Diagnosi di cardiopatia ischemica cronica: vantaggi e limiti relativi delle tecniche a confronto

RISONANZA MAGNETICA CARDIACA

LORENZO MONTI

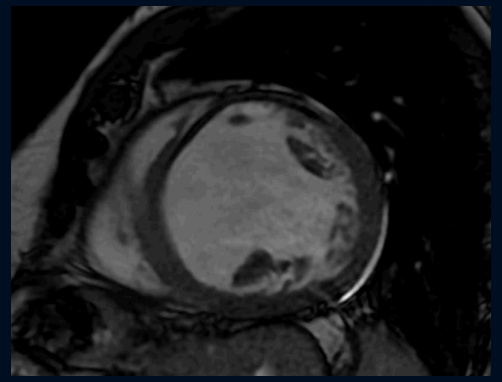
HUMANITAS RESEARCH HOSPITAL – ROZZANO (MI)

Risonanza Magnetica e CAD stabile: IL (MIO) PROTOCOLLO DI STUDIO

.
Localizer,
2-3-4 camere, VD

1- Netta visione endo-epi

(= quantificazione contrattilità)
>40%: segmento normale
10-40%: segmento ipocinetico
<10%: segmento acinetico



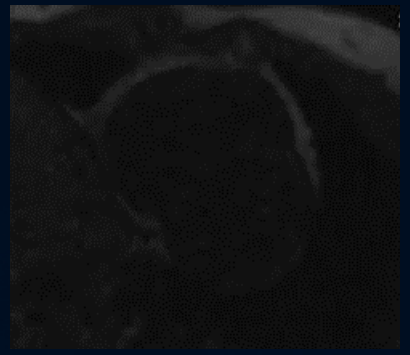
Eventuale stress dobutamina bassa dose

- → VS: Volume, massa, FE VS e WMSI
- → VD: volume ed FE
- → Atrii : volume

1: studio «CINE RM»

Gadolinio!!

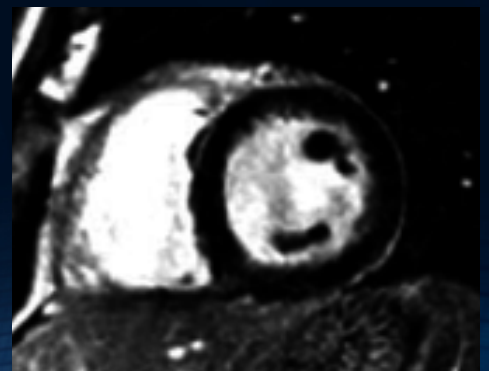
First pass al IV minuto di Adenosina a 140 mcg/Kg/min



→ Diagnosi di ischemia

2: stress perfusion

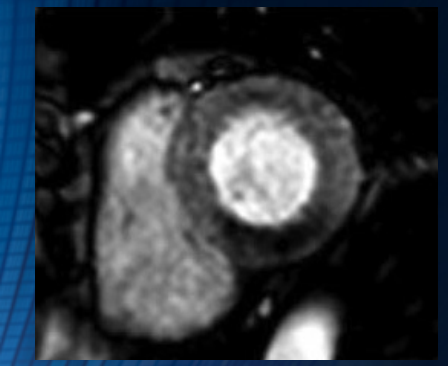
Cine asse corto 8mm gap 2, dopo 10' da mdc iniziano le tardive

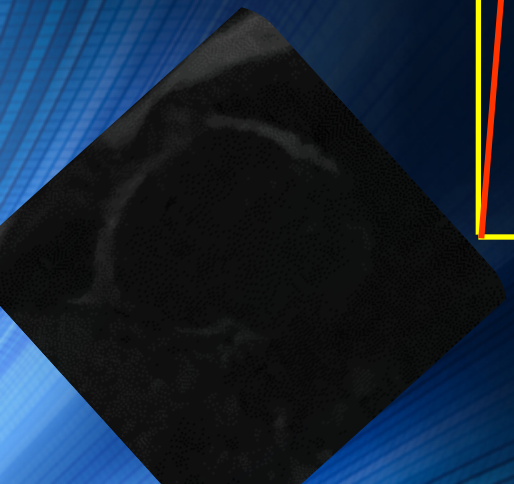


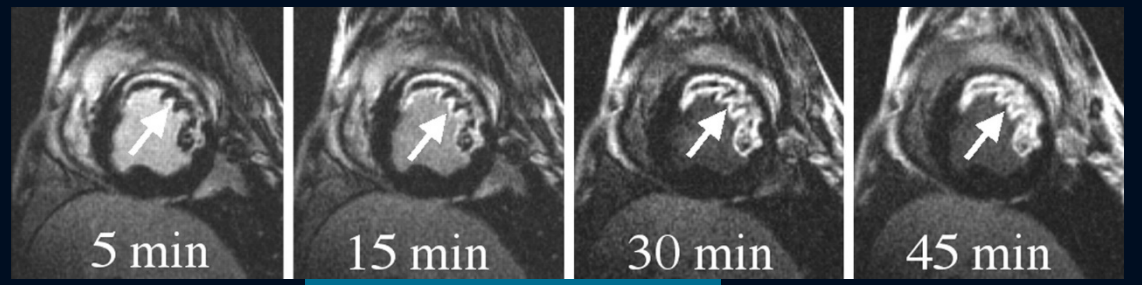
→ Vitalità
→ Diagnosi di ischemia

3: Late Enhancement

La cinetica del gadolinio

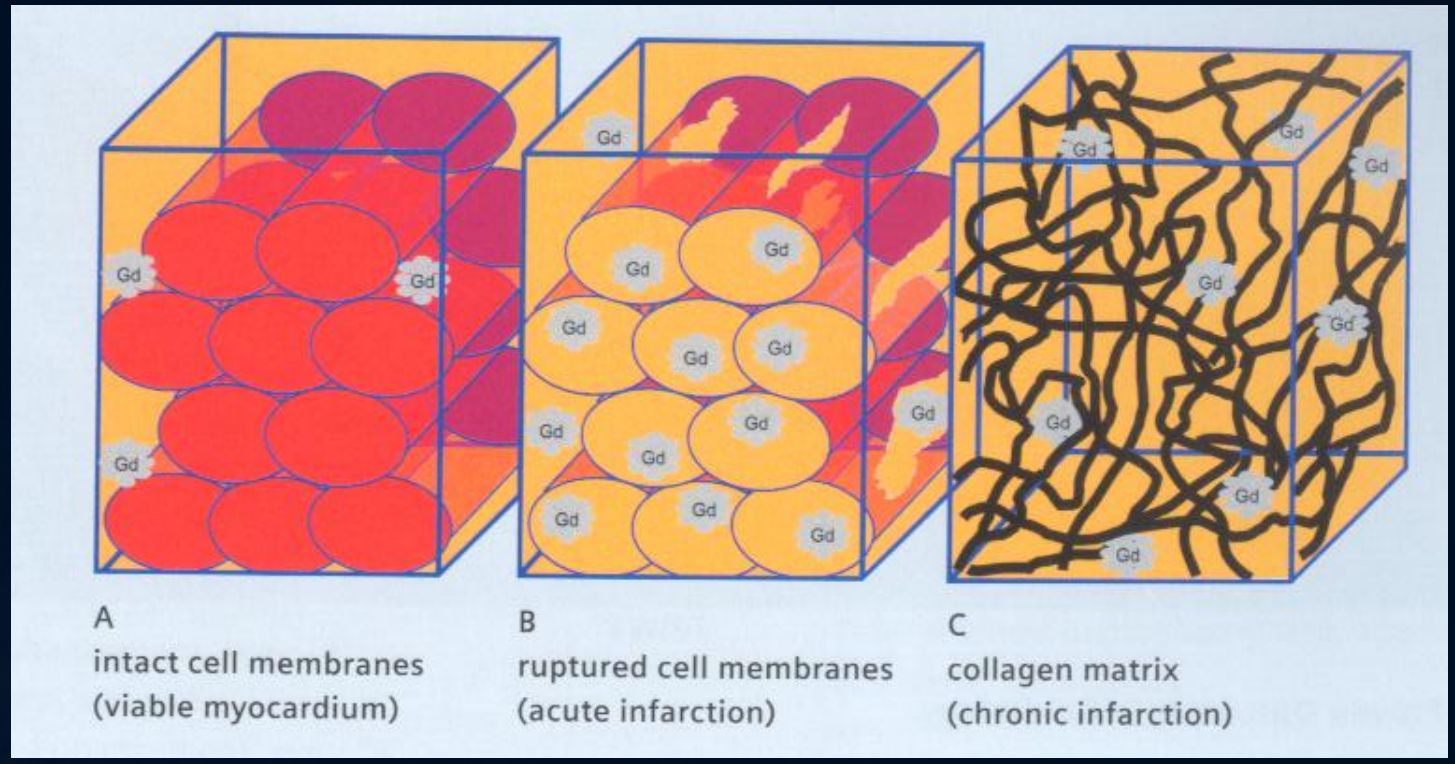






Dopo l'iniezione di gadolinio, si possono identificare 2 distinte fasi di enhancement miocardico:
1- Precoce (perfusione)
2- Tardivo (Delayed Enhancement)

Distribuzione di Gad è extracellulare



Maggiore sicurezza rispetto ai contrasti iodati

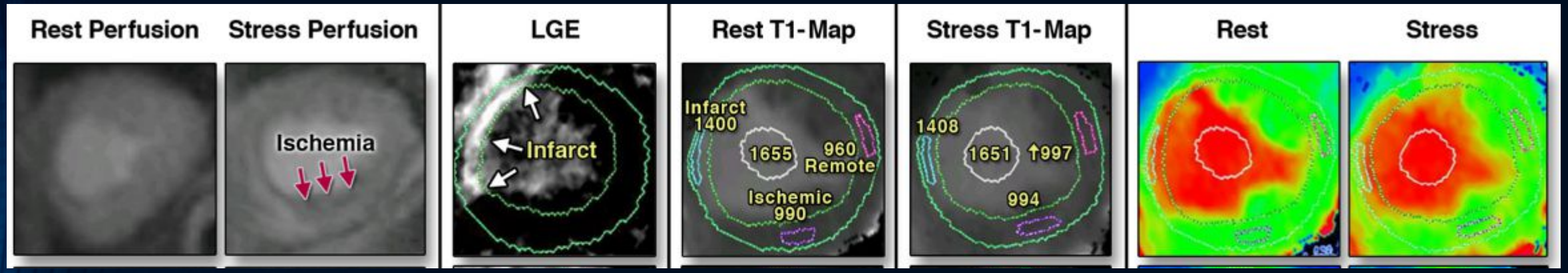
<1% reazioni avverse anafilattoidi

NSF non è mai stata segnalata in pz con eGFR > 30 ml/min

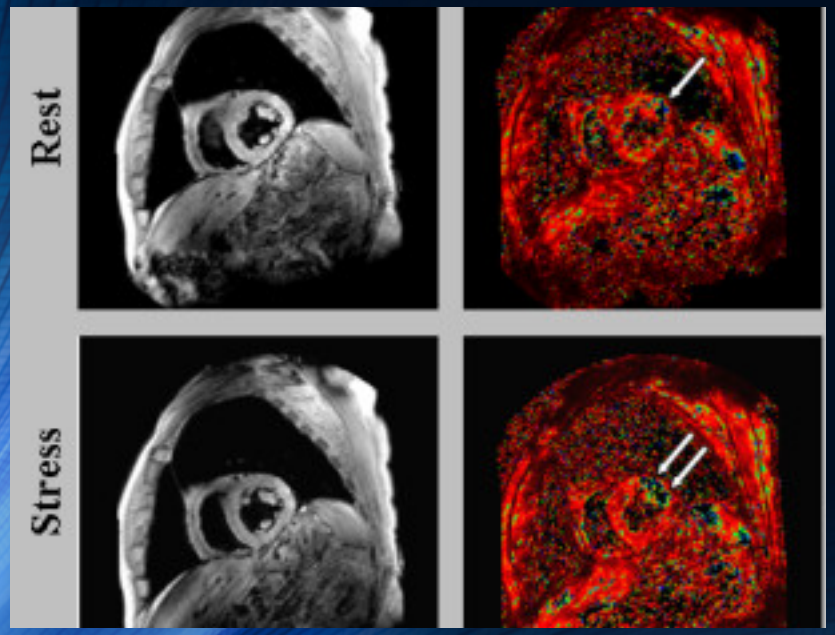
utile comunque avere un dosaggio recente di creatinina

Composti ciclici (forse) più sicuri dei lineari

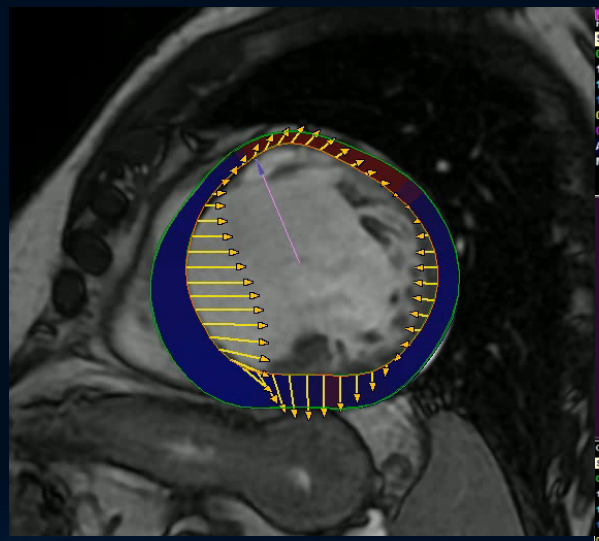
Risonanza Magnetica e CAD : le sequenze che non ho/non uso



Mappe T1 per diagnosi ischemia



BOLD per diagnosi ischemia



Tissue tracking for
Strain / strain rate

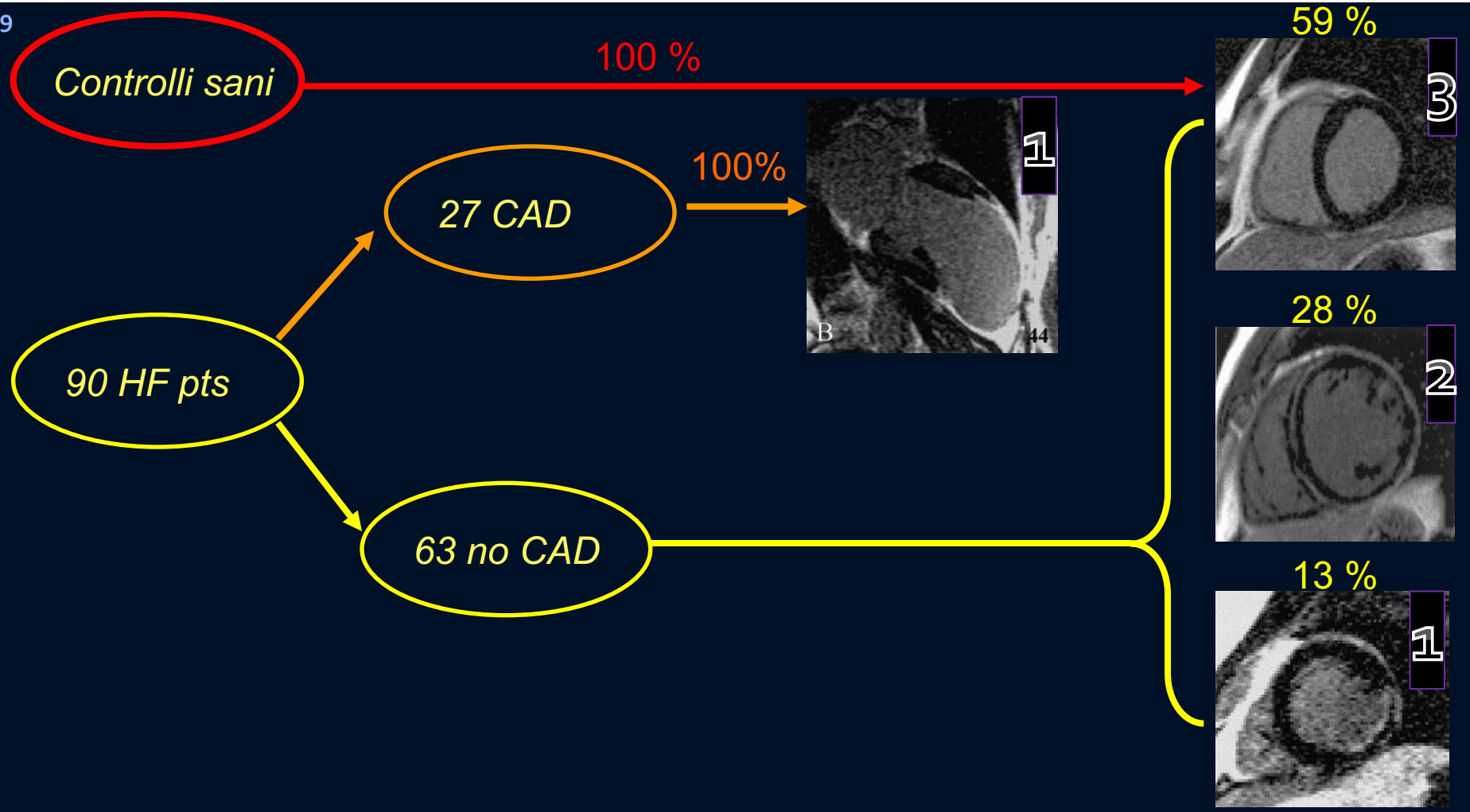
DOMANDE DEL CARDIOLOGO in CAD

1. Il paziente ha cardiopatia ischemica cronica?
2. Quali sono esattamente FE e volume del VS?
3. C'è miocardio vitale? Quanto?
4. Qual è la probabilità di recupero funzionale?
5. C'è anche ischemia?

Differentiation of Heart Failure Related to Dilated Cardiomyopathy and Coronary Artery Disease Using Gadolinium-Enhanced Cardiovascular Magnetic Resonance

J.A. McCrohon, FRACP, PhD; J.C.C. Moon, MB, BS, MRCP;
S.K. Prasad, MD, MRCP; W.J. McKenna, MD, FRCP, FESC; C.H. Lorenz, PhD;
A.J.S. Coats, DM, FRCP, FESC; D.J. Pennell, MD, FRCP, FESC

Circulation 2003;108:54-59



DOMANDE DEL CARDIOLOGO in CAD

1. Il paziente ha cardiopatia ischemica cronica?
2. Quali sono esattamente FE e volume del VS?
3. Miocardio vitale? Quanto?
4. Quale la probabilità di recupero funzionale?
5. Quanta ischemia?

End-diastolic volume (EDV) and ejection fraction (EF) are strong parameters of outcome in a large variety of patient groups

N Engl J Med 2002;346: 877– 83.
N Engl J Med 2005;352:225–37.

Comparison of Interstudy Reproducibility of Cardiovascular Magnetic Resonance With Two-Dimensional Echocardiography in Normal Subjects and in Patients With Heart Failure or Left Ventricular Hypertrophy

Am J Cardiol 2002;90:29–34

TABLE 3 Sample Sizes Required to Detect a Clinically Significant Change in End-Diastolic Volume, End-Systolic Volume, Ejection Fraction, and LV Mass (with a 90% power and an α error of 0.05)*

	Echocardiography		CMR		Reduction in Sample Size by CMR
	SD	Sample Size	SD	Sample Size	
Total study group					
10-ml change in end-diastolic volume	13.5	39	6.7	10	74%
10-ml change in end-systolic volume	14.0	42	5.4	7	83%
10-ml change in stroke volume	13.1	37	5.2	6	84%
3% absolute change in ejection fraction	6.1	87	2.1	11	87%
10-g change in LV mass	25.0	132	7.7	13	90%
Normals					
10-ml change in end-diastolic volume	6.4	9	4.3	4	55%
10-ml change in end-systolic volume	7.0	11	2.8	2	81%
10-ml change in stroke volume	8.0	14	4.0	4	71%
3% absolute change in ejection fraction	5.6	73	1.7	7	90%
10-g change in LV mass	15.9	54	4.2	4	93%
Heart failure					
10-ml change in end-diastolic volume	17.6	66	7.6	13	80%
10-ml change in end-systolic volume	19.7	82	7.4	12	85%
10-ml change in stroke volume	18.0	69	5.9	8	88%
3% absolute change in ejection fraction	7.0	115	2.4	14	88%
10-g change in LV mass	30.4	194	9.6	20	90%
LV hypertrophy					
10-ml change in end-diastolic volume	13.9	41	7.3	12	71%
10-ml change in end-systolic volume	12.2	32	4.6	5	84%
10-ml change in stroke volume	11.5	28	5.5	7	75%
3% absolute change in ejection fraction	5.9	82	2.2	12	85%
10-g change in LV mass	26.9	152	8.4	15	90%

STICH ECHO CORELAB*

STICH TRIAL
2136 PZ

2006 DATASET
(93,9%

1 APICAL VIEW
(72,8%)

2 APICAL VIEWS
(43,5%)

*
FE >35%: 18,5%
FE > 40% 7,9%

MESA TRIAL

5004 PAZIENTI

5004
DATASET
(100%)

4954
VALUTABILI
(99%)

DOMANDE DEL CARDIOLOGO in CAD

1. Il paziente ha cardiopatia ischemica cronica?
2. Quanto sono esattamente FE e volume del VS?
3. C'è miocardio vitale? Quanto?
4. Qual è la probabilità di recupero funzionale?
5. Come va l'ischemia?

The presence and extent of myocardial infarction are strong parameters of outcome and seem to be superior to EDV and EF in a large variety of patient groups.

Circulation 2006;113:2733– 43.
Am J Cardiol 2007;100:930–6.

La vitalità miocardica/miocardio ibernato con RM

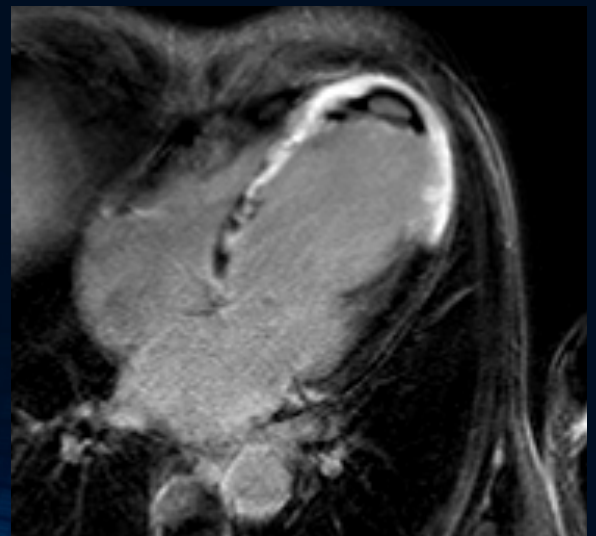
NB: FONDAMENTALE intendersi sui termini

1-Stunning: disfunzione contrattile da ipoperfusione transitoria. Ha edema (T2 +: IMA – Tako Tsubo) senza fibrosi (LGE); recupero spontaneo

2-Miocardio vitale:
miocardio disfunzionante senza fibrosi
Vs.
assenza di fibrosi

3- Miocardio ibernato: disfunzione contrattile per cronica ipoperfusione, recupera se rivascolarizzato.

E' diagnosi retrospettiva! Dopo la ripresa contrattile sarà evidente che l'effetto dell'ischemia era transitorio

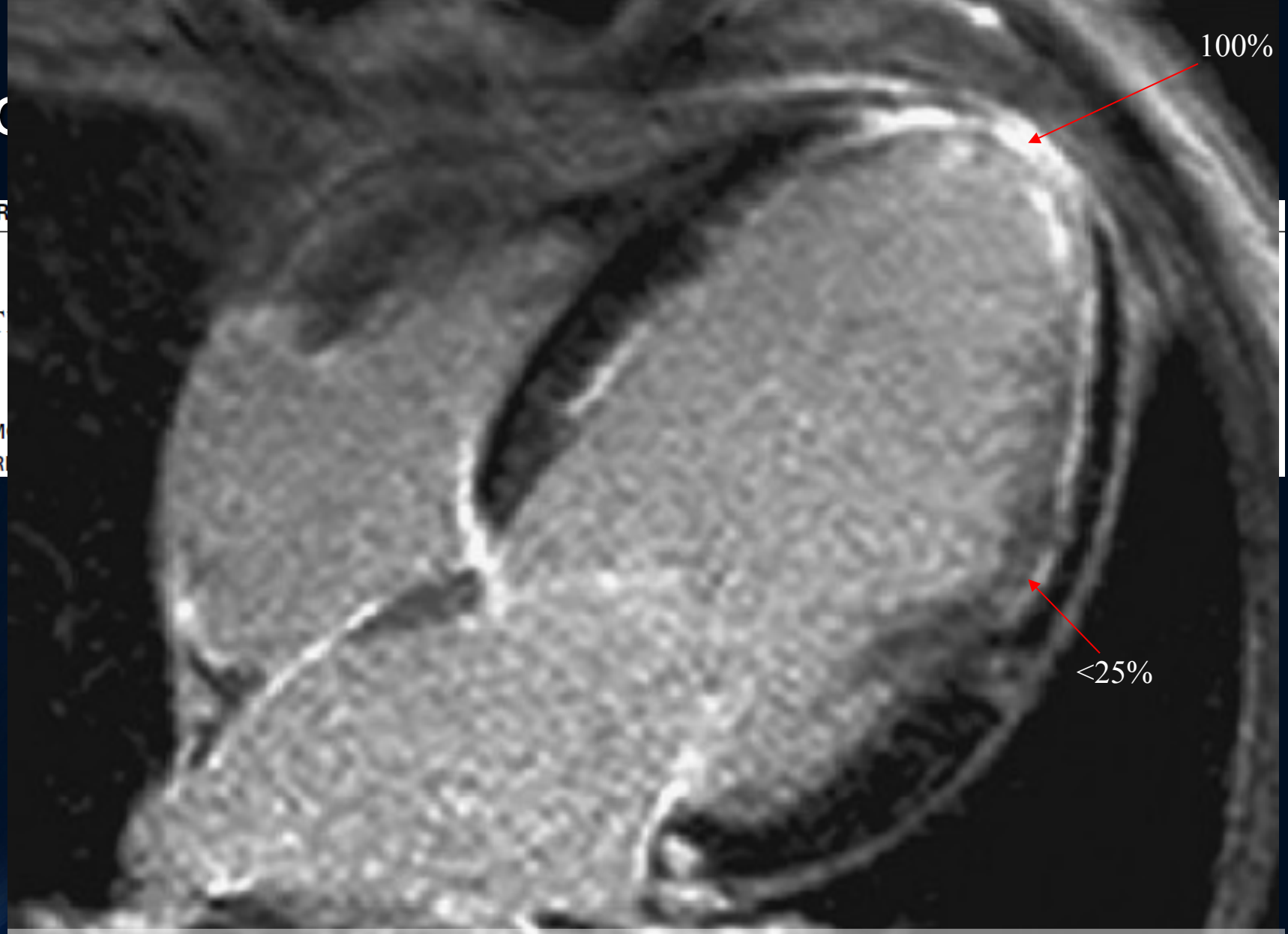


Ric

CONTR

T

RAYM
ORI



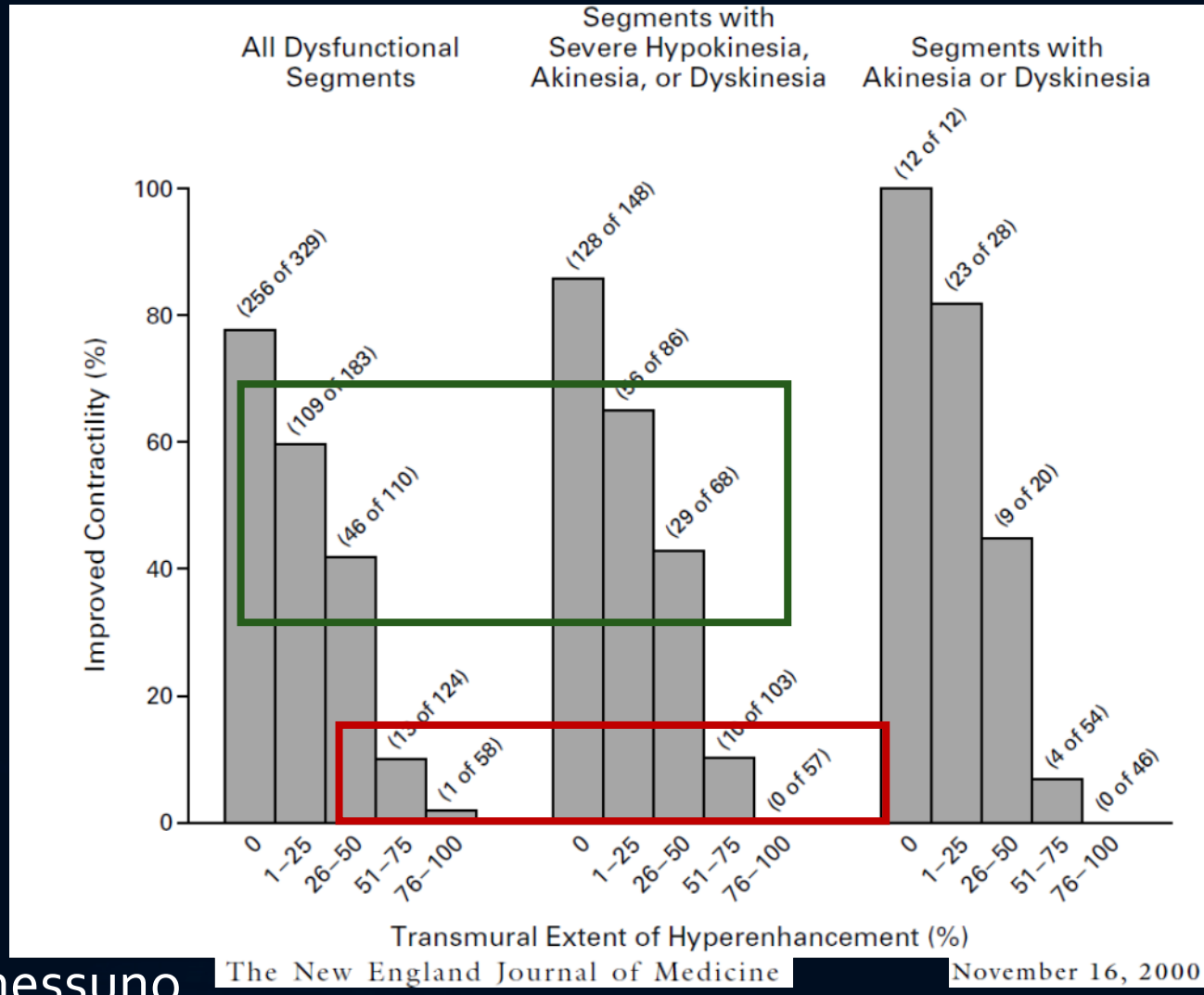
STUDIO DELLA TRANSMURALITÀ DI FIBROSI O "LATE ENHANCEMENT"

«Late enhancement»

- LE: Late Enhancement
- LGE: Late Gadolinium Enhancement
- DE: Delayed Enhancement
- CE: Contrast Enhancement

SONO LA STESSA COSA

- «Impregnazione tardiva»: non lo usa nessuno



QUALI I RISULTATI CLINICI?

RESEARCH

Pegg *et al. Journal of Cardiovascular Magnetic Resonance* 2010, **12**:56

Prediction of global left ventricular functional recovery in patients with heart failure undergoing surgical revascularisation, based on late gadolinium enhancement Cardiovascular Magnetic Resonance

Tammy J Pegg[1,2,3], Joseph B Selvanayagam[1,3], Joslin Jennifer[1], Jane M Francis[1], Theodoros D Karamitsos[1], Erica Dall'Armellina[1], Karen L Smith[4], David P Taggart[2], Stefan Neubauer[1*]

Conclusions: Based on a 50% transmural viability cutoff, patients with ≥10 viable+normal segments improve global LV function post revascularisation, while patients with fewer such segments do not. LGE-CMR is a simple and powerful tool for identifying which patients with impaired LV function will benefit from CABG.

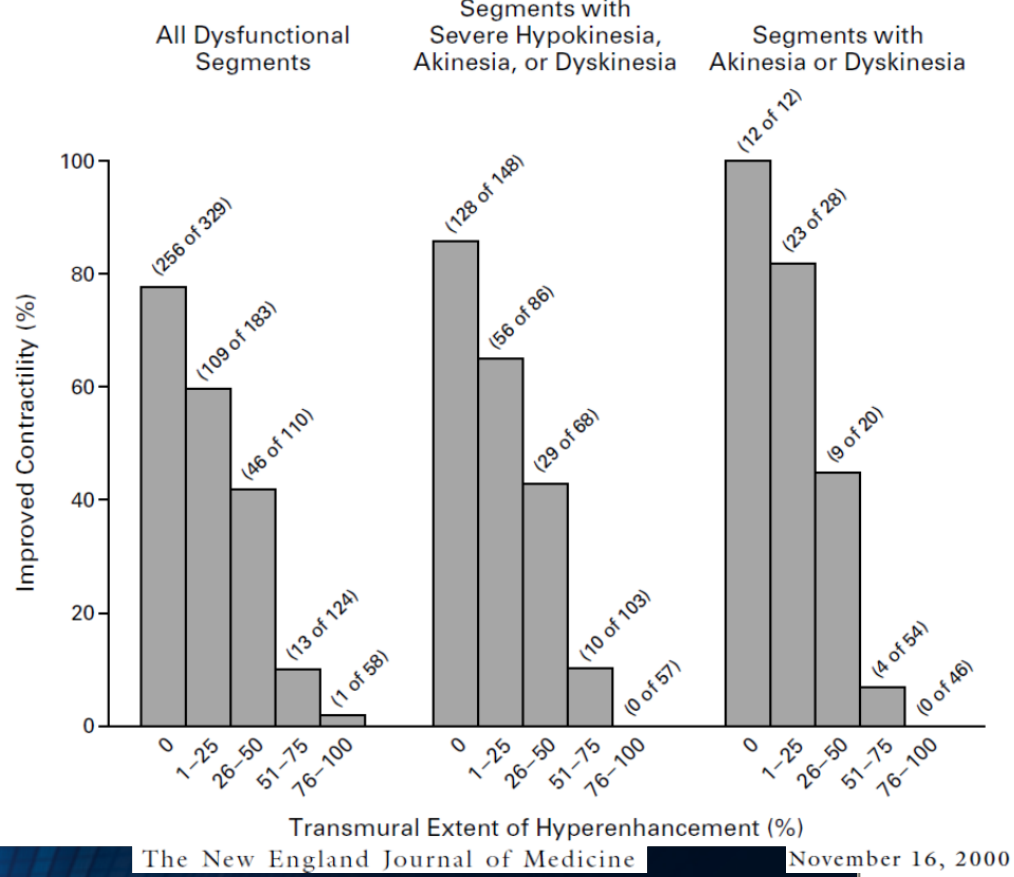
LVEF +3%?? +5%??

STICH TRIAL: VIABILITY

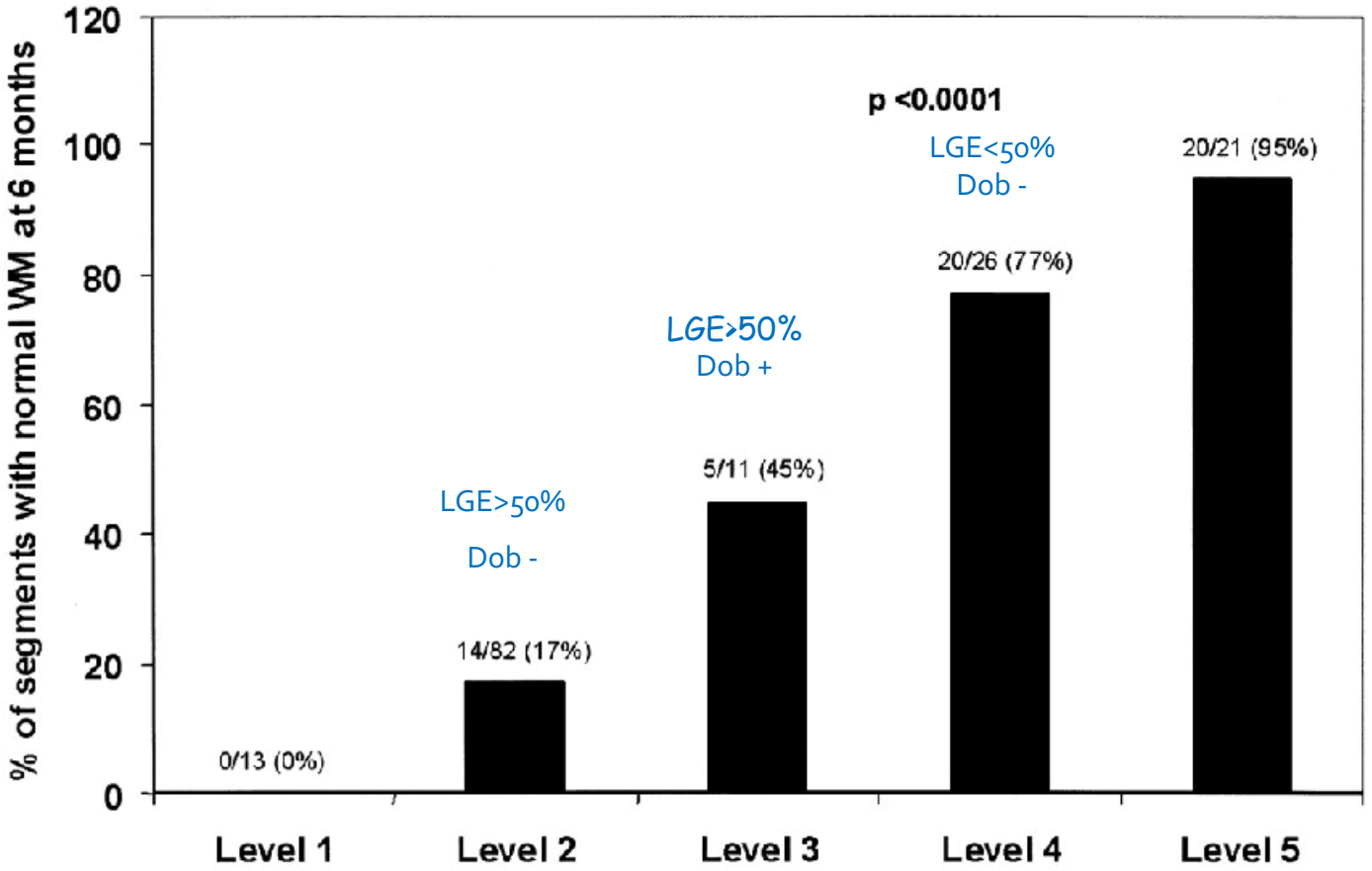
ECHO: >5 segmenti (31%LV mass)*

SPECT: >11 segmenti:65% LV mass

*81% dei pz avevano vitalità



The New England Journal of Medicine November 16, 2000



Wall thickness	-	+/-	+/-	+/-	+/-
Perfusion	-	+/-	+/-	+/-	+/-
Response to dobutamine	-	-	+	-	+
Non-transmural necrosis	-	-	-	+	+

Percentuale di segmenti che normalizzano l'inspessimento sistolico (wall thickening >2 mm) a 6 mesi dalla rivascolarizzazione, divisi in base al "five-level comprehensive score".

Indici di vitalità: spessore >5.5 mm, perfusione normale, inspessimento sistolico >2 mm sotto dobutamina a bassa dose, estensione transmurale della cicatrice <50%.

Bassa dose: migliora stratificazione?

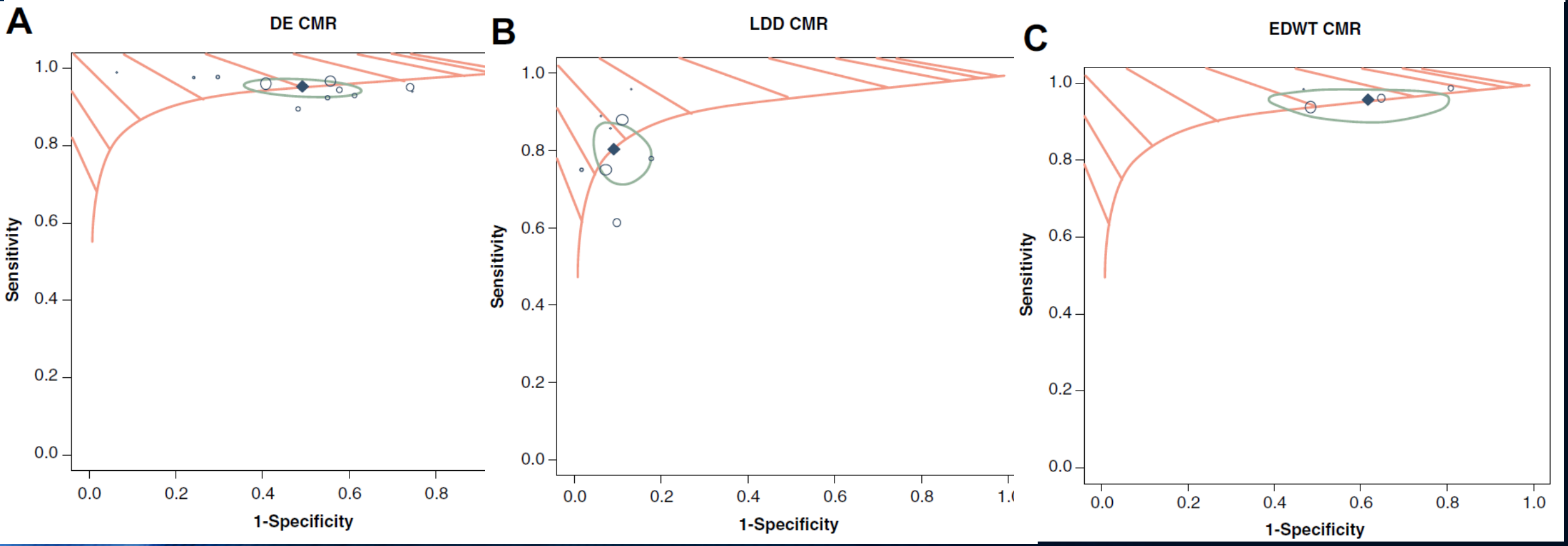
Prognostic Value of Myocardial Infarct Size and Contractile Reserve Using Magnetic Resonance Imaging

AUTORE	NUMERO PZ	TIPO PAZ		
Kaandorp et al. Am J Cardiol 2004;93:1461–4	48	CAD cronica	Piccola <25%→ sempre risposta a bassa dose Scar > 75% → minima risposta Scar 25-75% →utile dobu	
Wellnhofer et al. Circulation 2004;109:2172– 4.	29	CAD cronica Pre e post rivascoalrizz.	DSMR meglio di scar nei segmenti con scar non tansmurale	
Kelle et al. JACC 2009;54:1770–7	177	CAD cronica	Estensione LGE predice prognosi Risposta a bassa dose predice eventi	

CMR Imaging Assessing Viability in Patients With Chronic Ventricular Dysfunction Due to Coronary Artery Disease

A Meta-Analysis of Prospective Trials

JACC: CARDIOVASCULAR IMAGING VOL. 5, NO. 5, 2012



EDITORIAL COMMENT

Myocardial Viability

Dead or Alive Is Not the Question!*

Eike Nagel, MD, PhD, Andreas Schuster, MD

London, United Kingdom

JACC: CARDIOVASCULAR IMAGING, VOL. 5, NO. 5, 2012

MAY 2012:509–12

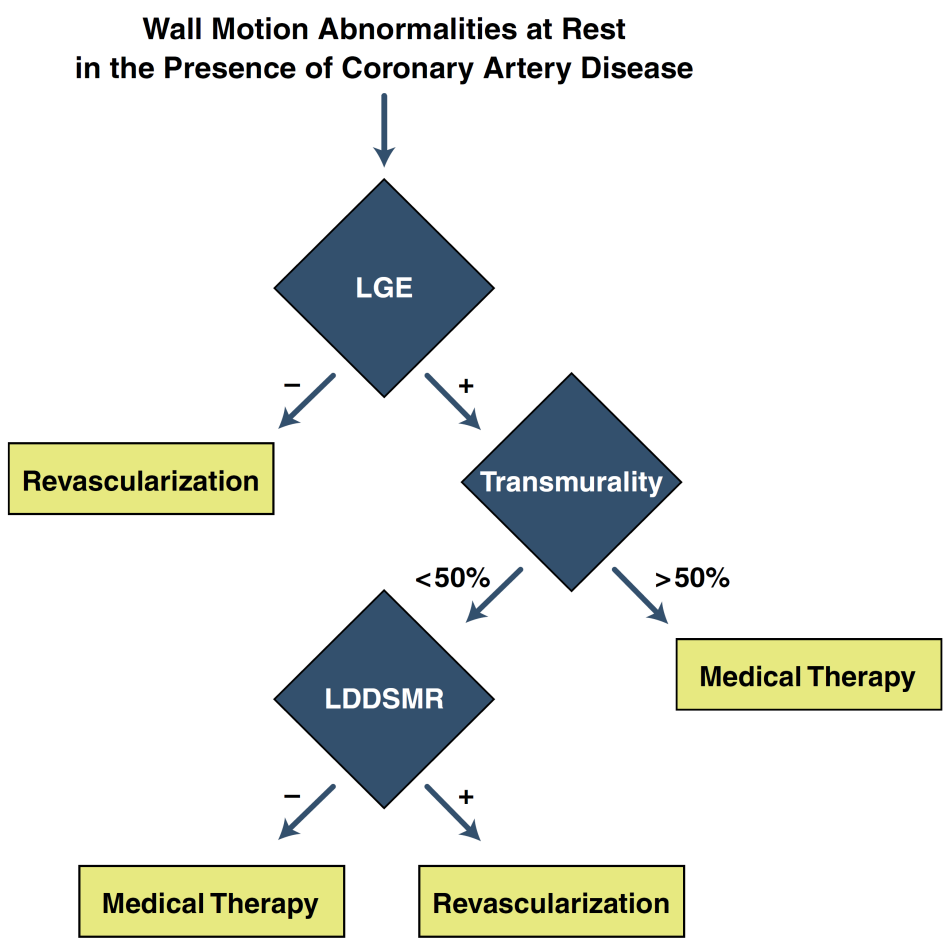


Figure 1. Algorithm to Assess Hibernating Myocardium With CMR

In the presence of wall motion abnormalities at rest in segments subtended by a diseased coronary artery, scar imaging serves as a first-line test. In the absence of scar (likelihood of functional recovery ~78% [19]) and in the presence of scar with a transmurality of >50% (likelihood of functional recovery ~8% [19]), late gadolinium enhancement (LGE) is sufficient to predict functional recovery. In the presence of scars with a transmurality of 1% to 50% (likelihood of functional recovery ~53% [19]), low-dose dobutamine stress magnetic resonance (LDDSMR) testing allows for the assessment of contractile reserve, which guides further management. CMR = cardiac magnetic resonance.

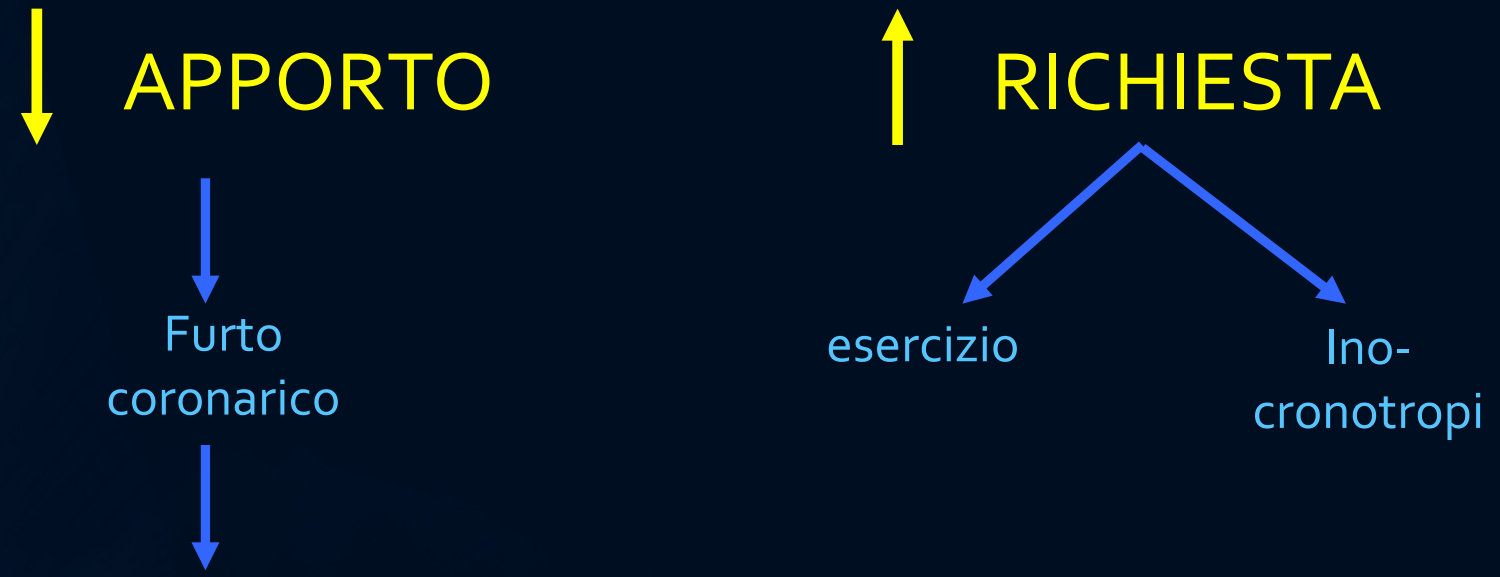
DOMANDE DEL CARDIOLOGO in CAD

1. Il paziente ha cardiopatia ischemica cronica?
2. Sono esattamente FE e volume del VS?
3. Miocardio vitale? Quanto?
4. Quali le probabilità di recupero funzionale?
5. C'è anche ischemia?

The presence of large amounts of myocardial ischemia is a strong predictor of negative outcome.

Circulation 2003; 107:2900 –7.

STRESS RM

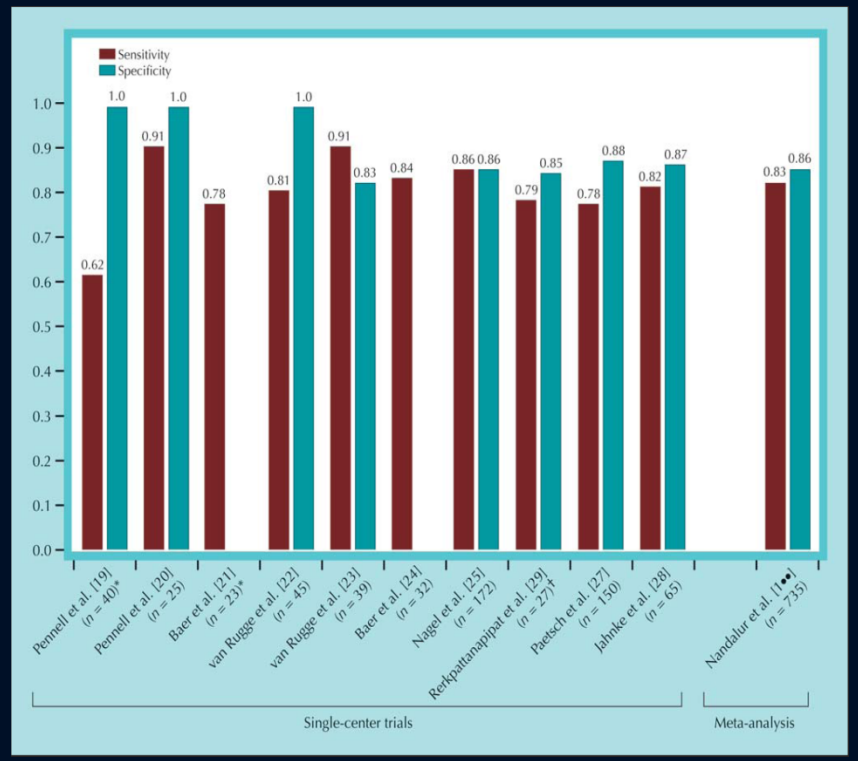

APPORTO
Furto coronarico
Stress adenosina – dipiridamolo (perfusione)
RICHIESTA
esercizio
Ino-cronotropi
Stress dobutamina (WMA)

Risonanza Magnetica – CAD

stress RM

Stress RM dobutamina

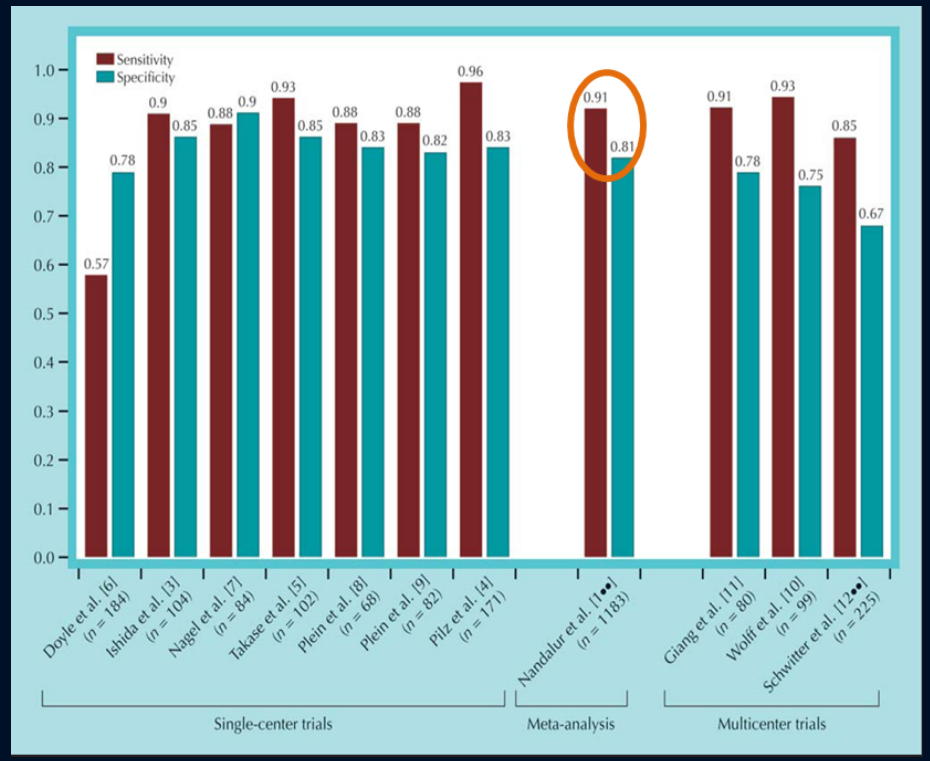
Studio WMA
Reaz. avv. gravi possibili



Ecostress: Non inferiore ma finestra – operatore dip.

Stress RM adenosina

Studio perfusione
Quantificazione
No reaz. avv. gravi

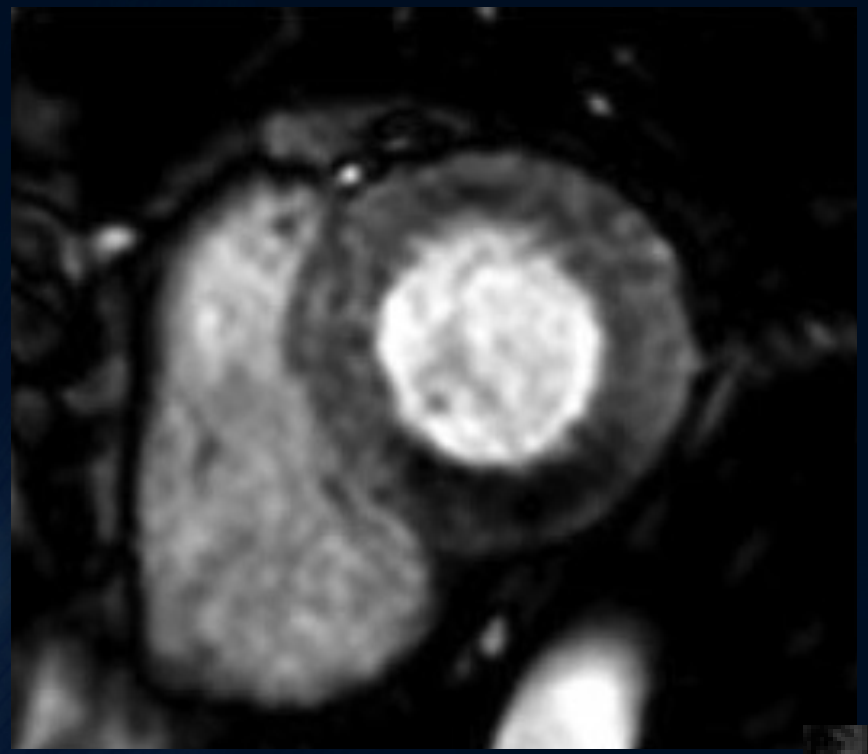


Scinti adenosina:
Sens 90%
Spec 78%

Current Cardiology Reports 2009, 11:54–60

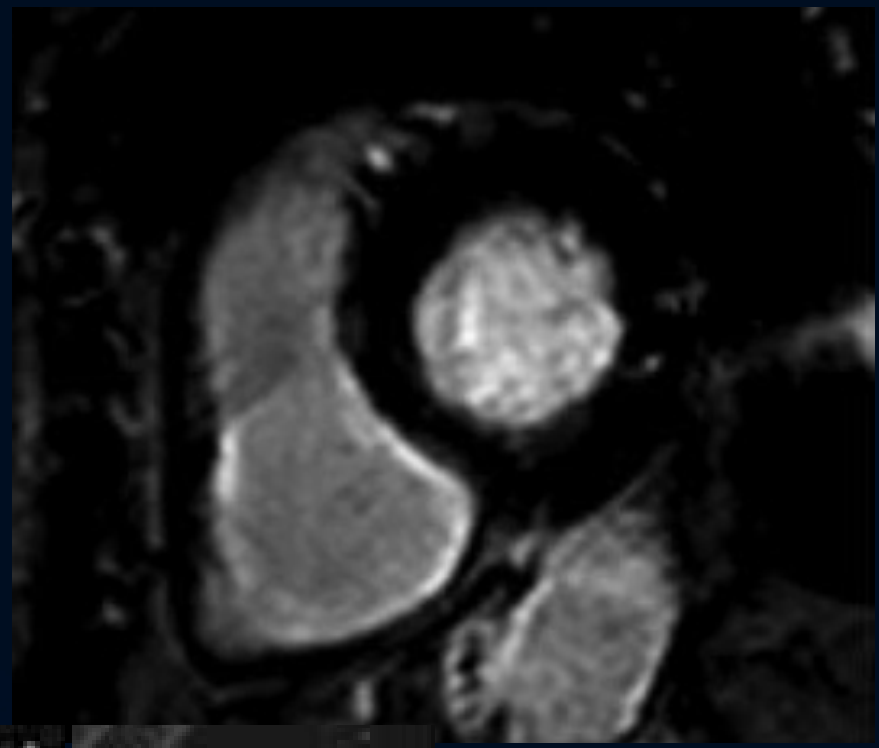
STRESS RM: come si referta stress vs LGE (non vs rest)

Stress perfusion: ritardo

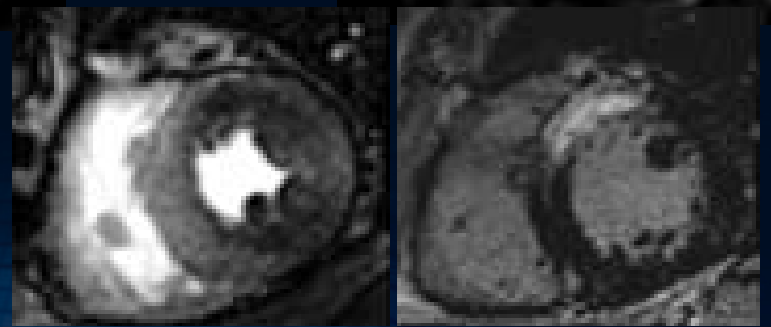


+

LGE assente in sede di ritardo



ISCHEMIA inducibile: un difetto a base subendocardica, con distribuzione coronarica, che perdura per almeno 5 battiti

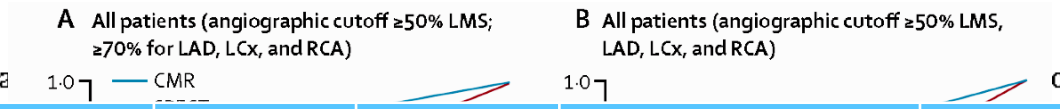


STRESS adenosina: i risultati dei trials clinici

ANNO	Studio	Pz	tipo	Risultato
1998, Eur Heart J	MR IMPACT	234	Multicentrico, vs SPECT e CXA	ROC analisi: MR meglio di SPECT
2012, Eur Heart J	MR IMPACT II	533	Multicentrico, vs SPECT e CXA	1° end point: non inferiorità vs SPECT: verificato
2012, JCMR	MR IMPACT II, subgroup analysis	533	Multicentrico, vs SPECT e CXA	2° endpoint: superiorità RM verificata nei sottogruppi: multivaso, senza IMA, donne…
2012, The Lancet	CE-MARC	752	Monocentrico (Leeds)	CMR meglio di gated SPECT

Cardiovascular magnetic resonance and single-photon emission computed tomography for diagnosis of coronary heart disease (CE-MARC): a prospective trial

John P Greenwood, Neil Maredia, John F Younger, Julia M Brown, Jane Nixon, Colin C Everett, Petra Bijsterveld, John P Ridgway, Aleksandra Radjenovic, Catherine J Dickinson, Stephen G Ball, Sven Plein



Summary

Background In pa… omputed tomography *Lancet* 2012; 379: 453–60

	Sens	Spec	VPP	VPN	Accuratezza
CE MARC (n=752)	86,5	81,4	77,2	90,5	**82%**
HUMANITAS (n=243)	92,9	72,7	50	96,7	**79%**

79·1% (74·8–82·8). The sensitivity and negative predictive value of CMR and SPECT differed significantly (p<0·0001 for both) but specificity and positive predictive value did not (p=0·916 and p=0·061, respectively).

Interpretation CE-MARC is the largest, prospective, real world evaluation of CMR and has established CMR's high diagnostic accuracy in coronary heart disease and CMR's superiority over SPECT. It should be adopted more widely than at present for the investigation of coronary heart disease.

Ischemia: si può quantificare con MR???

14)Perfusion Scoring:

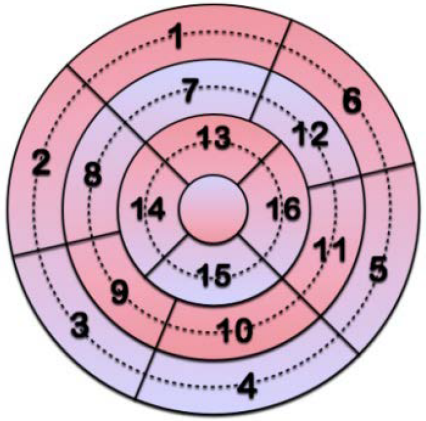
1=Non-Diagnostic

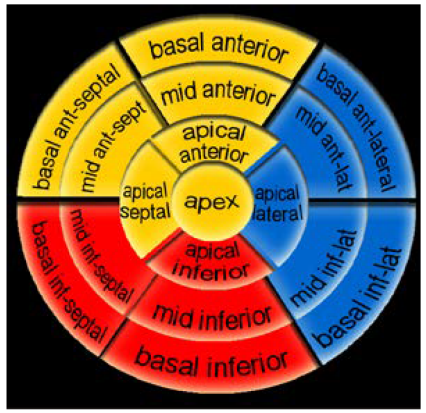
2=Normal

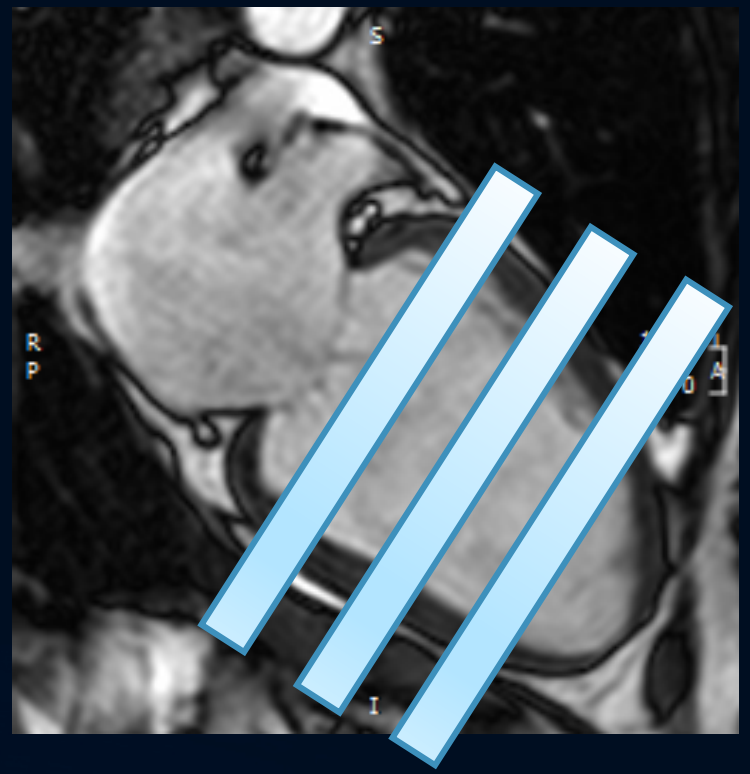
3=1-50% seg with perfusion deficit (**1 sub segment**)

4=51-100 % seg with **transmural** gradient perfusion deficit (**2 sub segments**)

Segments	STRESS	REST
1. Basal anterior		
2. Basal anteroseptum		
3. Basal inferoseptum		
4. Basal inferior		
5. Basal inferolateral		
6. Basal anterolateral		
7. Mid anterior		
8. Mid anteroseptum		
9. Mid inferoseptum		
10. Mid inferior		
11. Mid inferolateral		
12. Mid anterolateral		
13. Apical anterior		
14. Apical septal		
15. Apical inferior		
16. Apical lateral		
Total of Sub Segments		







15)Severity of Ischemia: **Moderate:** ☐ **Severe**: ☐

16)Comments:

A chi faccio stress RM

1- Pz con pregresse multiple rivascolarizzazioni
    prericoveri
    sintomi atipici in pluri rivascolarizzati

2- Dubbia rilevanza di stenosi coronariche
    CTO (ischemia > 10% massa VS = 30% dei casi)
    lesioni non culprit di IMA

3- Test ergometrico non conclusivo e rischio medio-alto.

4- Mismatch clinica / precedenti esami (eco , spect; CCTA)

A quanti faccio stress RM

HUMANITAS 2016

1- ricerca ischemia miocardica CON STRESS ADENOSINA

CARDIOLOGI

31% dell'attività di cardioRM

4-5 mesi lista attesa SSN: limitata disponibilità

sempre maggiore ricorso a CCTA

2- ricerca vitalità in CAD, ± LDDobu

CARDIOCHIRURGHI

5% dell'attività cardio RM

3- diagnostica di CMD ischemica vs. non ischemica: 3%

Risonanza Magnetica Cardiaca

VANTAGGI

- Senza radiazioni
- Caratterizzazione strutturale
- Gold standard in FE e VTD
- Gold standard per la visualizzazione dell'infarto
- Massima accuratezza nella diagnosi di ischemia

SVANTAGGI

- Limited access in cardiology Contra-indications
- Functional analysis limited in arrhythmias
- Limited 3D quantification of ischaemia (…)
- Cost