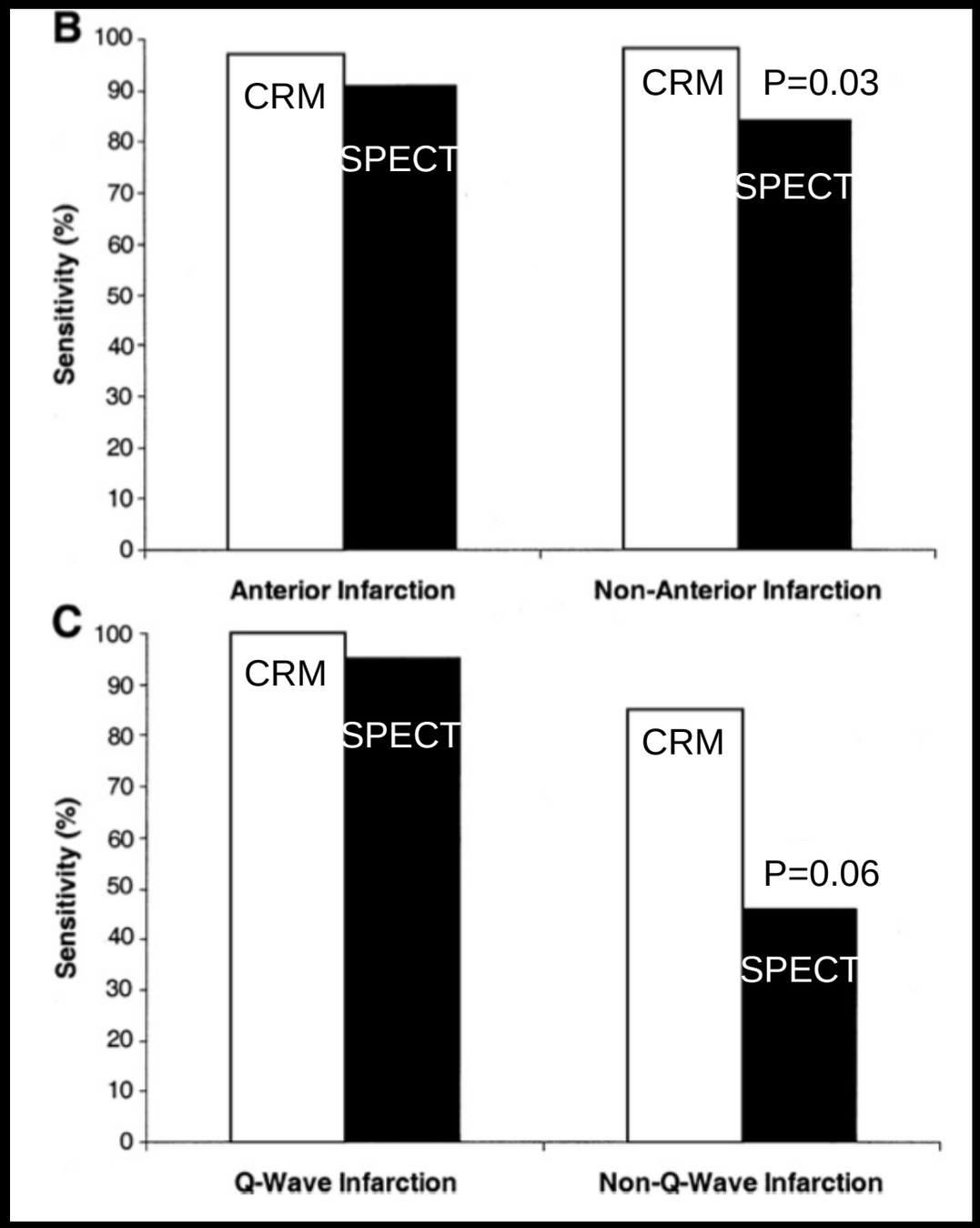

Ibrahim et al. J Am Coll Cardiol 2007; 49: 208

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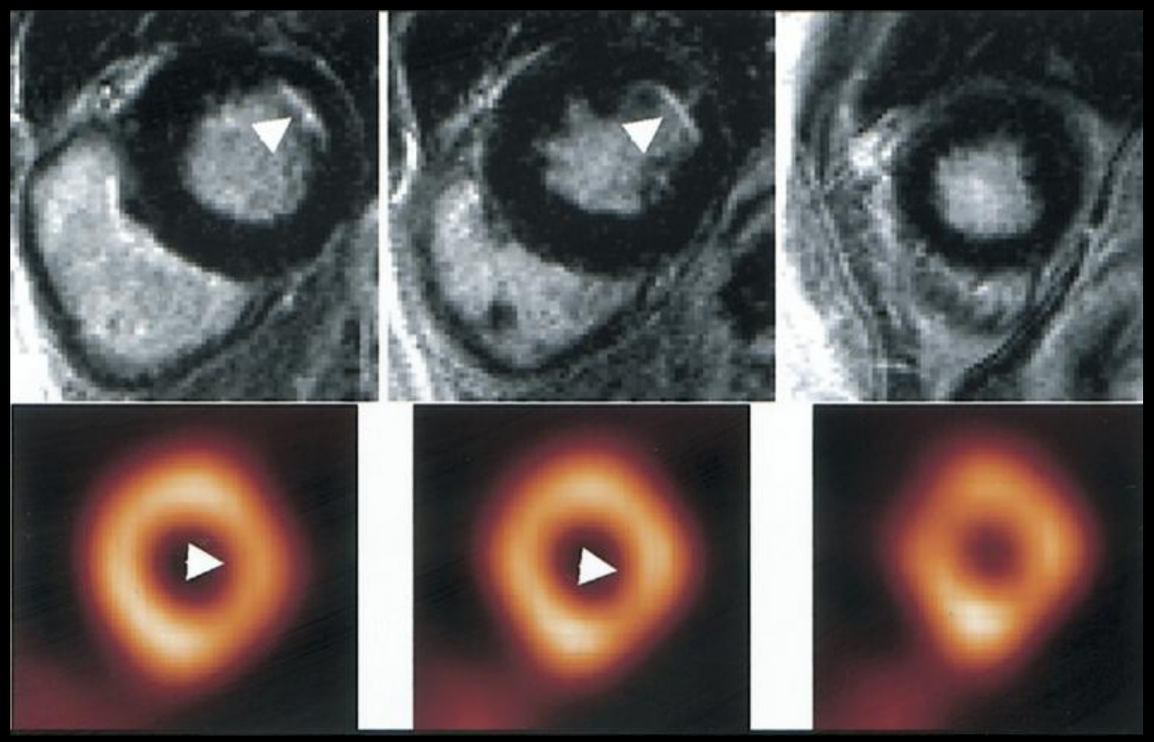
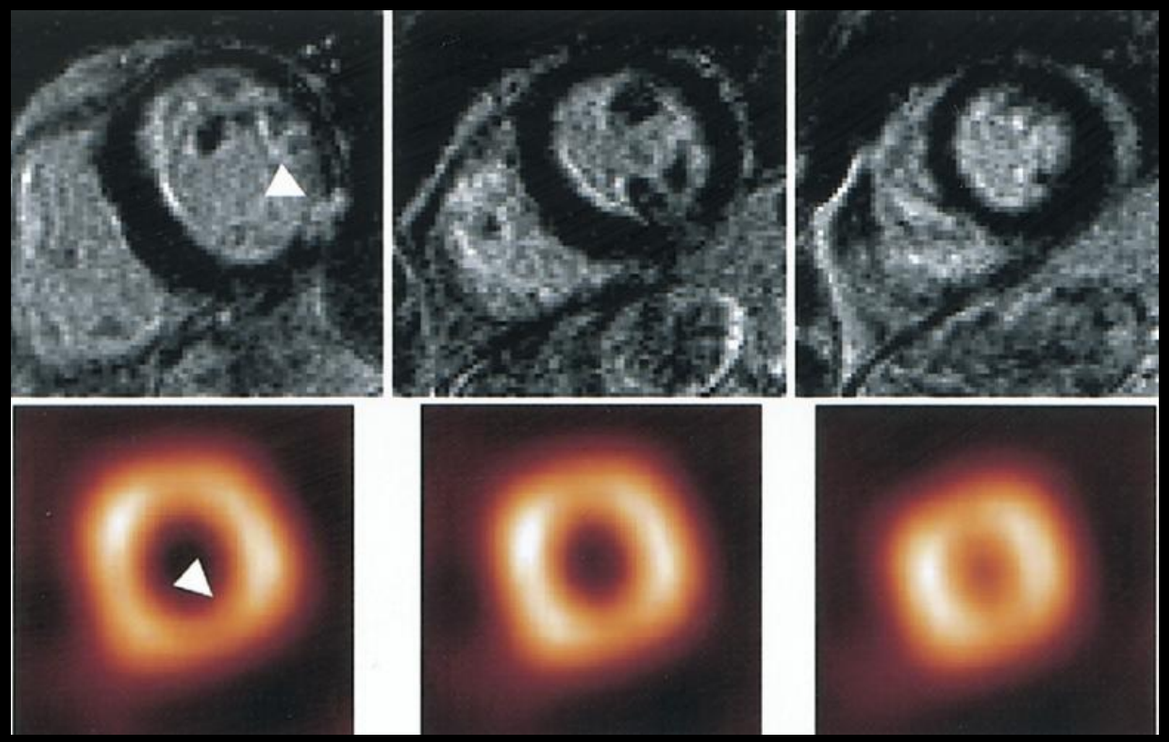
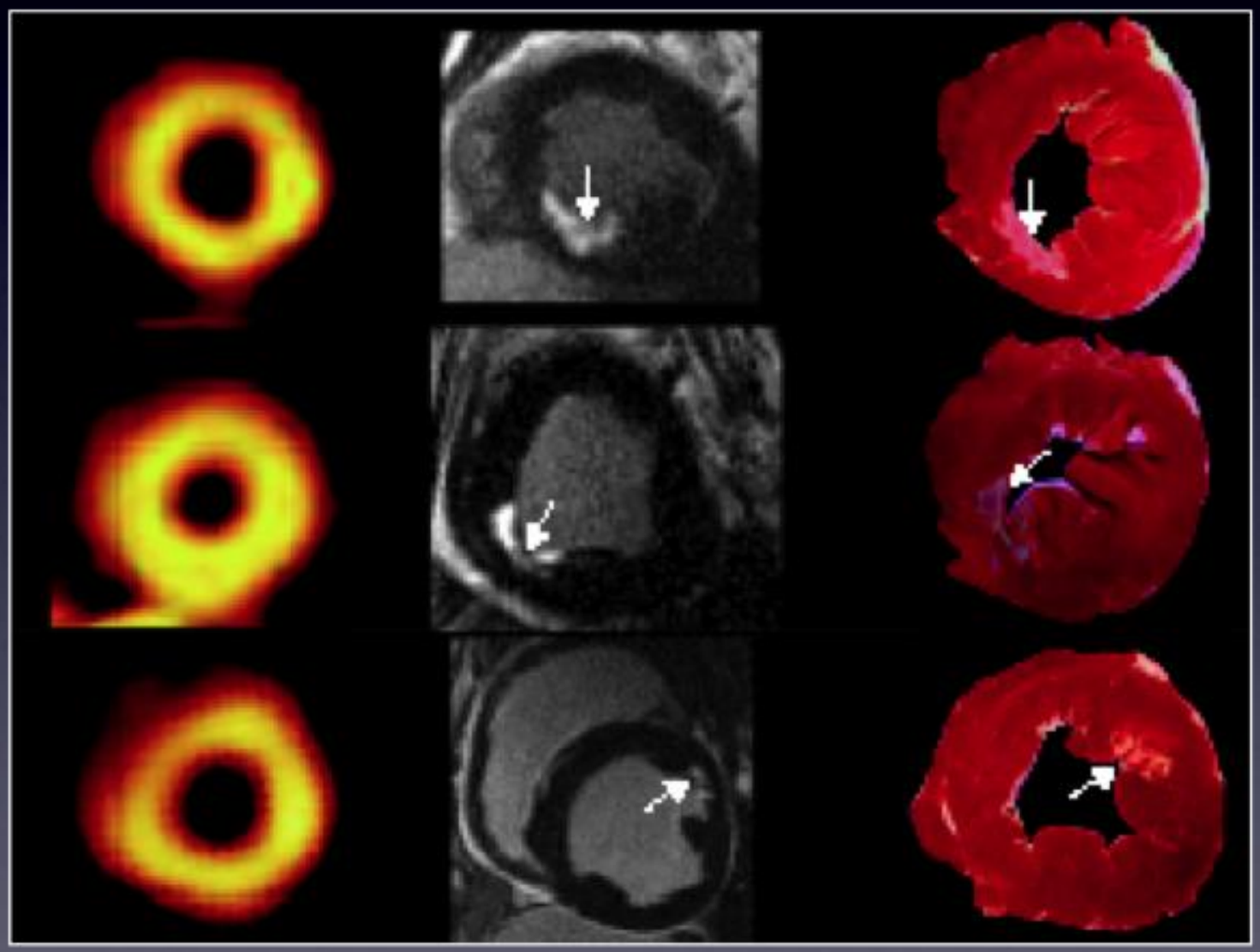




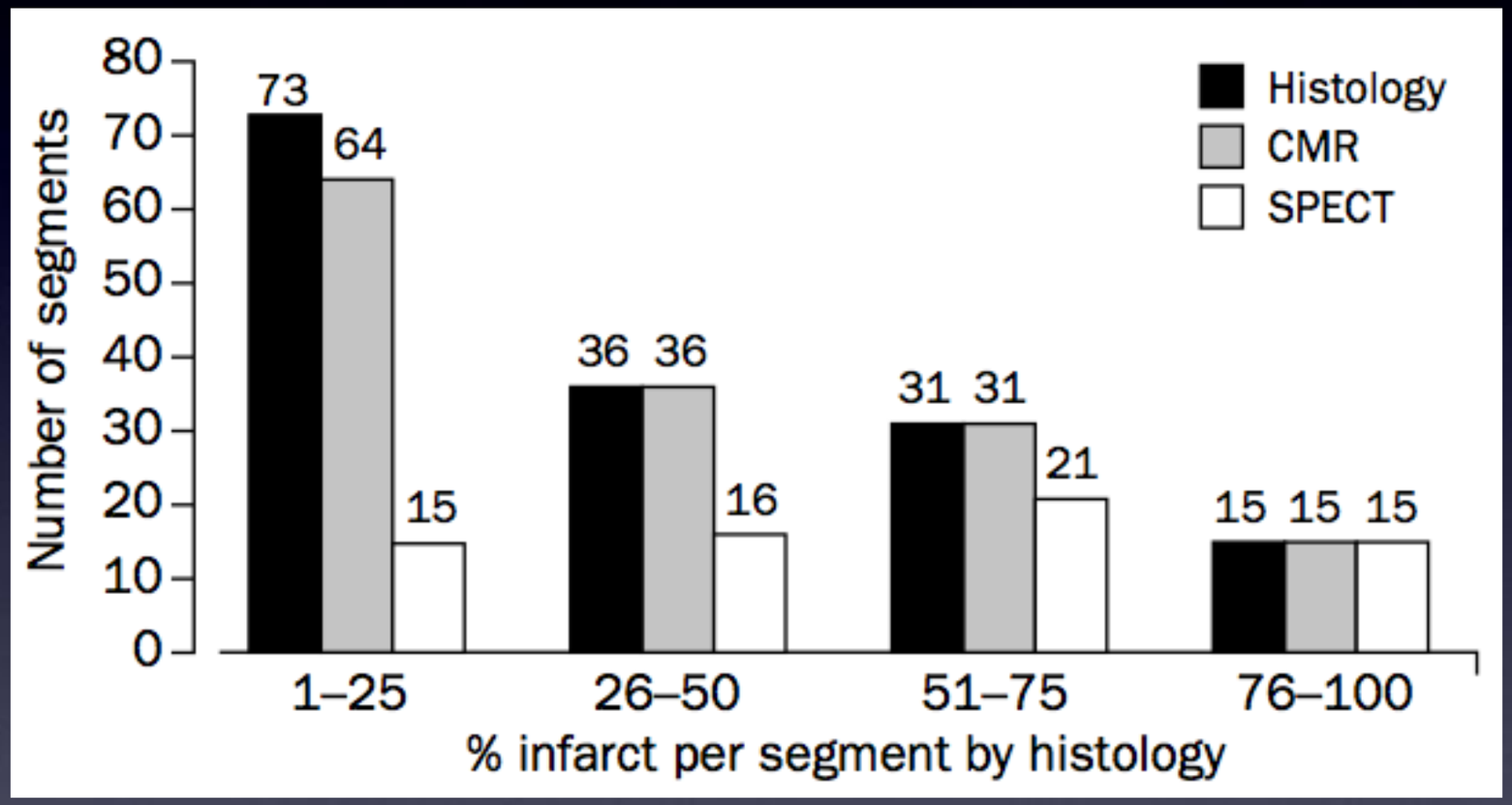
Ibrahim et al. J Am Coll Cardiol 2007; 49: 208

Contrast-enhanced MRI and routine single photon emission computed tomography (SPECT) perfusion imaging for detection of subendocardial myocardial infarcts: an imaging study



Wagner et al. Lancet 2003;361

Contrast-enhanced MRI and routine single photon emission computed tomography (SPECT) perfusion imaging for detection of subendocardial myocardial infarcts: an imaging study

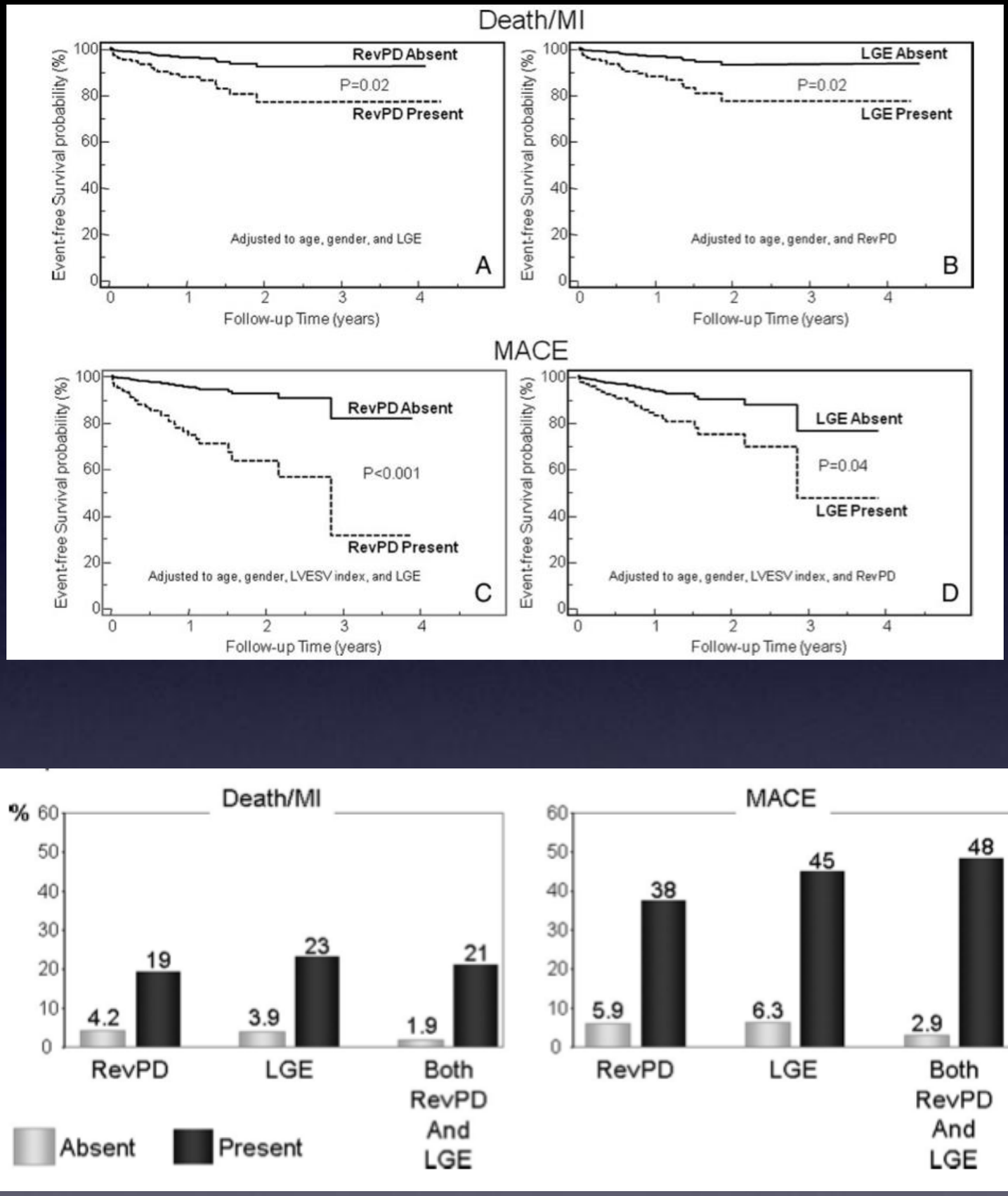


Complementary Prognostic Values of Stress Myocardial Perfusion and Late Gadolinium Enhancement Imaging by Cardiac Magnetic Resonance in Patients With Known or Suspected Coronary Artery Disease

Kevin Steel, DO; Ryan Broderick, MD; Vijay Gandla, MD; Eric Larose, MD; Frederick Resnic, MD; Michael Jerosch-Herold, PhD; Kenneth A. Brown, MD; Raymond Y. Kwong, MD, MPH

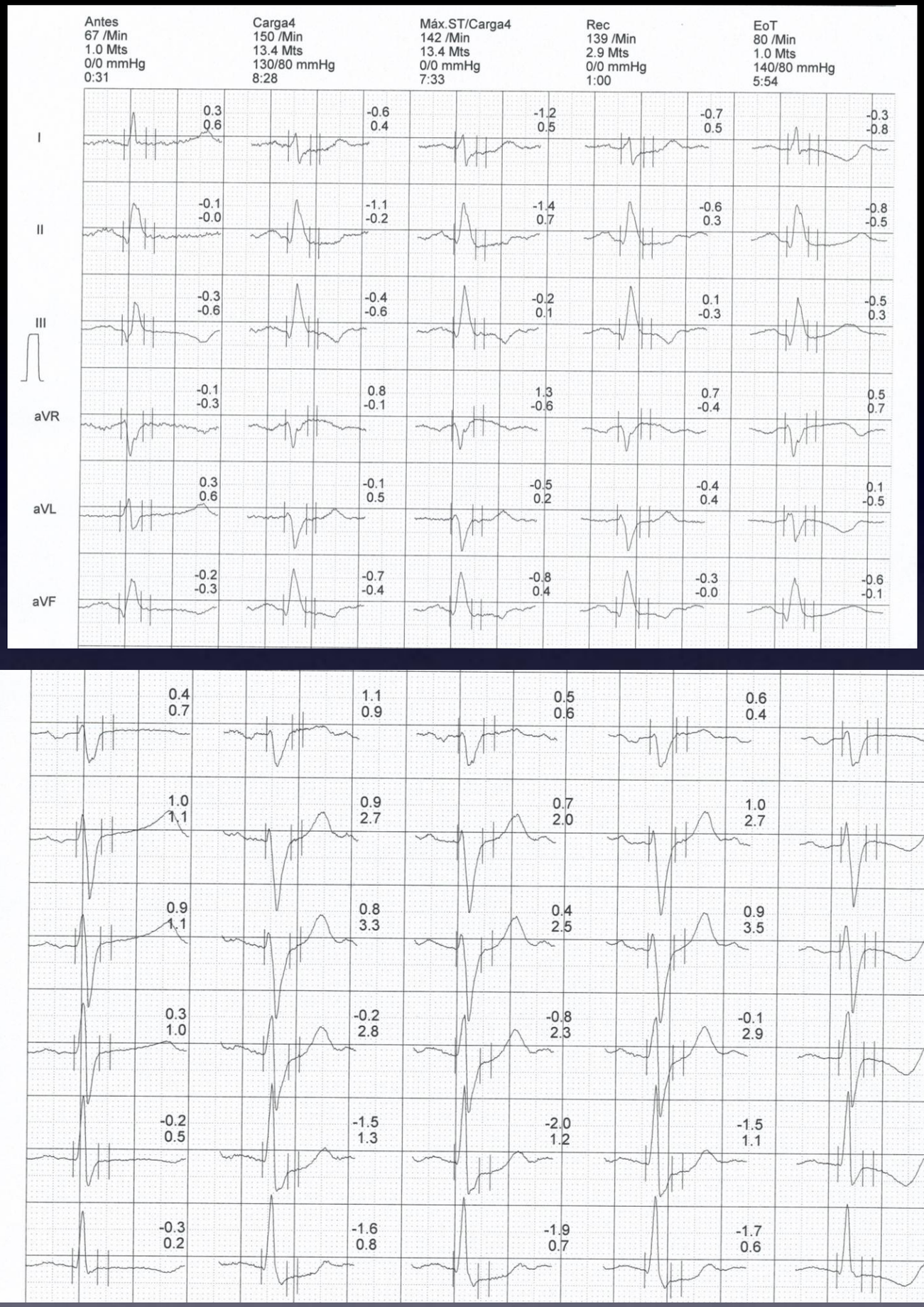
Circulation 2009;120:1390-1400

- N = 254
- Referidos para descartar isquemia miocárdica por clínica
- Seguimiento 17 meses: 49 eventos (12 MC, 16 IAM, 21 H)

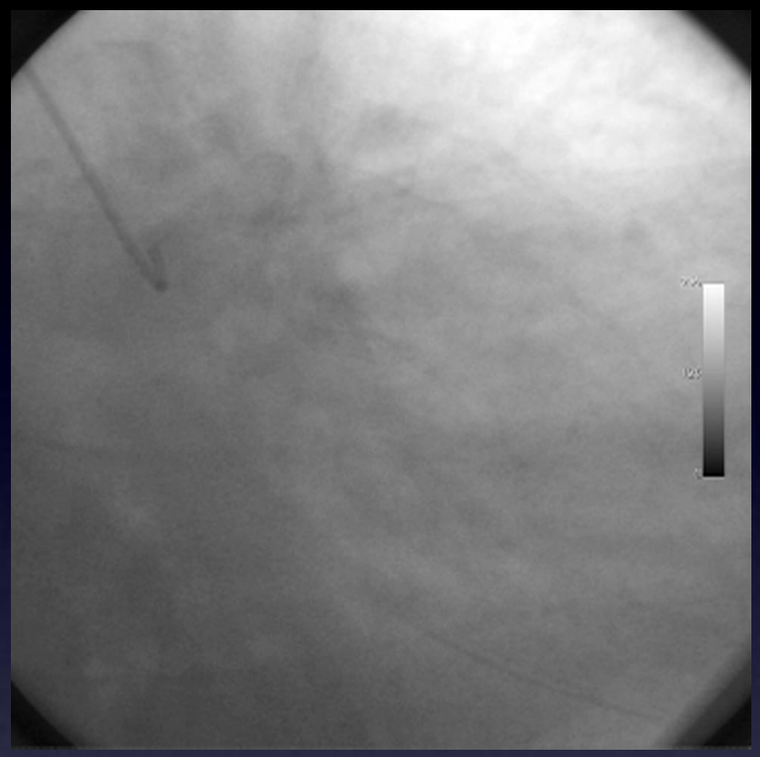

Death/MI
Event-free Survival probability (%)
RevPD Absent
P=0.02
RevPD Present
Adjusted to age, gender, and LGE
A
Follow-up Time (years)
LGE Absent
P=0.02
LGE Present
Adjusted to age, gender, and RevPD
B
MACE
RevPD Absent
P<0.001
RevPD Present
Adjusted to age, gender, LVESV index, and LGE
C
LGE Absent
P=0.04
LGE Present
Adjusted to age, gender, LVESV index, and RevPD
D
% 60
4.2
19
3.9
23
1.9
21
RevPD
LGE
Both RevPD And LGE
Absent
Present
5.9
38
6.3
45
2.9
48

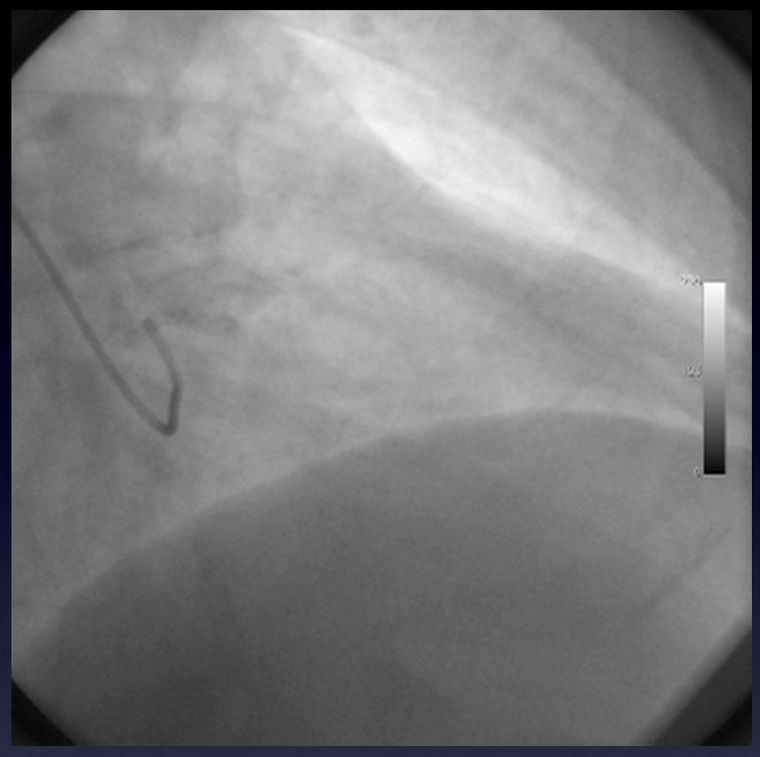
Varón 50 a, Exfumador, HTA, DM tipo 2

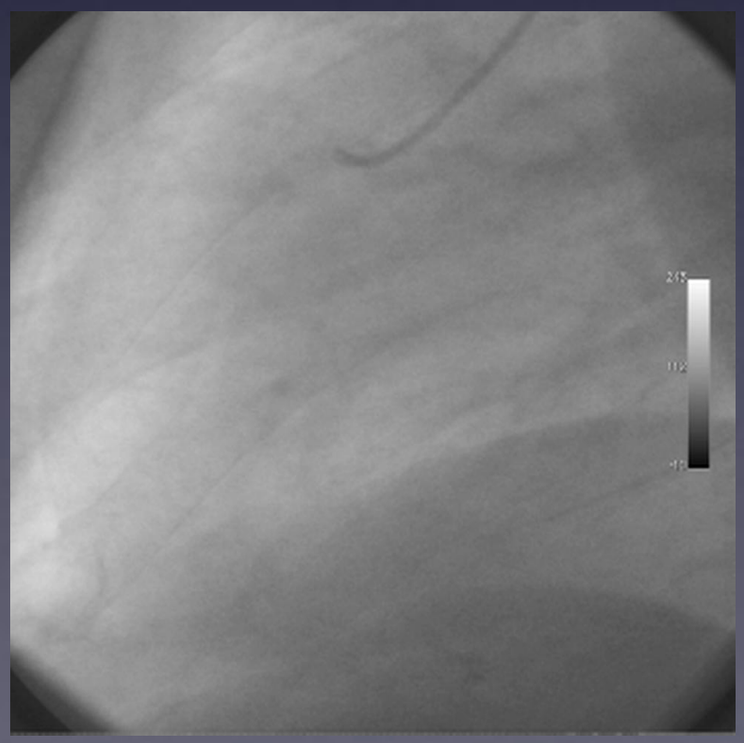
Sin antecedentes personales o familiares de cardiopatía previa.
Nunca ángor, disnea, palpitaciones, mareo o síncope.


Antes
67 /Min
1.0 Mts
0/0 mmHg
0:31
Carga4
150 /Min
13.4 Mts
130/80 mmHg
8:28
Máx.ST/Carga4
142 /Min
13.4 Mts
0/0 mmHg
7:33
Rec
139 /Min
2.9 Mts
0/0 mmHg
1:00
EoT
80 /Min
1.0 Mts
140/80 mmHg
5:54
I
0.3 0.6
-0.6 0.4
-1.2 0.5
-0.7 0.5
-0.3 -0.8
II
-0.1 -0.0
-1.1 -0.2
-1.4 0.7
-0.6 0.3
-0.8 -0.5
III
-0.3 -0.6
-0.4 -0.6
-0.2 0.1
0.1 -0.3
-0.5 0.3
aVR
-0.1 -0.3
0.8 -0.1
1.3 -0.6
0.7 -0.4
0.5 0.7
aVL
0.3 0.6
-0.1 0.5
-0.5 0.2
-0.4 0.4
0.1 -0.5
aVF
-0.2 -0.3
-0.7 -0.4
-0.8 0.4
-0.3 -0.0
-0.6 -0.1
V1
0.4 0.7
1.1 0.9
0.5 0.6
0.6 0.4
0.6 0.4
V2
1.0 1.1
0.9 2.7
0.7 2.0
1.0 2.7
0.6 0.0
V3
0.9 1.1
0.8 3.3
0.4 2.5
0.9 3.5
0.4 -0.1
V4
0.3 1.0
-0.2 2.8
-0.8 2.3
-0.1 2.9
-0.2 -0.6
V5
-0.2 0.5
-1.5 1.3
-2.0 1.2
-1.5 1.1
-0.8 -0.9
V6
-0.3 0.2
-1.6 0.8
-1.9 0.7
-1.7 0.6
-0.8 -0.6

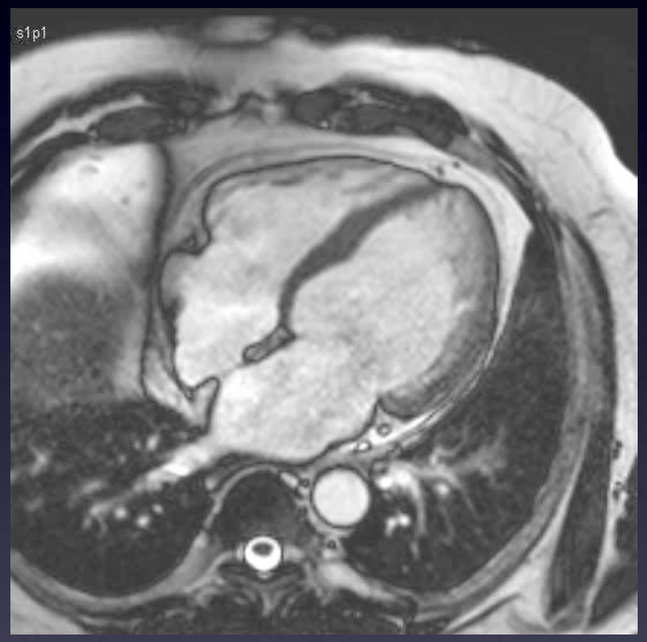
Varón 50 a, Exfumador, HTA, DM 2
Asintomático. Alteración ECG. PE (+) eléctrica

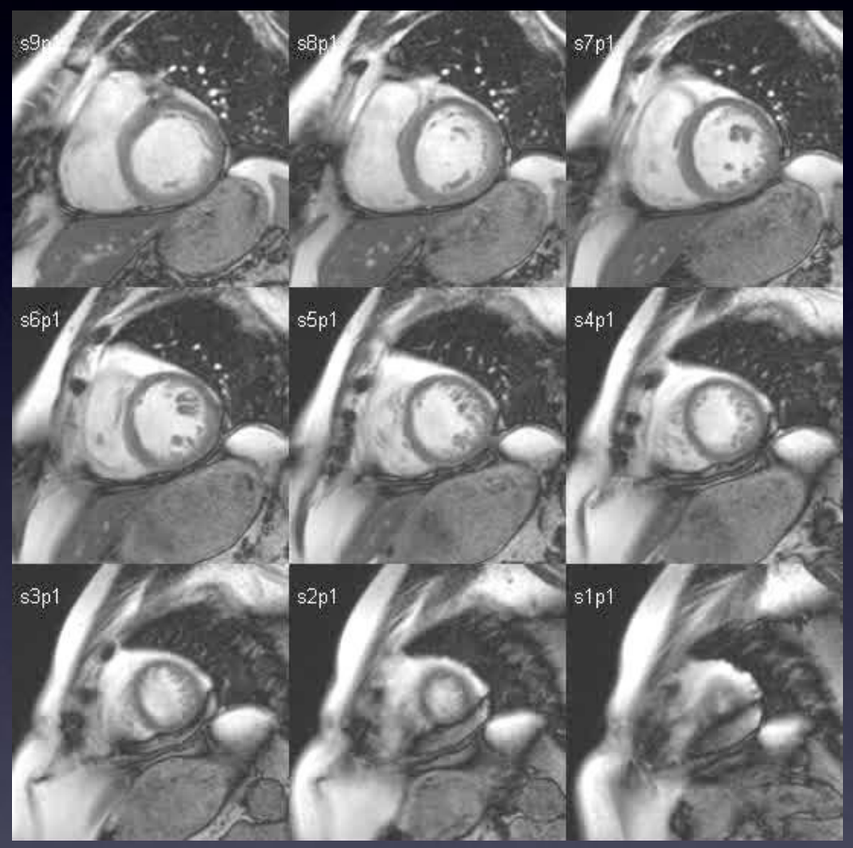






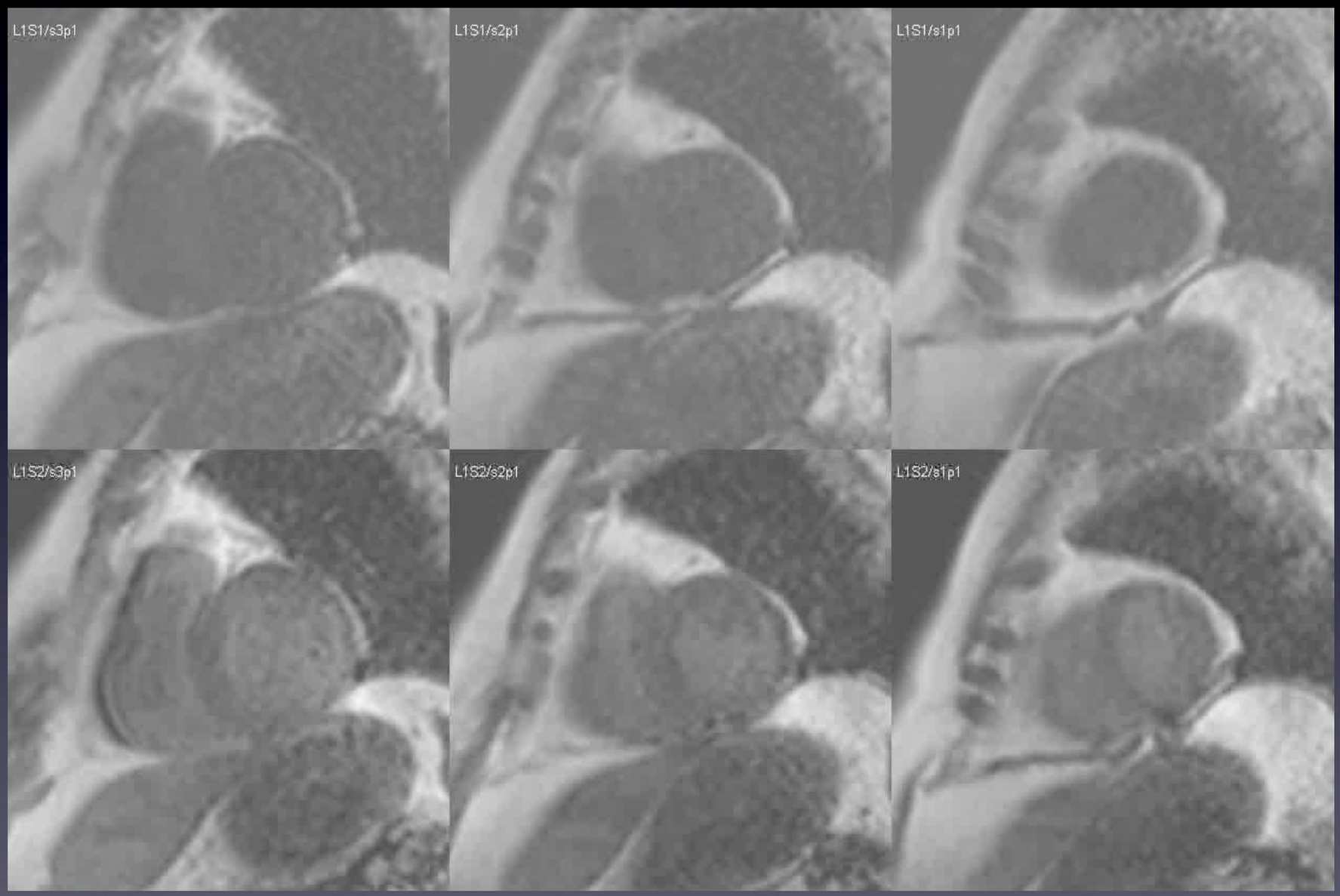
Varón 50 a, Exfumador, HTA, DM 2
Asintomático. Alteración ECG. PE (+) eléctrica





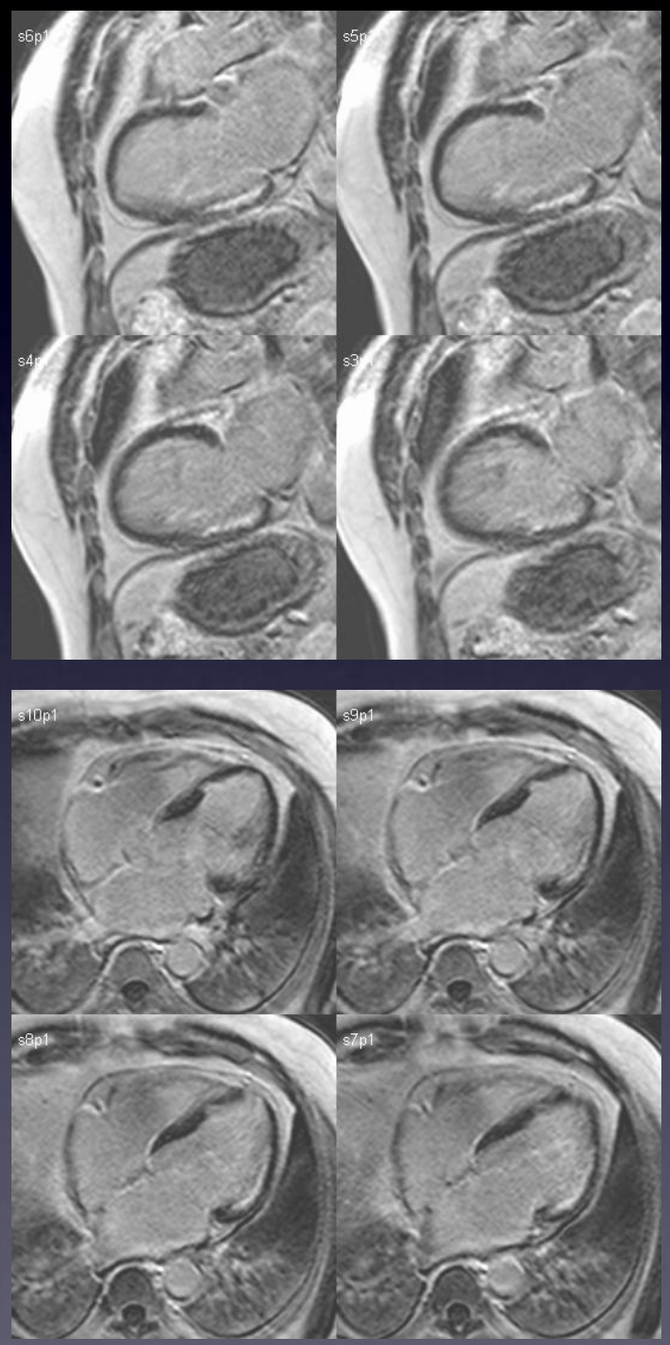
Varón 50 a, Exfumador, HTA, DM 2
Asintomático. Alteración ECG. PE (+) eléctrica

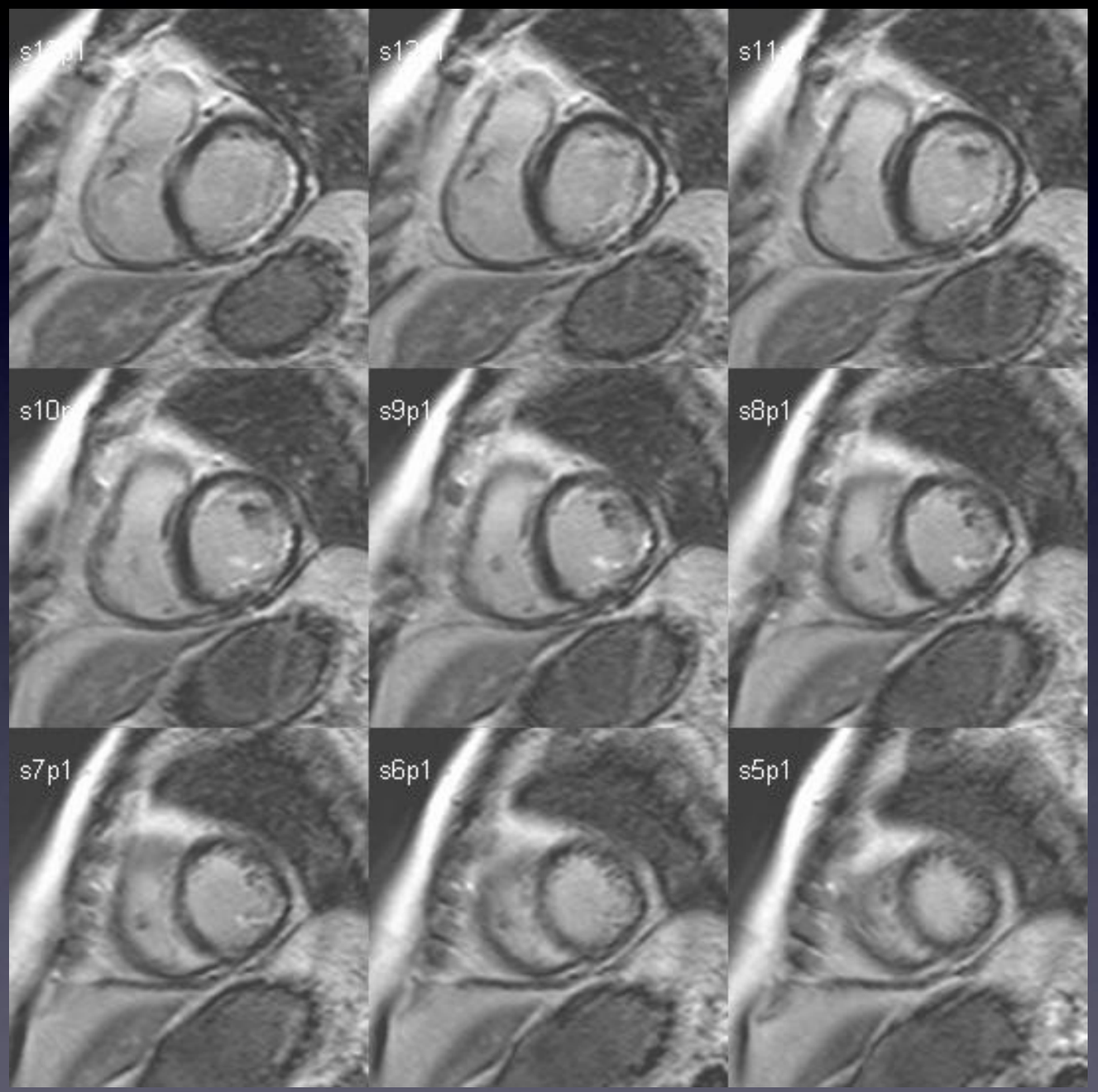
Adenosina



Basal

Varón 50 a, Exfumador, HTA, DM 2
Asintomático. Alteración ECG. PE (+) eléctrica

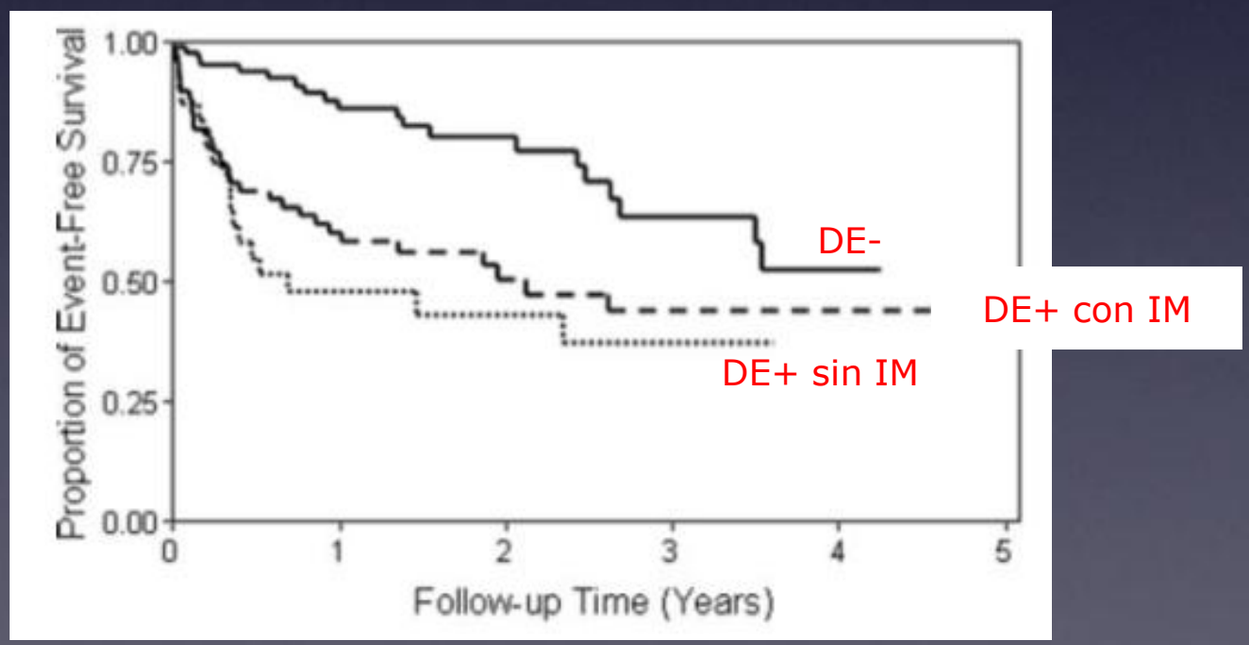




Incidence and Prognostic Implication of Unrecognized Myocardial Scar Characterized by Cardiac Magnetic Resonance in Diabetic Patients Without Clinical Evidence of Myocardial Infarction

Raymond Y. Kwong, MD, MPH; Hamid Sattar, MD; Henry Wu, MD; Gabriel Vorobiof, MD; Vijay Gandla, MD; Kevin Steel, DO; Samuel Siu, MD; Kenneth A. Brown, MD

- Alta prevalencia RT (+) (28%) en pacientes diabéticos SIN historia de infarto
- RT (+) se asocia a un incremento del nº de eventos y mortalidad
- Diabéticos sin hª de infarto con RT (+) tienen tasa de eventos similar a aquellos con infarto



Circulation 2008;118:1011

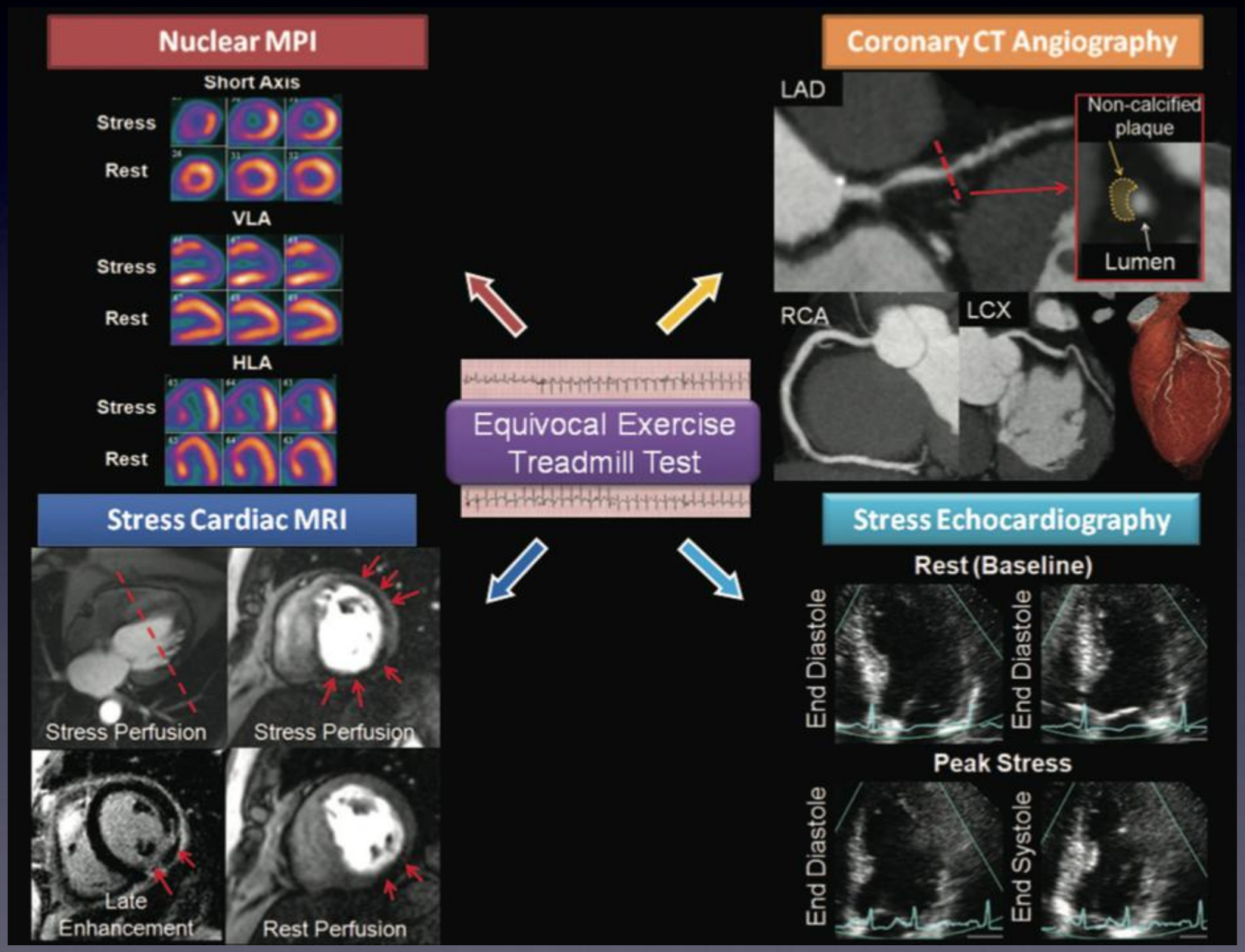
Estudi de la perfussió miocàrdica a la cardiopatia isquèmica per CRM: una alternativa al SPECT?

- ✓ Si, és una bona alternativa amb una millor especificitat
- ✓ Valor afegit del contrast tardà
- ✓ CRM estrès: funció VE global i segmentària + perfussió + necrosi/viabilitat
- ✓ SPECT vs. CRM??? DISPONIBILITAT

CLINICIAN UPDATE

Selecting a Noninvasive Imaging Study After an Inconclusive Exercise Test

Ron Blankstein, MD; Adam D. DeVore, MD



Circulation 2010;122:1514-1518

Appropriateness Criteria:

SPECT

Detection of CAD: Symptomatic Evaluation of Ischemic Equivalent (Nonacute)		
4.	• Intermediate pretest probability of CAD • ECG uninterpretable OR unable to exercise	**A (9)**

Hendel al. Circulation 2009; 119: e561

Stress-Echo

Detection of CAD: Symptomatic—Evaluation of Chest Pain Syndrome or Anginal Equivalent		
4.	• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise	A (9)

Douglas et al. Circulation 2008; 117: 1478

CMR

Detection of CAD: Symptomatic—Evaluation of Chest Pain Syndrome (Use of Vasodilator Perfusion CMR or Dobutamine Stress Function CMR)		
3.	• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise	**A (7)**

Hendel et al. J Am Coll Cardiol 2006; 48: 1475

MDCT

Detection of CAD: Symptomatic—Evaluation of Chest Pain Syndrome (Use of CT Angiogram)		
2.	• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise	**A (7)**

Hendel et al. J Am Coll Cardiol 2006; 48: 1475

TCMD y CRM en la EAC: Papel Respectivo en la Práctica
Unidad de Imagen Cardiaca Sant Pau-Creu Blanca

Asintomático Alto Riesgo	Sintomático Sospecha EAC	Sintomático EAC Conocida
TCMD *Screening*	Ergometría ↓ TCMD ↓ CRM	CRM ↓ Angio Invasiva

Estratificación de riesgo en la C.I. crónica
DETECCIÓN INFARTO SILENTE

Imaging

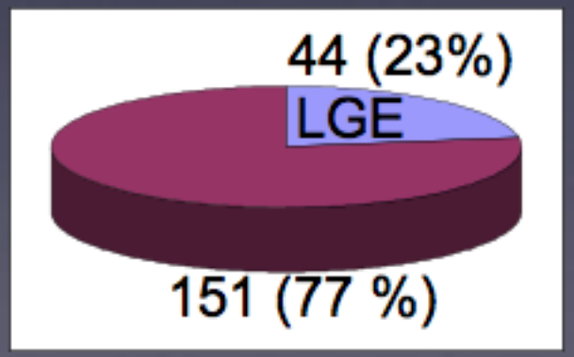
Impact of Unrecognized Myocardial Scar Detected by Cardiac Magnetic Resonance Imaging on Event-Free Survival in Patients Presenting With Signs or Symptoms of Coronary Artery Disease

Raymond Y. Kwong, MD, MPH; Anna K. Chan, MBBS; Kenneth A. Brown, MD; Carmen W. Chan, MBBS; H. Glenn Reynolds, MSc; Sui Tsang, BS; Roger B. Davis, ScD

Circulation 2006;113:2733-2743

Patient Population

We studied a consecutive series of patients with symptoms or signs suspicious of CAD who underwent CMR for clinical purposes. Patients had either (1) an unknown status of CAD and were referred for assessment of LV function and myocardial scar as part of a noninvasive CAD work-up or (2) known angiographically determined CAD and were referred for prediction of segmental wall motion recovery after revascularization. Patients with any of



but no history of MI

Estratificación de riesgo en la C.I. crónica
DETECCIÓN INFARTO SILENTE

followed up for a median of 16 months (range, 6 to 42 months)

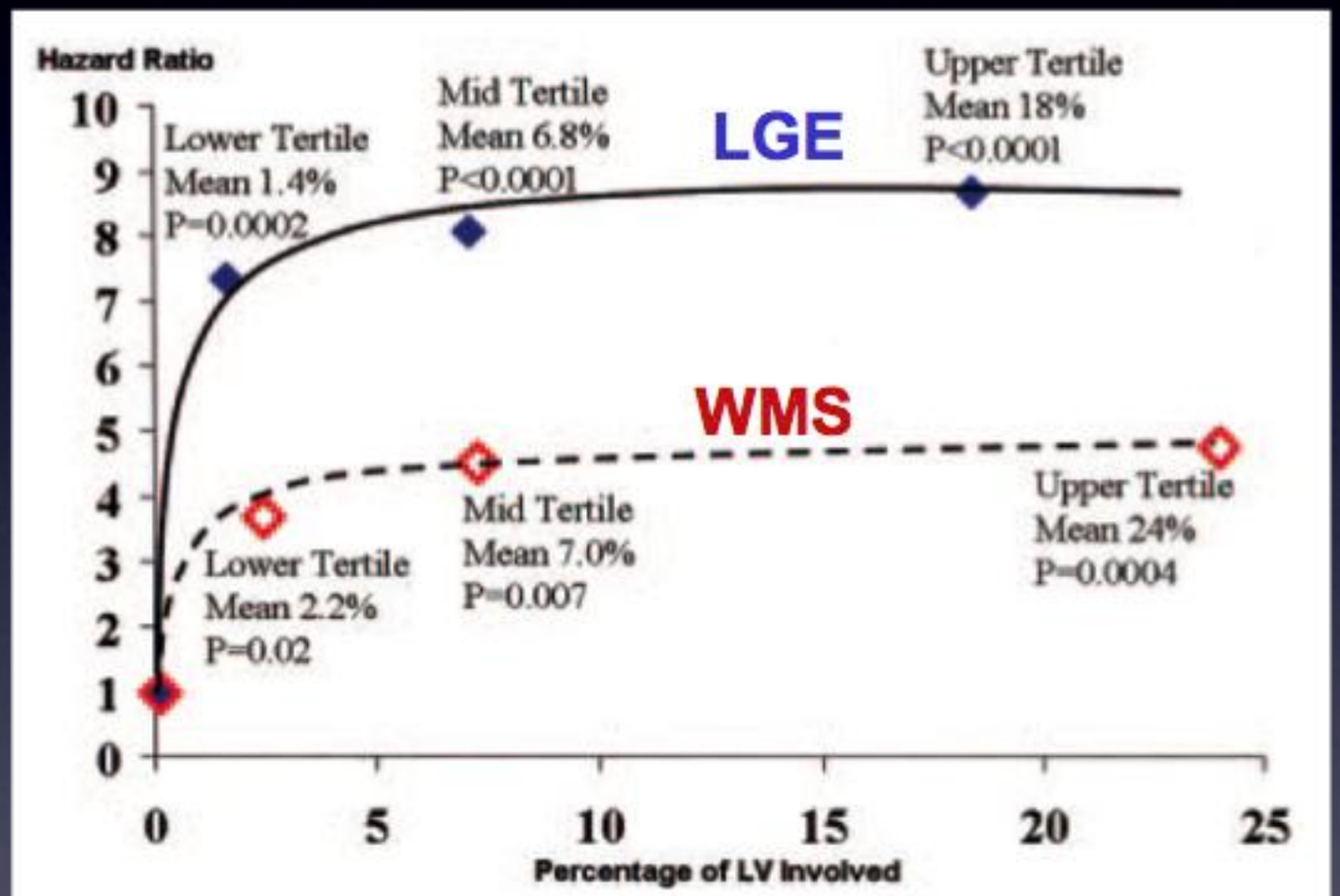
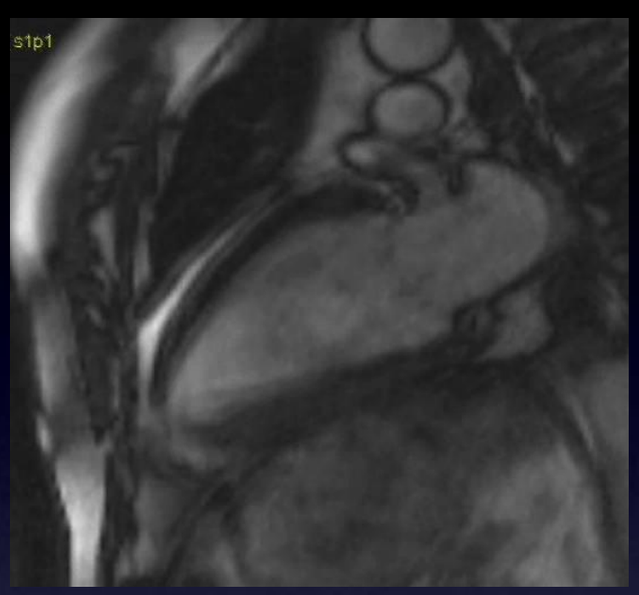
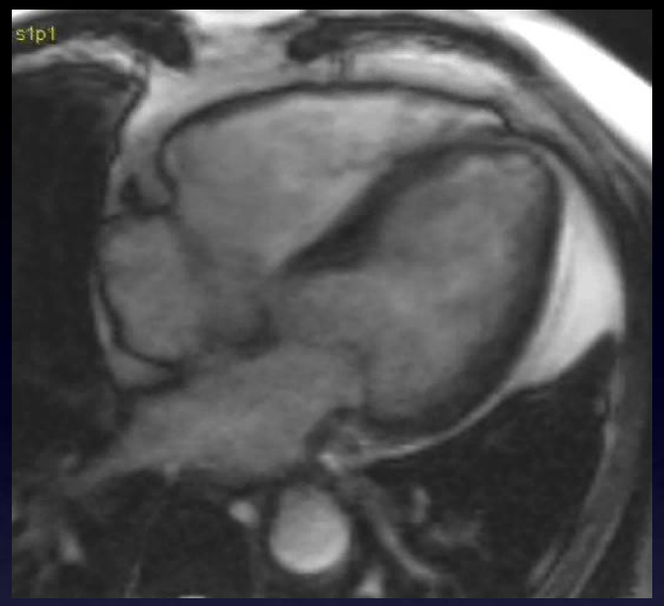


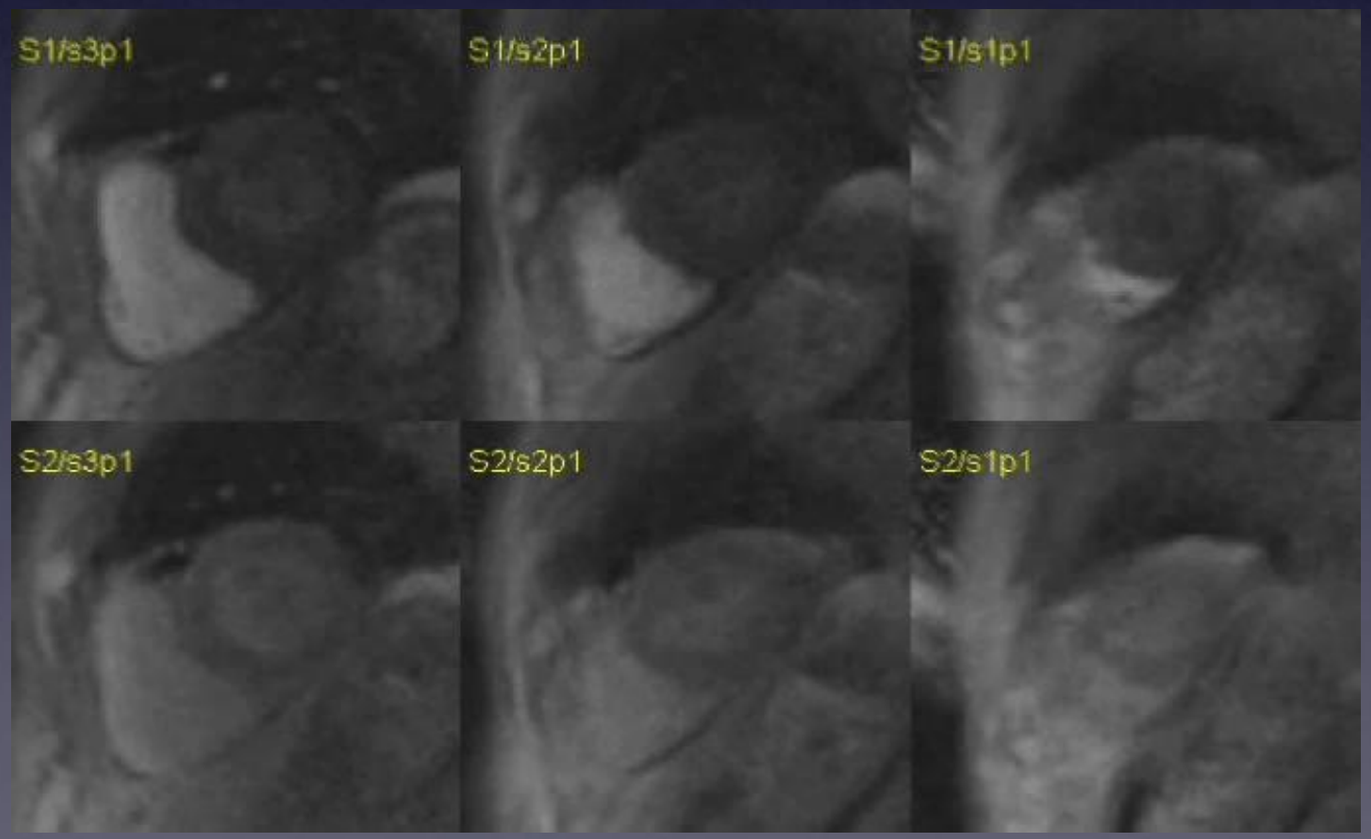
Figure 5. LGE% and WMS% in tertiles and HR for MACE.

Circulation 2006;113:2733-2743

CRM en la Valoración de Pacientes con CTO



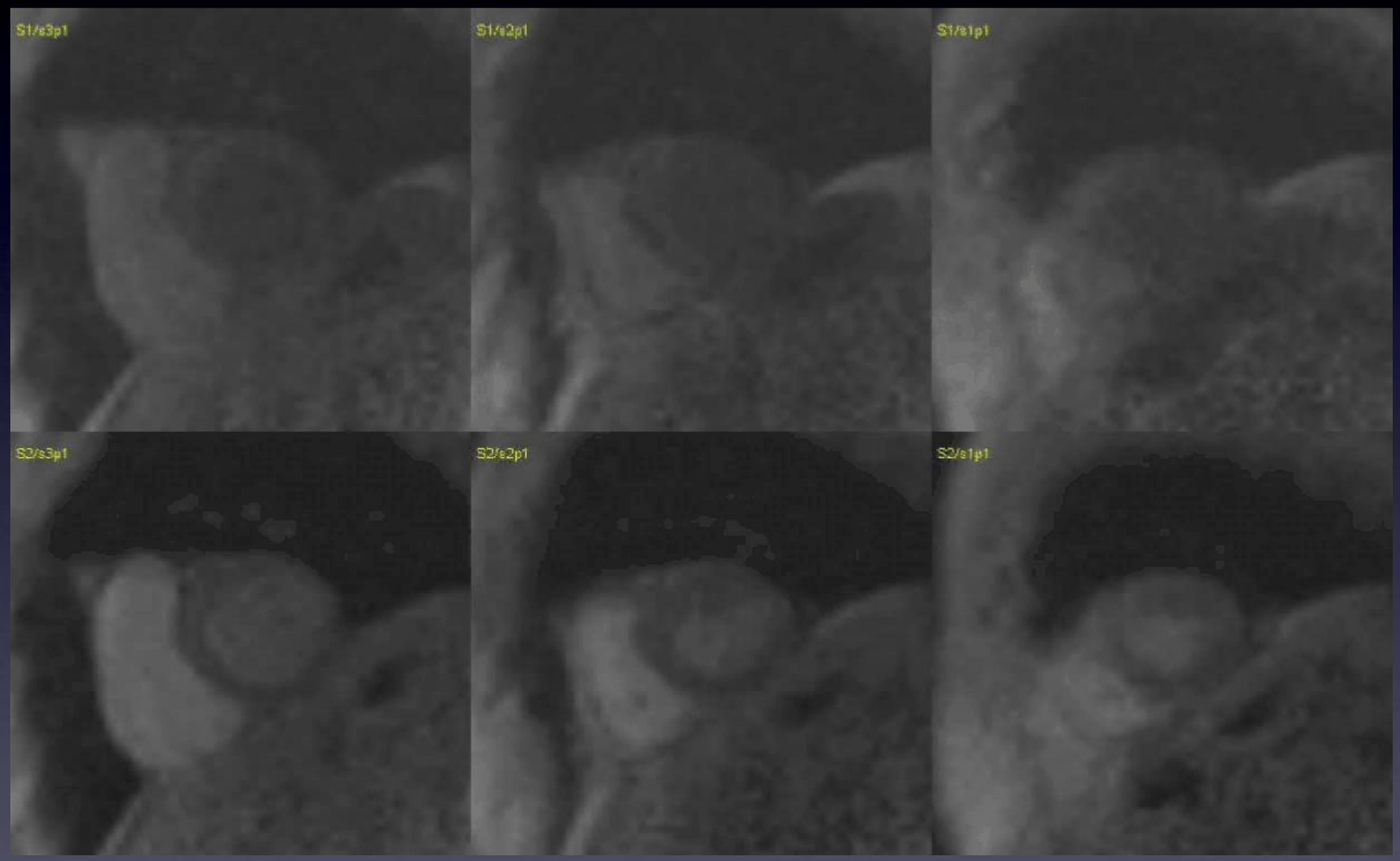


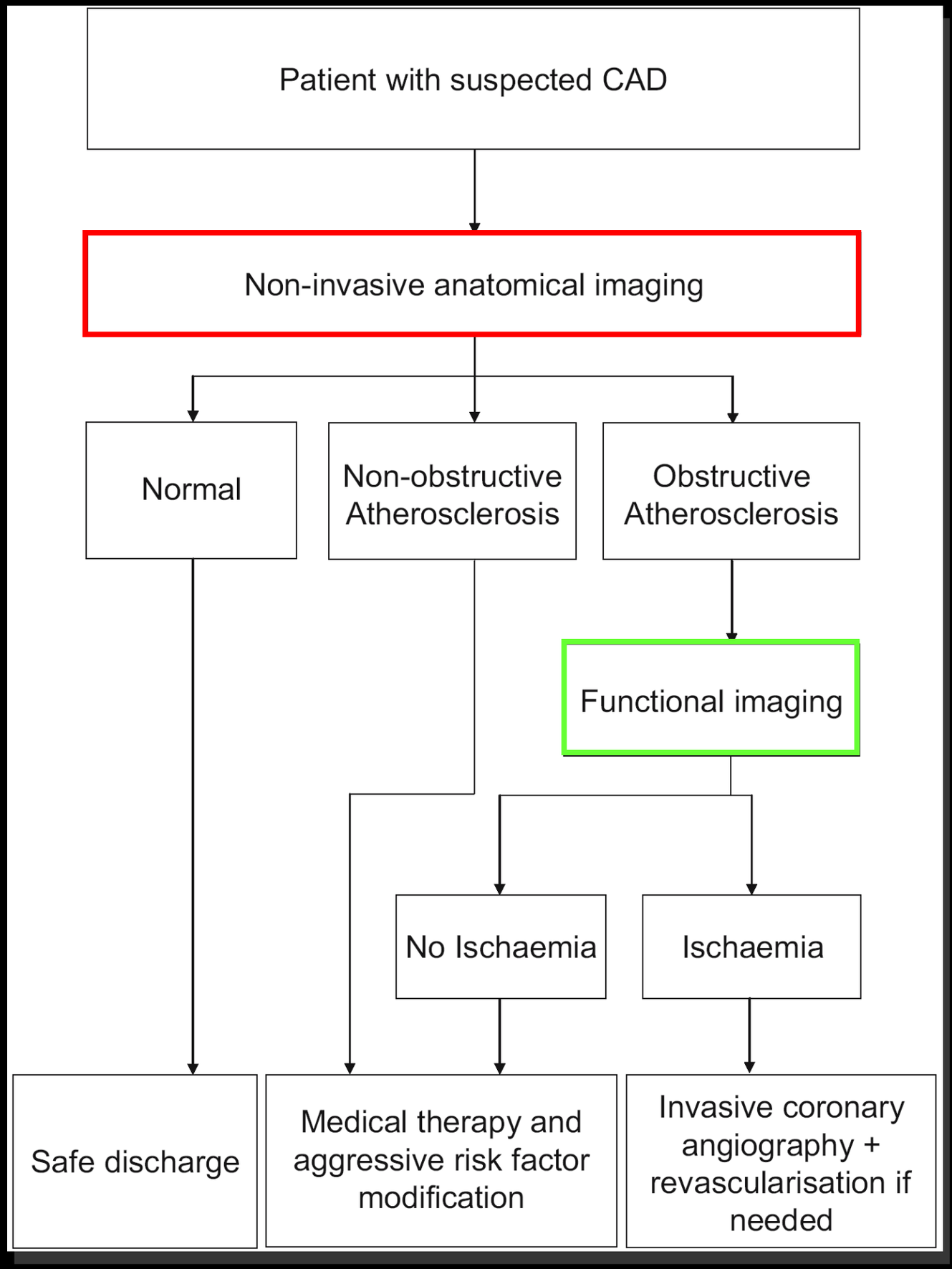


CRM en la Valoración de Pacientes con CTO

ADN

Rest





Schuijf et al. Eur J Nucl Med Mol Imaging 2007; 34: 1