



VII CONGRESSO DI **ECOCARDIOCHIRURGIA**



ICHI

La valutazione della funzione contrattile, della perfusione miocardica e della composizione tissutale con RM nella caratterizzazione dei pazienti con cardiopatia ischemica cronica.

Il confronto con la medicina nucleare e l'eco-stress.

Dr Lorenzo Monti

*Radiologia, Cardiologia
I.R.C.C.S. Istituto Clinico Humanitas
Rozzano - MI –
Milano, 6 Maggio 2014*

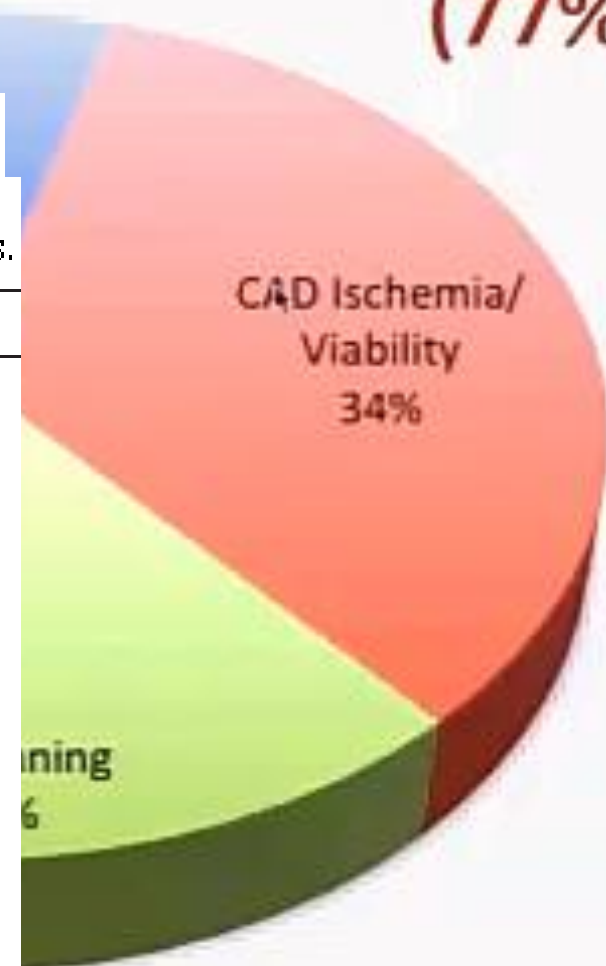
Reasons of CMR Referral

N= 32,840
(77%)

Italian registry of cardiac magnetic resonance

Table 2 European Journal of Radiology 83 (2014) e15–e22
Clinical indications to CMR with corresponding examination's results.

Clinical indication	Prevalence
ARVC	11.2%
Iron Overload	9.9%
Acute myocarditis	9.8%
HCM	9.2%
DCM	8.7%
<u>Viability</u>	<u>6.9%</u>
AMI	5.9%
<u>Ischemia/stress</u>	<u>3.0%</u>
Non-compaction	3.0%
Myocardial storage disease	2.2%
Cardiac and pericardial masses	1.8%
Tako-tsubo	1.1%
Congenital disease	0.6%
Valvular disease	0.5%
Pericardial disease	0.4%
Pulmonary hypertension	0.4%
Biventricular function	0.3%



** Non-cardiac MRA not included

Cardiopatía ischemica cronica.

Quali possibilità per l'imaging di II livello?

1. Il sintomo è dovuto a ischemia inducibile?
 - **Ricerca ischemia**: devo procedere a diagnostica invasiva
2. Ha senso rivascolarizzare questo territorio?
 - **Ricerca vitalità**: coronarie di solito già note, ma devo rivascolarizzare?
3. Volumi, struttura e FE del ventricolo sinistro
 - Valutazione funzionale** per:
 - ICD? CRT?
 - CCH (mitrale ischemica? Plastica ventricolare?)
 - prognosi



PARTE 1: VITALITA' MIOCARDICA

CORONARIA CHIUSA

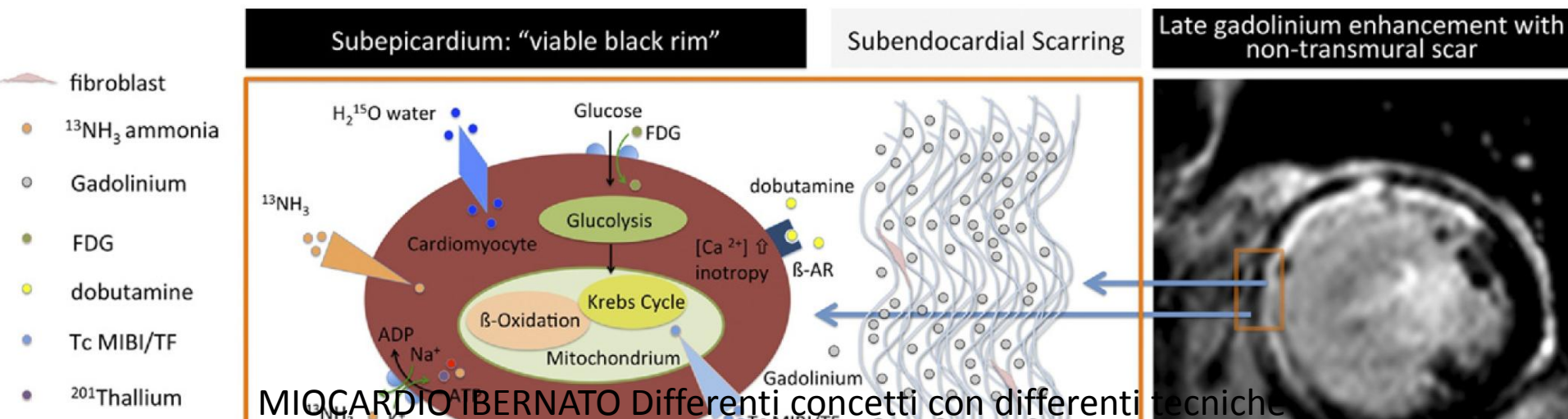
MIOCARDIO ASSOTTIGLIATO in CAD

1. Miocardio vitale:
 - Disfunzionante, senza (SIGNIFICATIVA QUOTA DI) fibrosi
2. Miocardio ibernato:
 - Definizione retrospettica: include il recupero della funzione – solo allora si può definire che l'effetto dell'ischemia fosse transitorio



Imaging in the Management of Ischemic Cardiomyopathy

Special Focus on Magnetic Resonance

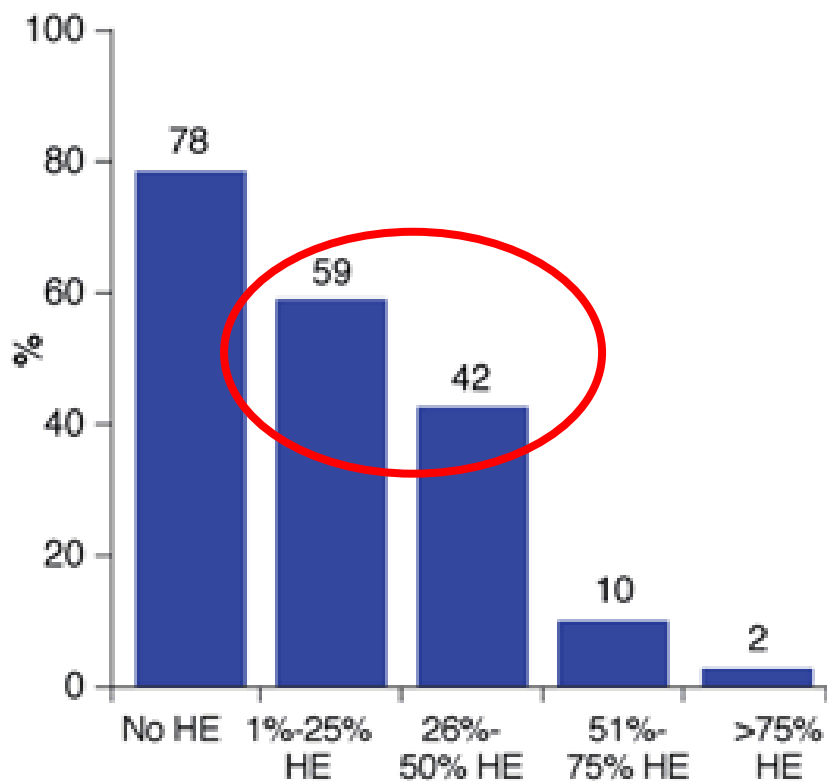


Modalities and Targets	Metabolism	Perfusion	Nonviability Scar	Contractile Reserve
CMR	-	+	+	+
CT	-	+	+	-
Echocardiography	-	+	(+)	+
PET	+	+	-	-
SPECT	+	+	-	(+)
	Assessment of functional integrity of myocardial cells	Detection of blood flow toward the myocardium	Exact localization and size of necrosis/fibrosis	Assessment of contractile function

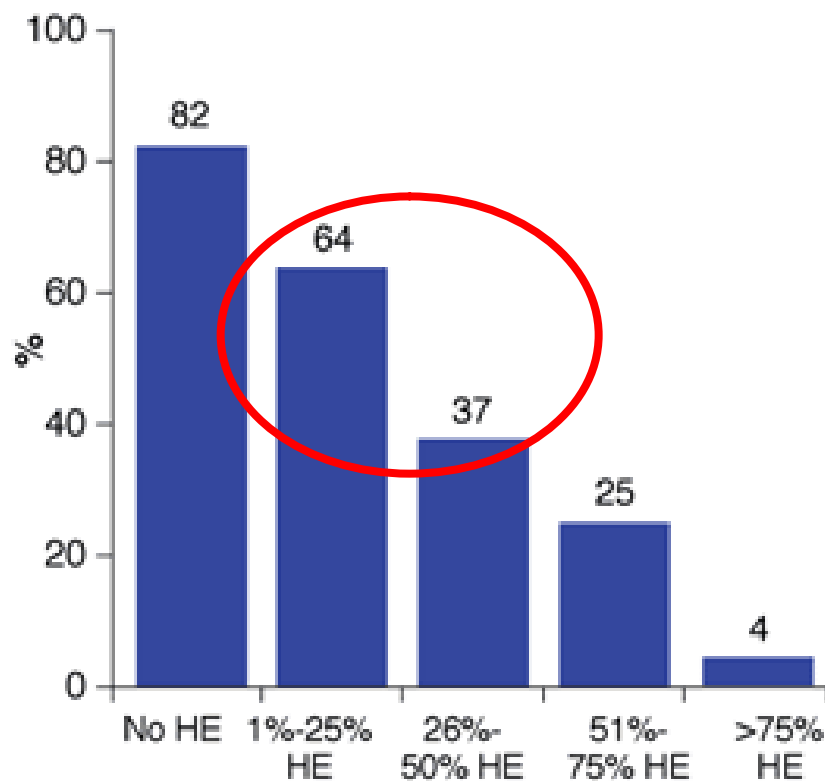


Risonanza Magnetica e miocardio ibernato

Percentage of segments with regional function improvement at 3 months (Kim et al.)



Percentage of segments with regional function improvement at 6 months (Selvanayagam et al.)

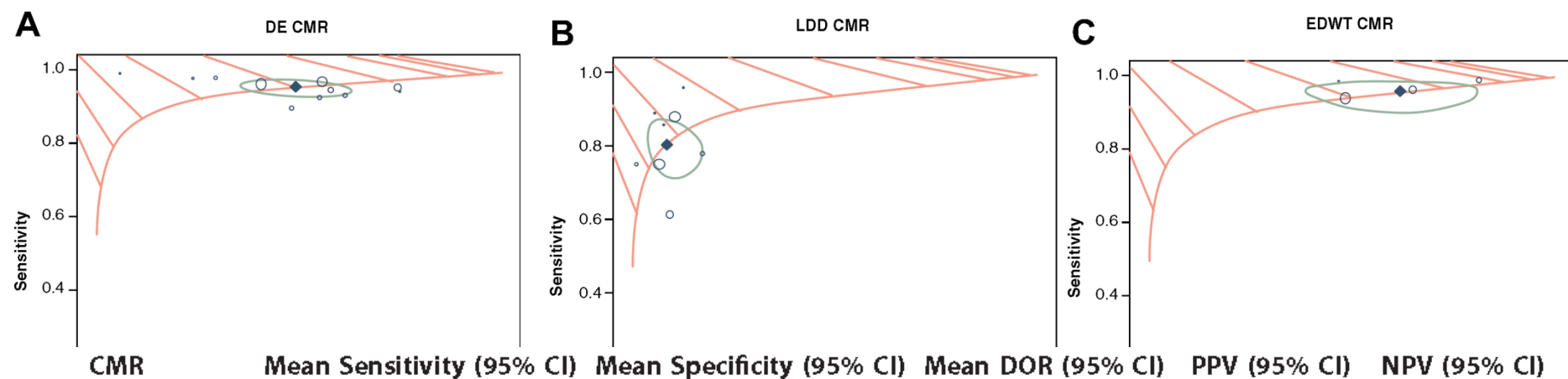


<25% necrosi
>50% necrosi

→ recupero
→ recupero improbabile

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

A Meta-Analysis of Prospective Trials

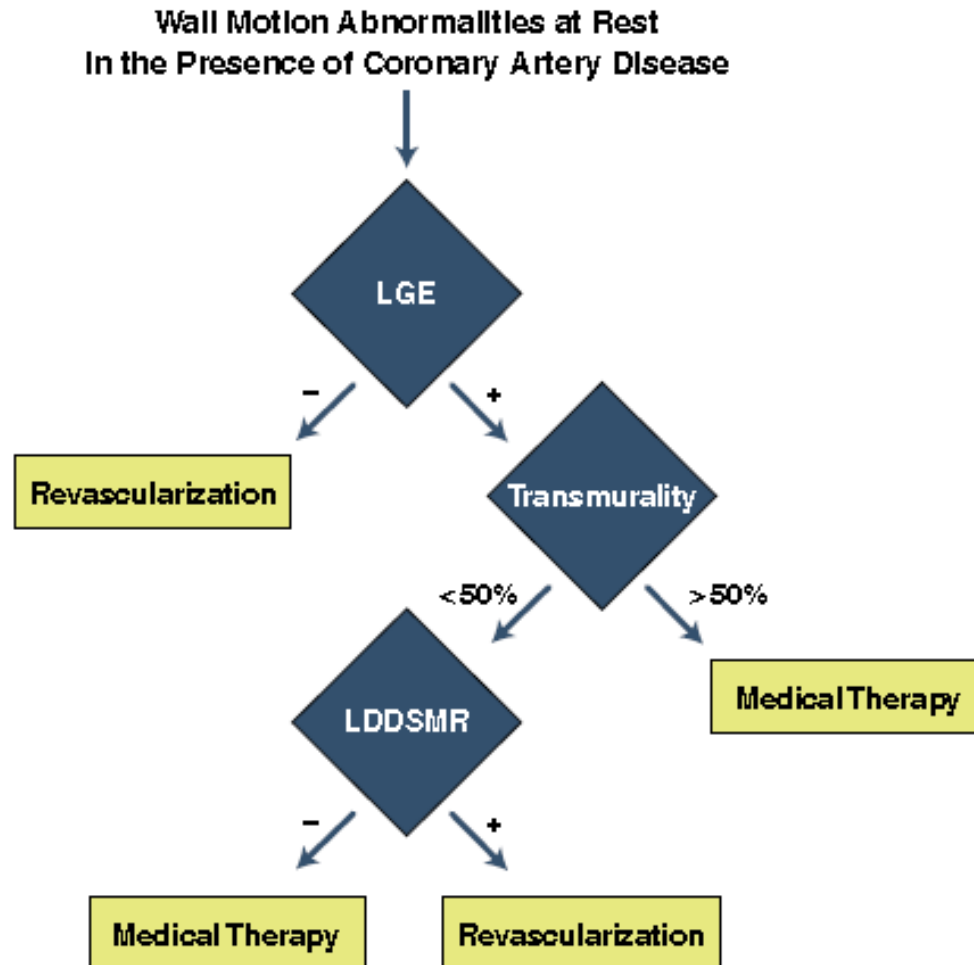


CMR	Mean Sensitivity (95% CI)	Mean Specificity (95% CI)	Mean DOR (95% CI)	PPV (95% CI)	NPV (95% CI)
DE CMR	0.95 (0.93–0.97)	0.51 (0.40–0.62)	21.12 (10.98–40.55)	0.69 (0.56–0.80)	0.90 (0.85–0.93)
LDD CMR	0.81 (0.73–0.86)	0.91 (0.84–0.95)	41.57 (18.25–94.68)	0.93 (0.87–0.97)	0.75 (0.65–0.83)
EDWT CMR	0.96 (0.91–0.98)	0.38 (0.23–0.57)	13.33 (4.16–42.74)	0.71 (0.49–0.86)	0.85 (0.70–0.93)

CONCLUSIONS DE CMR provides the highest sensitivity and NPV, whereas LDD CMR provides the best specificity and PPV. In light of these findings, integrating these 2 methods should provide increased accuracy in evaluating patients with chronic LV dysfunction being considered for revascularization.



RICERCA VITALITA': in pratica

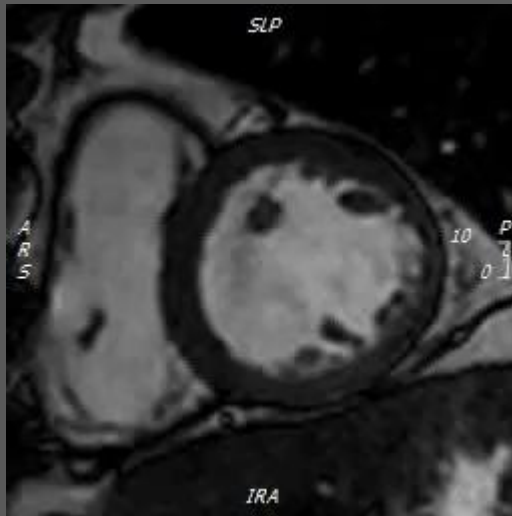


VTD 196 ml
FE 56%
Massa 150 g

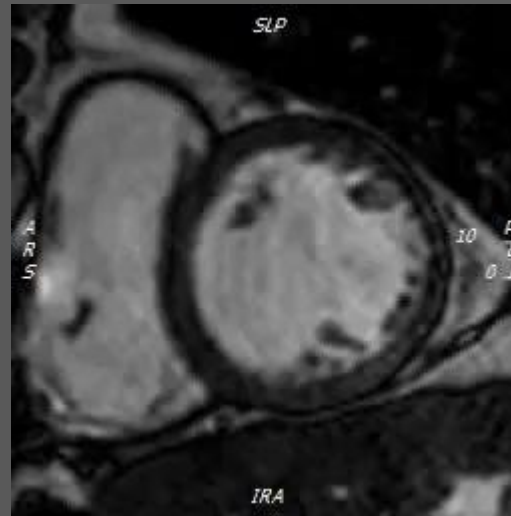
CTO IVA e CD

Vitalità anteriore +
infero-posteriore
NO LGE

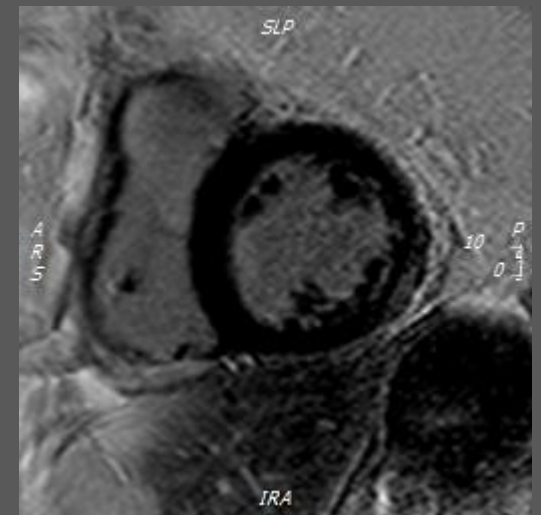
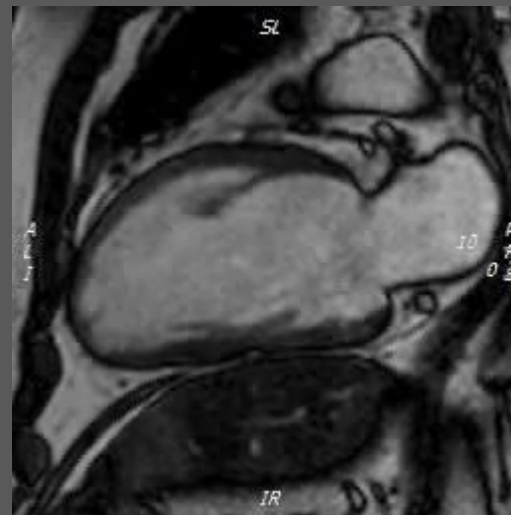
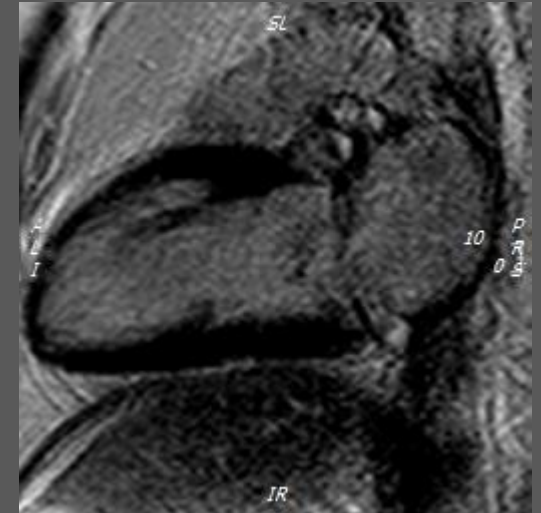
Basale



20 gamma



LGE



PARTE 2: ISCHEMIA INDUCIBILE



APPORTO



Furto
coronarico



Stress adenosina –
dipiridamolo
(perfusione)



RICHIESTA



esercizio

Ino-
cronotropi

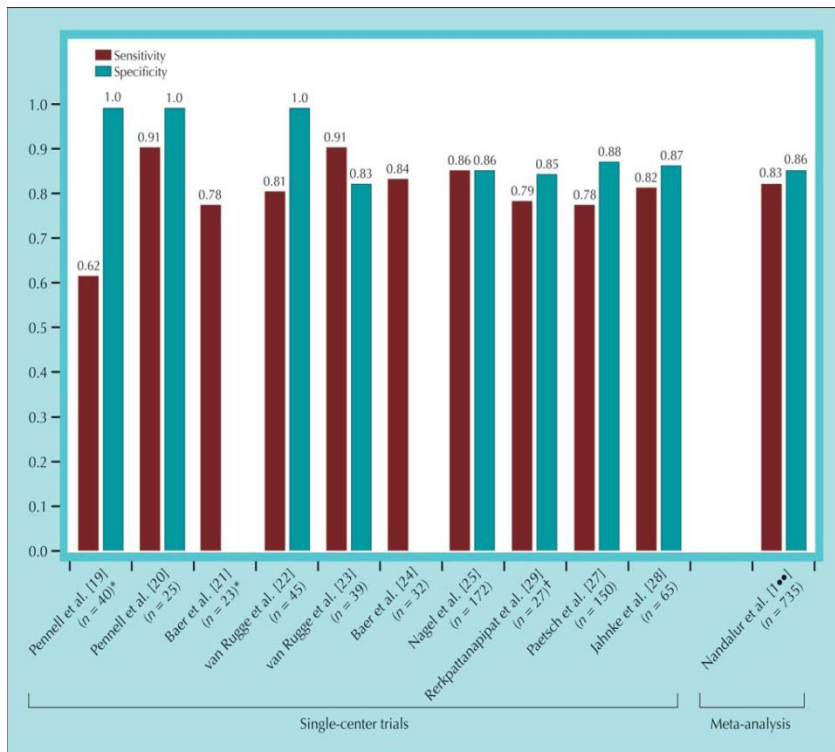
Stress dobutamina
(WMA)

Risonanza Magnetica - CAD

2- ricerca ischemia

Stress RM dobutamina

Studio WMA
Reaz. avv. gravi
possibili

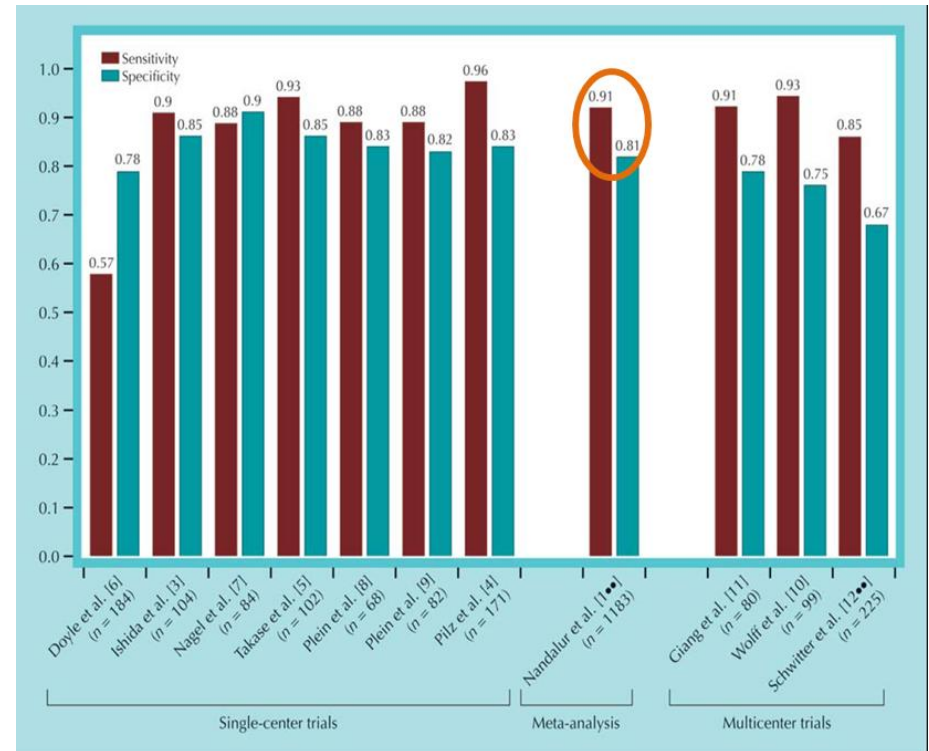


Sensibilità 83%
Specificità 86%

Ecostream: Non
inferiore ma finestra –
operatore dip.

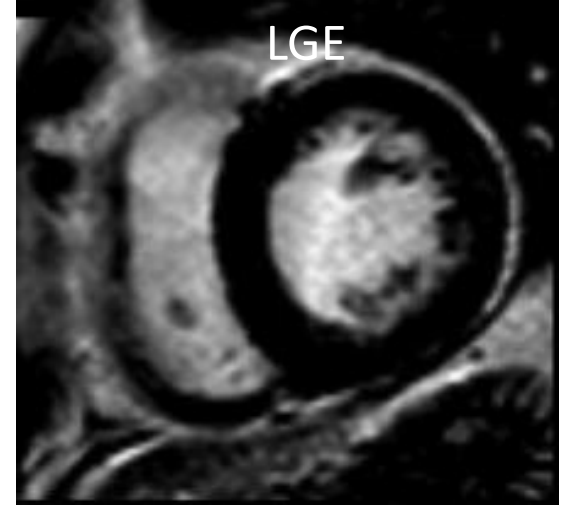
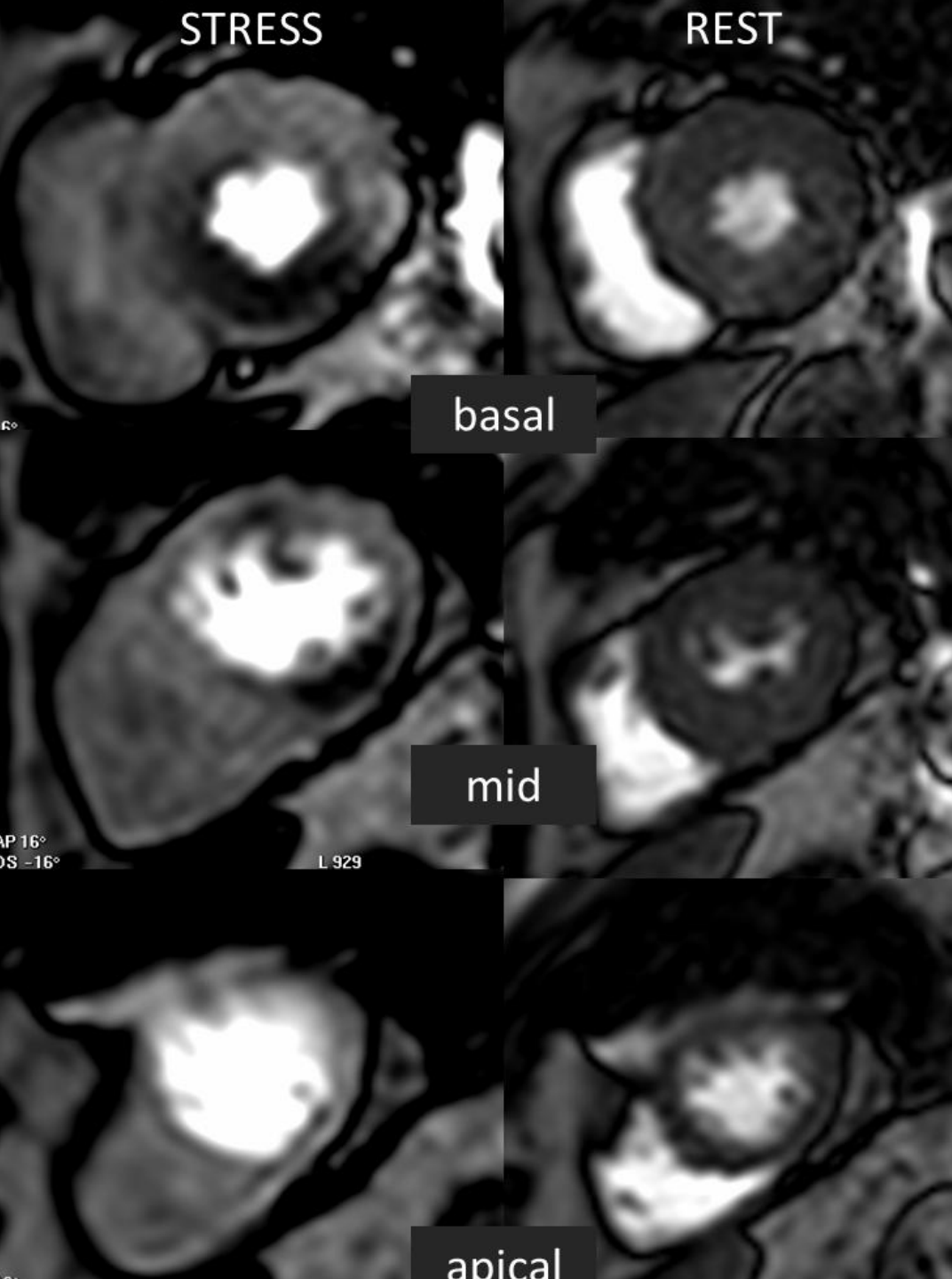
Stress RM adenosina

Studio perfusione
Quantificazione
No reaz. avv. gravi



Sensibilità 91%
Specificità 81%

Scinti adenosina:
Sens 90%
Spec 78%



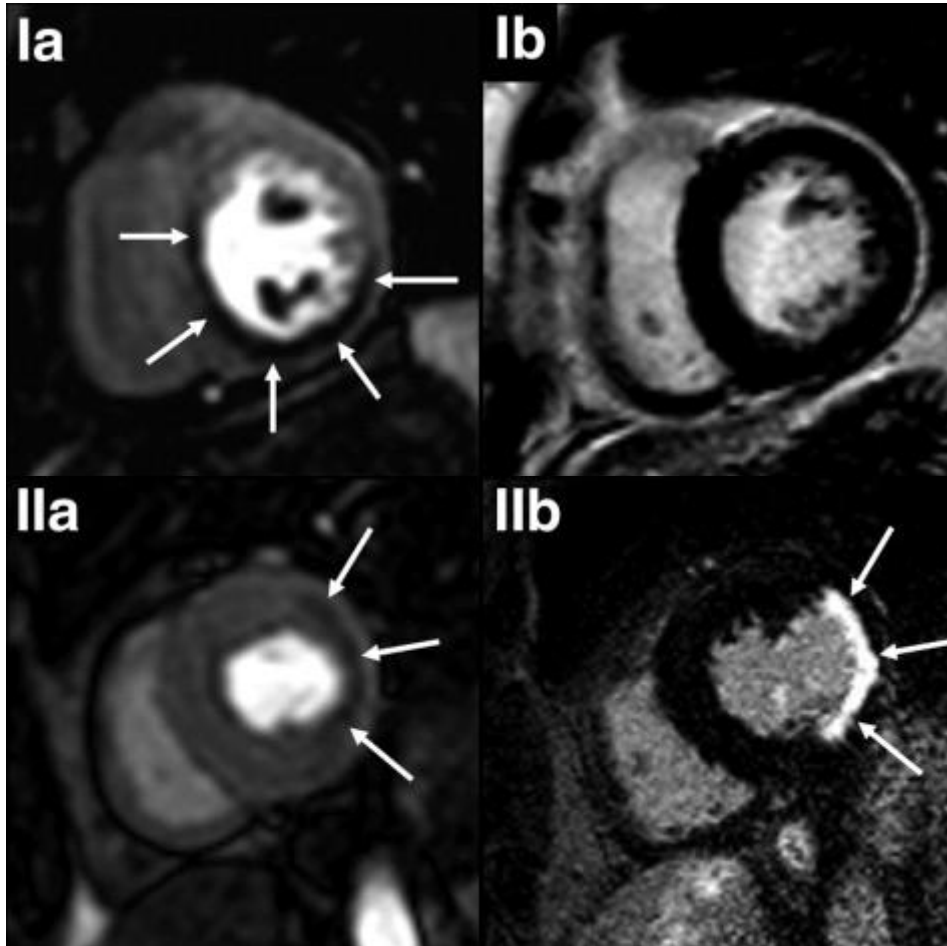
79 y.o. male, diabetic.
Asymptomatic during adenosine
infusion.

**Critical (90% prox) right
coronary artery stenosis.**

ANALISI VISUALE: ritardo di perfusione a base subendocardica

STRESS perfusion

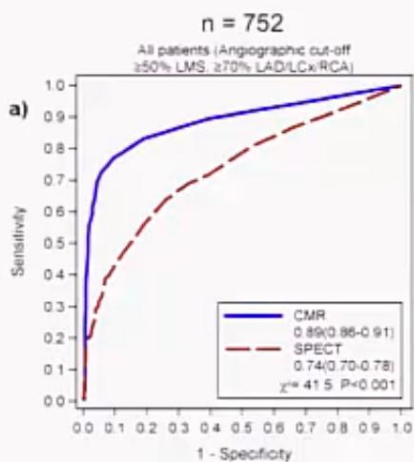
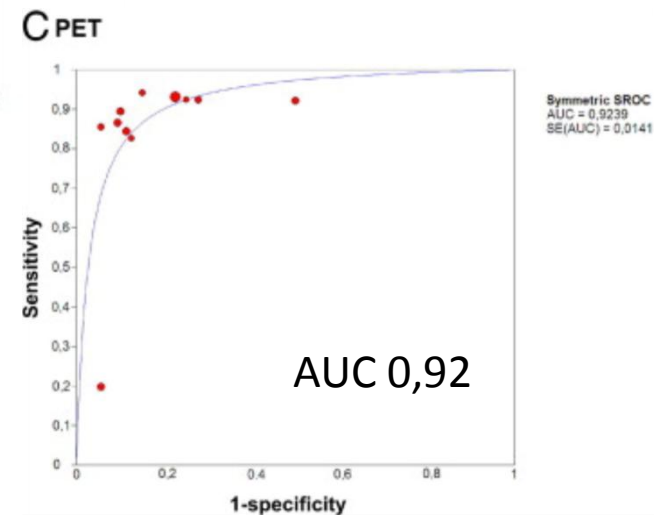
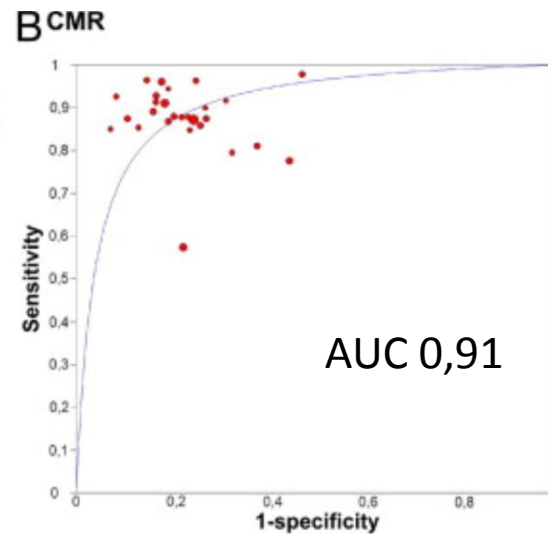
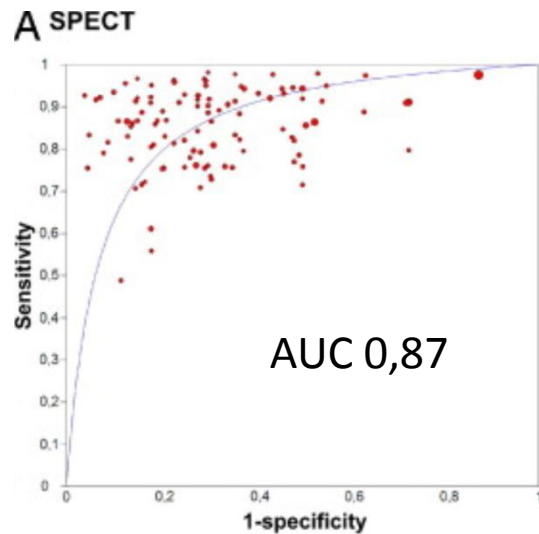
LGE



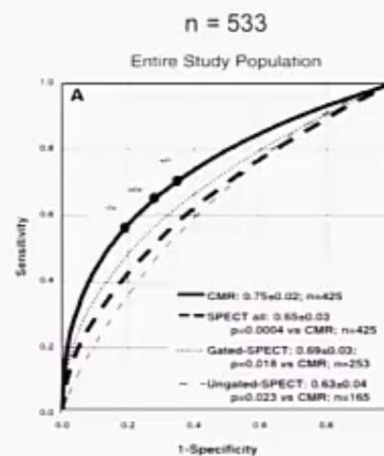
Ischemia inducibile

Pregresso infarto;
non ischemia inducibile

Analisi visuale della perfusione RM



Single-Centre (CEMARC)



Multi-Centre (MR-IMPACT 2)

Jaarsma, JACC 2012;59(19):1719-1728

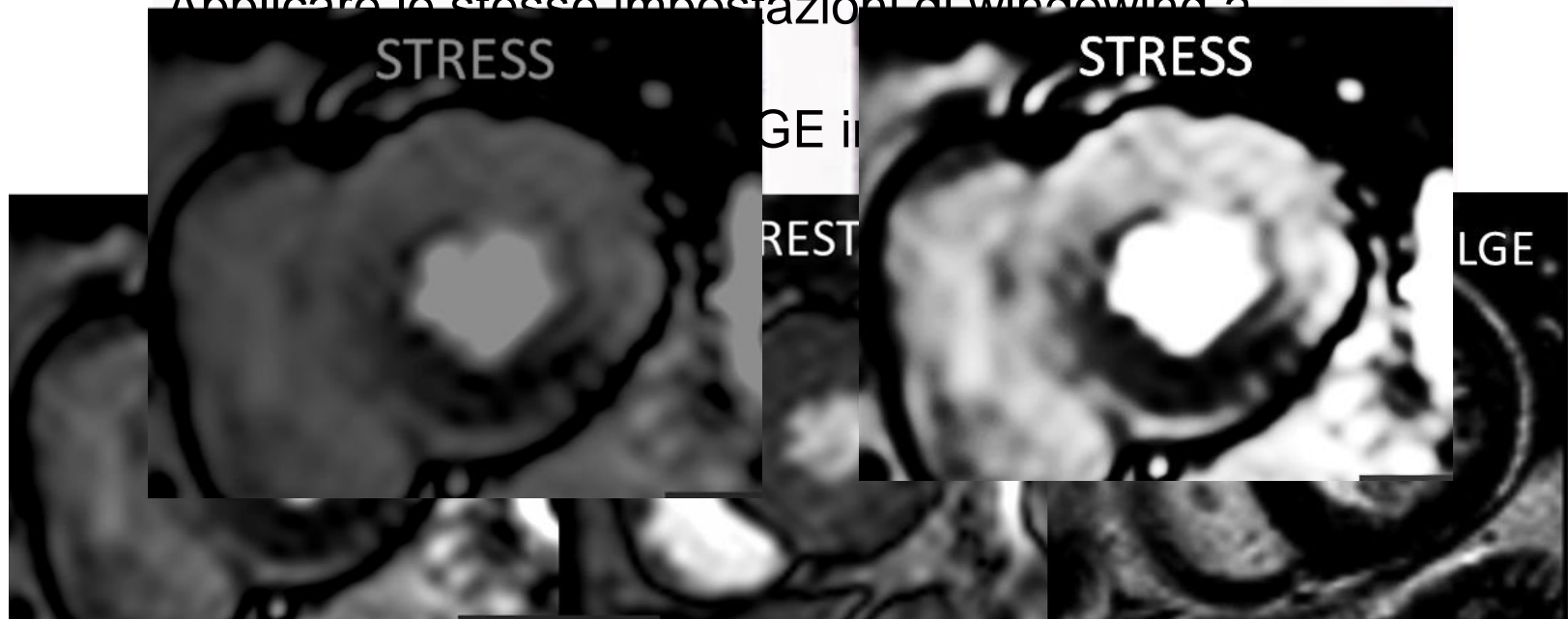


Standardizzazione dell'analisi visuale

«Windowing»:

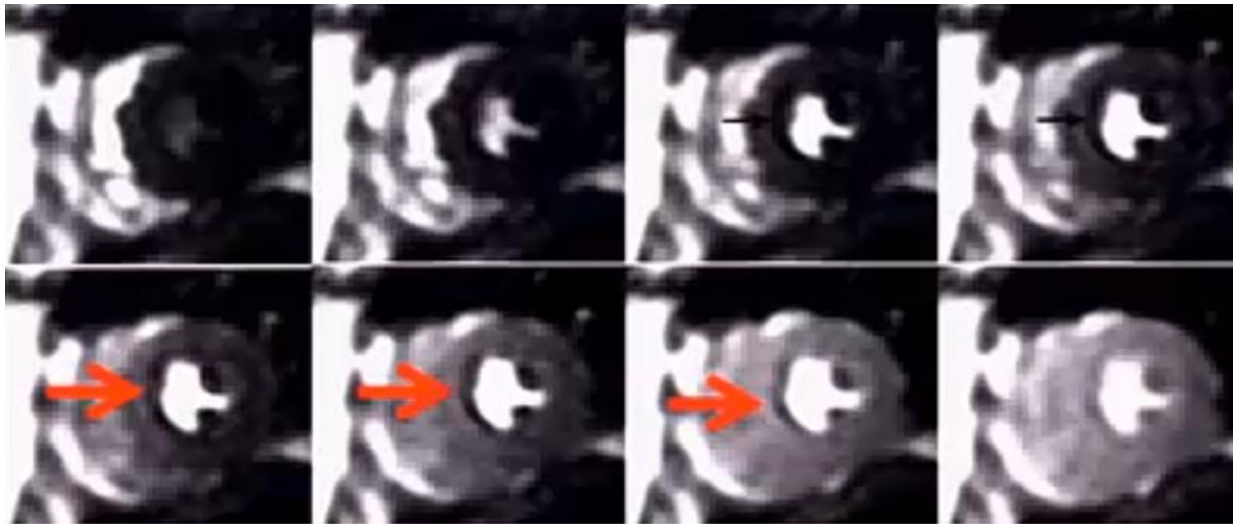
- Miocardio quasi nero prima dell' arrivo del contrasto
- La cavità VD e VS deve avere un segnale grigio chiaro, non bianco

Applicare le stesse impostazioni di windowing a



Diagnosi di un difetto di perfusione

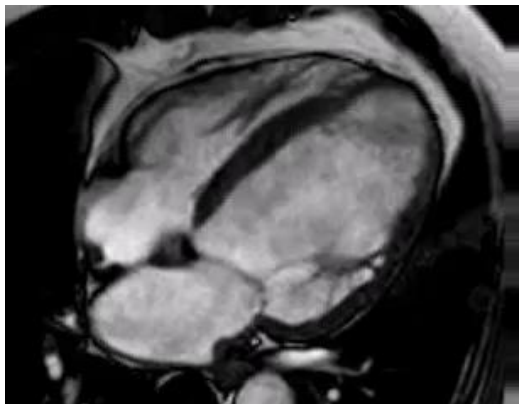
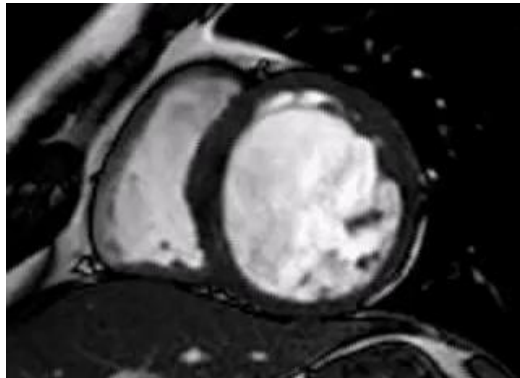
- Compare con l'arrivo del contrasto in cavità VS (NON prima)
- Persiste oltre il picco di segnale della cavità VS
- 1 pixel di ampiezza
- Distribuzione subendocardica e/o gradiente endo-epicardico
- Coerente con l'anatomia coronarica



PARTE 3: Valutazione FE con RM

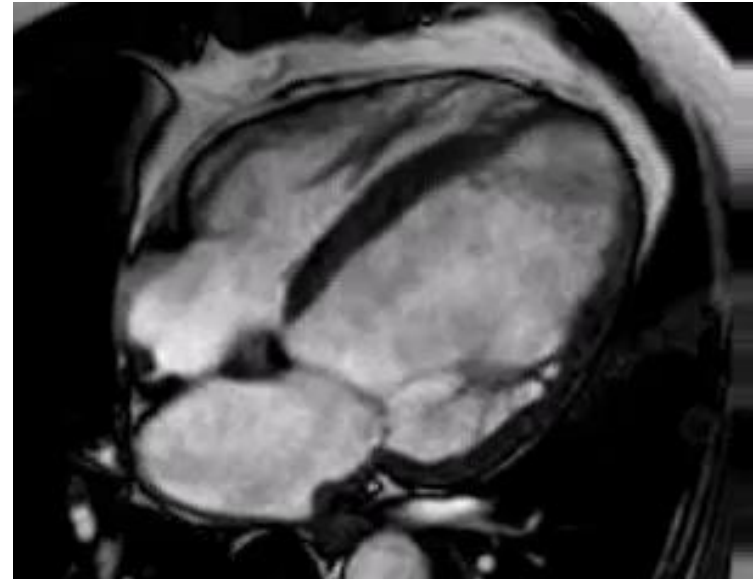
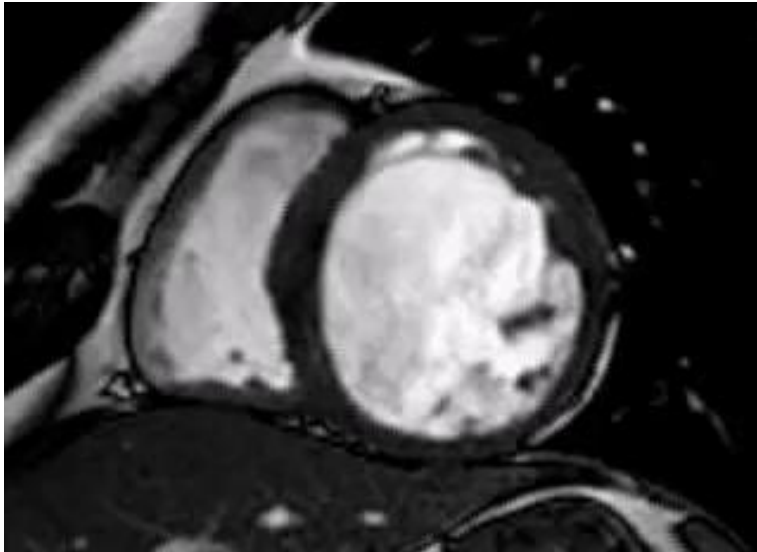
- Descrivere la cinetica di ogni segmento non normale
- Fornire massa - volume (indicizzati) + FE di VS e VD

* 2, 3 e 4 camere + Assi corti (10-12 slices)



Risonanza Magnetica e CAD

Netta visualizzazione endo-epicardio



POSSIBILITA':

Quantificazione VTD; FE; MASSA e contrattilità

>40%: **segmento normale**
10-40%: **segmento ipocinetico**
<10%: **segmento acinetico**

stress dobutamina,
senza limiti di finestra

IPOCINESIA.. L'esempio della dobutamina

- Dob Stress MR: Kappa 0.51 (0.78 tra esperti della metodica). Disagreement: 14%
- Dob Stress Echo: Kappa 0.39 (0.5 tra esperti della metodica). Disagreement 19%.

Kappa di Cohen

0-0,4: concordanza scarsa;

0,4-0,6: concordanza discreta;

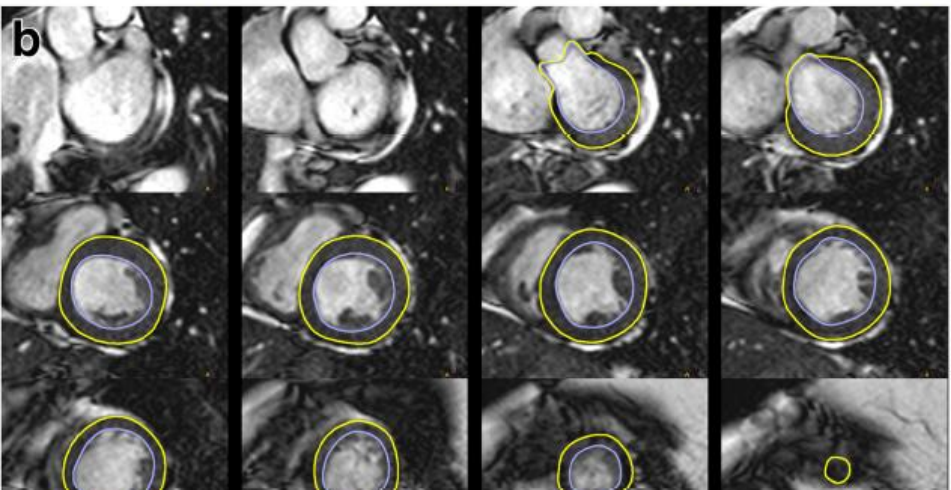
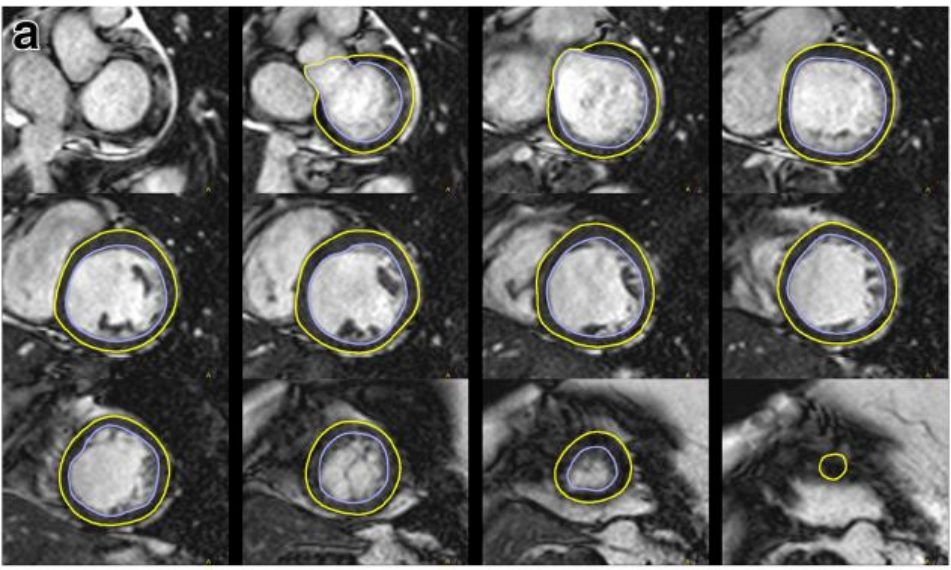
0,6-0,8: concordanza buona;

0,8-1: ottima.



Standardized image interpretation and post processing in cardiovascular magnetic resonance: Society for Cardiovascular Magnetic Resonance (SCMR) Board of Trustees Task Force on Standardized Post Processing

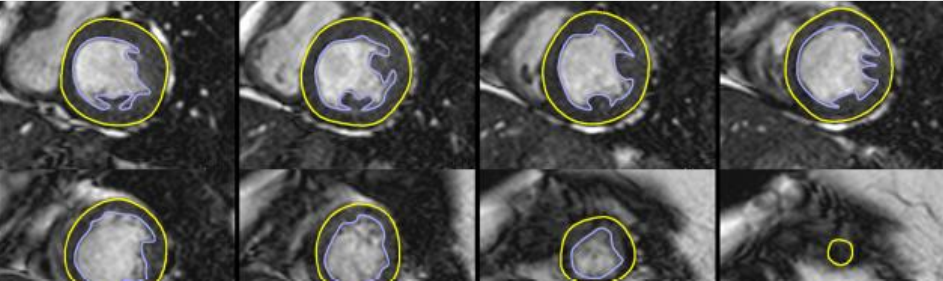
Journal of Cardiovascular Magnetic Resonance 2013, **15**:35



2. Quantitative analysis

i) General recommendations

ii) Capillary phase contrast MRI end-diastolic and volume, LV end-systolic volume, LV ejection fraction, LV stroke volume, LV output, LV mass, and BSA. In clinical practice, indexed values of all except ejection fraction. i) Reevaluation of the stack of short axis images with appropriate analysis packages. or exclusion of papillary inclusions of the endocardial and epicardial borders at end-diastole and end-systole



Slice 7 mm, gap 3 mm. Tempo di acquisizione 3-5 min; tempo di post-processing 10-15 min.

Valutazione FE con RM: valori di riferimento

Table 2. Males: Left ventricular volumes, systolic function and mass (absolute and indexed to body surface area) by age decile (mean, 95% confidence interval)

Journal of Cardiovascular Magnetic Resonance (2006) 8, 417–426

Males	20–29 years	30–39 years	40–49 years	50–59 years	60–69 years	70–79 years
	Absolute values					
EDV [mL] SD 21	167 (126, 208)	163 (121, 204)	159 (117, 200)	154 (113, 196)	150 (109, 191)	146 (105, 187)
ESV [mL] SD 11	58 (35, 80)	56 (33, 78)	54 (31, 76)	51 (29, 74)	49 (27, 72)	47 (25, 70)
SV [mL] SD 14	109 (81, 137)	107 (79, 135)	105 (77, 133)	103 (75, 131)	101 (73, 129)	99 (71, 127)
EF [%] SD 4.5	65 (57, 74)	66 (57, 75)	66 (58, 75)	67 (58, 76)	67 (58, 76)	68 (59, 77)
Mass [g] SD 20	148 (109, 186)	147 (109, 185)	146 (108, 185)	146 (107, 184)	145 (107, 183)	144 (106, 183)
	Indexed to body surface area (BSA)					
EDV /BSA [mL/m ²] SD 9.0	86 (68, 103)	83 (66, 101)	81 (64, 99)	79 (62, 97)	77 (60, 95)	75 (58, 93)
ESV /BSA [mL/m ²] SD 5.5	30 (19, 41)	29 (18, 39)	27 (17, 38)	26 (15, 37)	25 (14, 36)	24 (13, 35)
SV /BSA [mL/m ²] SD 6.1	56 (44, 68)	55 (43, 67)	54 (42, 66)	53 (41, 65)	52 (40, 64)	51 (39, 63)
Mass /BSA [g/m ²] SD 8.5	76 (59, 93)	75 (59, 92)	75 (58, 91)	74 (57, 91)	73 (57, 90)	73 (56, 89)

Papillary muscles
were included when
measuring mass
and excluded
when measuring
volumes

Slices 7 mm, gap?

Table 3. Myocardial mass and function by age and gender

Journal of Cardiovascular Magnetic Resonance (2005) 7, 775–782

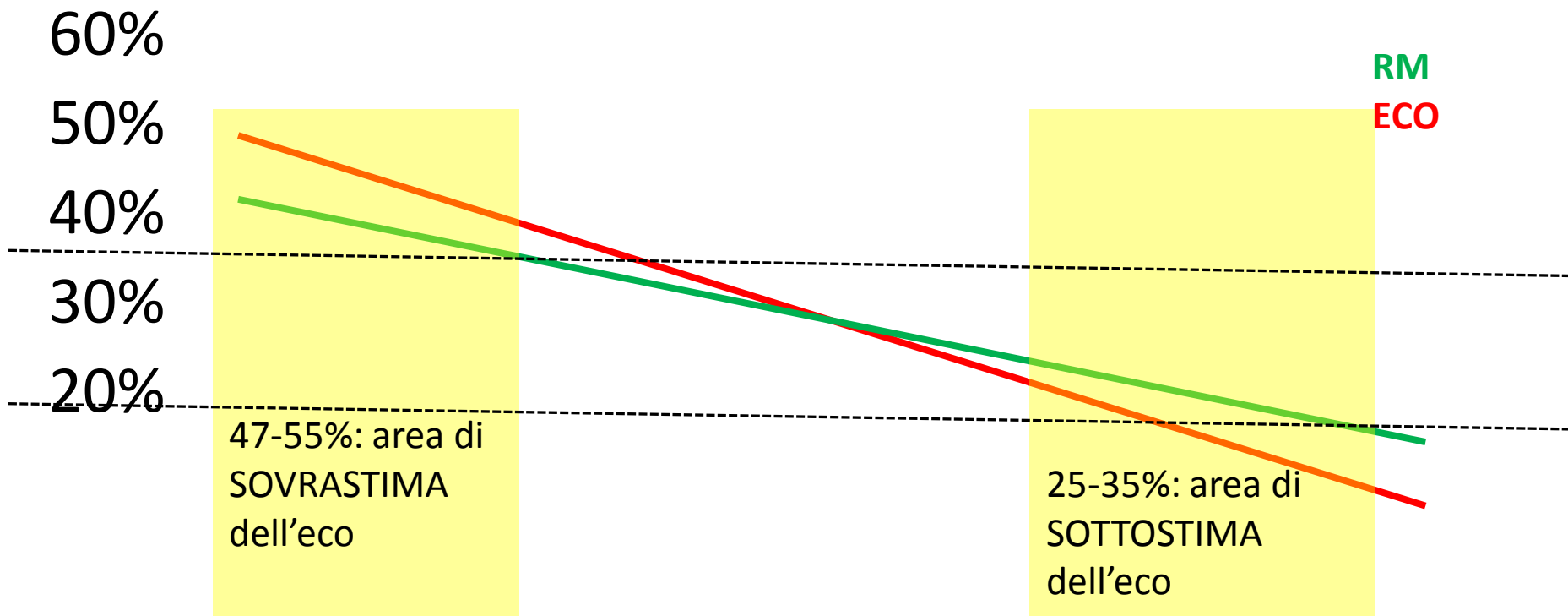
	Male (n = 63)		p	Female (n = 45)		p
	< 35 years (n = 31)	≥ 35 years (n = 32)		< 35 years (n = 23)	≥ 35 years (n = 22)	
LV ejection fraction (%)	67 ± 5 (57–77)	71 ± 6 (59–83)	.01	69 ± 6 (57–81)	69 ± 6 (57–81)	.90
LV mass (g)	131 ± 21 (89–173)	120 ± 23 (74–166)	.05	92 ± 20 (52–132)	92 ± 19 (54–130)	.94
LV mass index (g/m ²)	67 ± 10 (47–87)	60 ± 9 (42–78)	.005	53 ± 9 (35–71)	52 ± 9 (34–70)	.76
LV end-diastolic volume (mL)	173 ± 29 (115–231)	149 ± 25 (99–199)	.001	137 ± 25 (87–187)	128 ± 23 (82–174)	.23
LV end-diastolic volume index (mL/m ²)	90 ± 11 (68–112)	75 ± 11 (53–97)	< .001	80 ± 9 (62–98)	73 ± 11 (51–95)	.03

Papillary muscles
were included in the
mass
and excluded from
the volume
Calculations

Slice 7mm, gap 3 mm

I punti meno chiari

- FE in RM : NON ha gli stessi valori di riferimento dell'ecocardiografia.
Quali conseguenze quando si confrontano le 2 metodiche?



Le criticità

PRO

- Ricerca di miocardio ibernato:
 - Facile e veloce il LGE
 - Utile associare dobutamina
- Ricerca di ischemia:
 - veloce (2h vs 1 giorno della SPECT),
 - Affidabile - non meno della SPECT
- Caratterizzazione funzionale
 - Gold standard

CONTRO

- Non sempre disponibile
 - (fuori da Milano)
 - Dobutamina in radiologia
- Necessita di lungo training e di standardizzazione dell'approccio
- Mancano grossi studi prognostici

La prospettiva della RM

- Abbiamo a disposizione una metodica
 - Gold standard per volumi e funzione
 - con la migliore risoluzione spaziale per la definizione di fibrosi
 - con dati di vitalità e di ischemia in un solo esame...
 - Senza radiazioni ionizzanti



Parere personale...

