



Métodos de Diagnóstico de Isquémia
Vantagens e desvantagens

Nuclear e Sistemas híbridos

Luís Oliveira

Congresso
**Novas Fronteiras
em Cardiologia**

8 a 10 fevereiro.2013

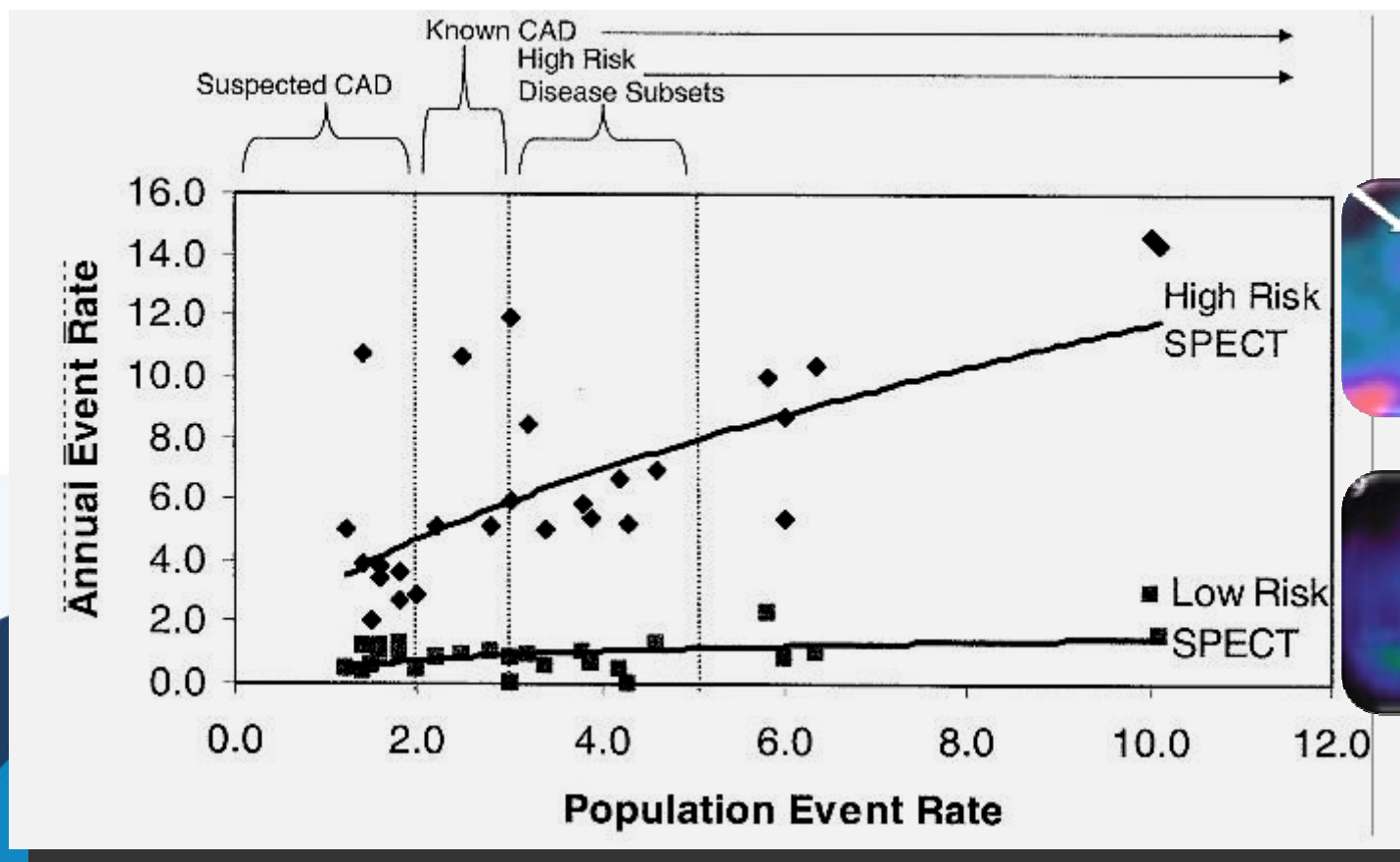
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Cintigrafia perfusão miocárdica

Prognóstico: > 100.000 doentes



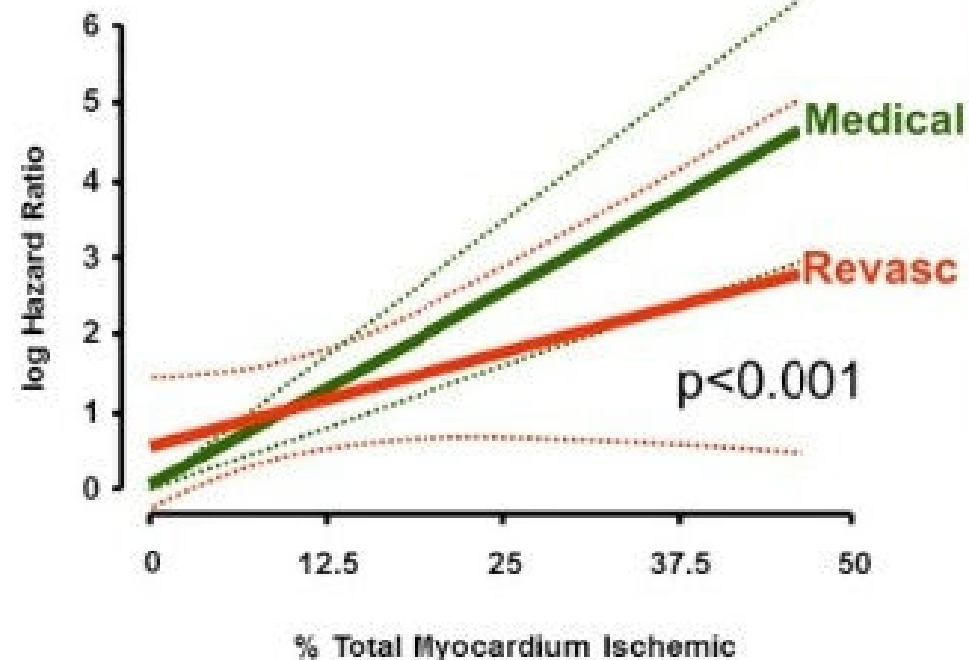
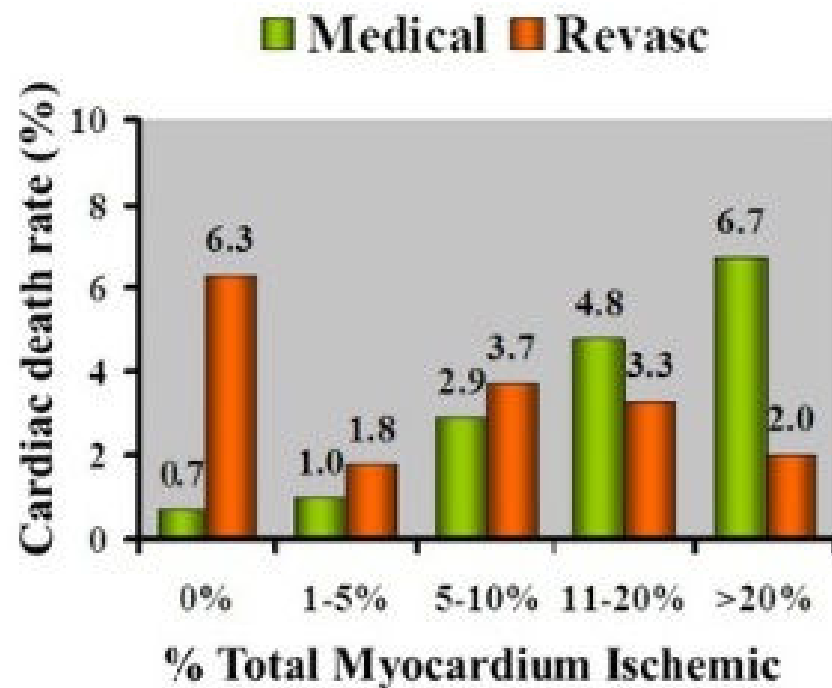
Shaw, J Nucl Cardiol, 2004



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Nuclear

Revascularização Vs terapêutica médica



13555 doentes, 8,7A seguimento, grupo com fibrose <10%

Hachamovitch, Eur Heart J, 2011



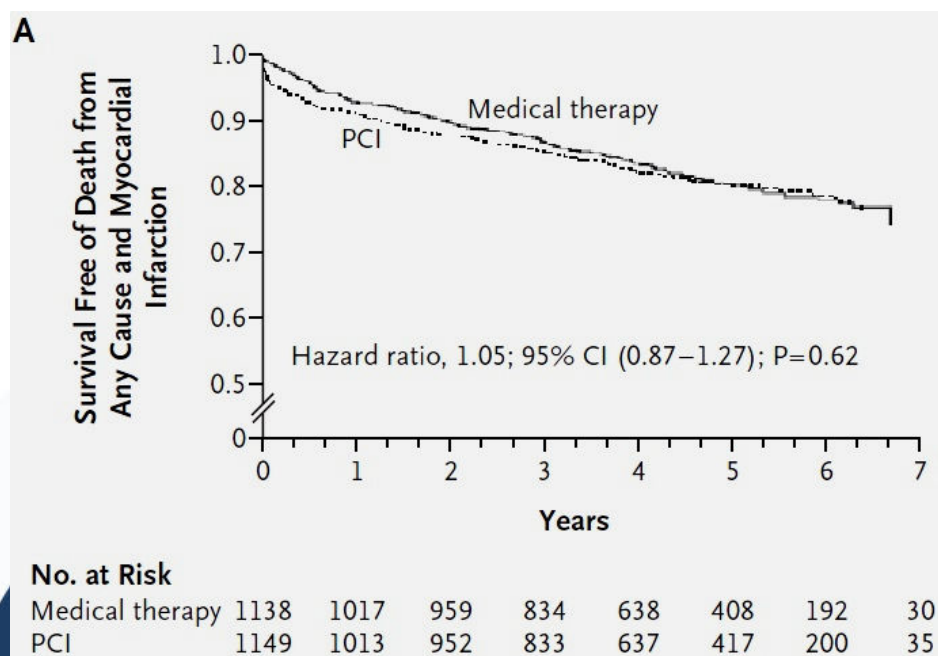
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Nuclear

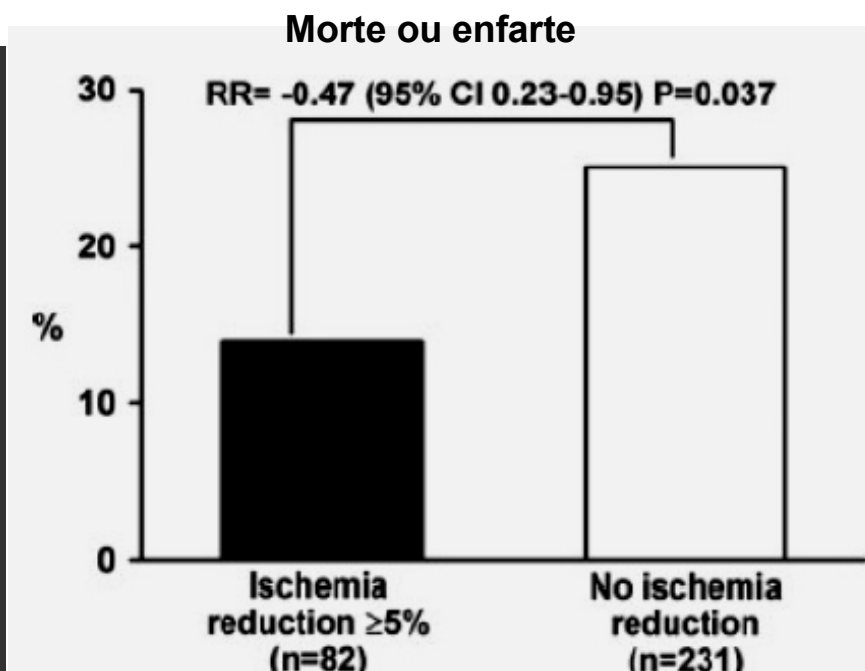
Impacto do tratamento da isquemia



2287 doentes, lesão coronária >70%, 4,6A seguimento, excluídos TCCE e P. esf. grave



Boden, NEJM, 2007



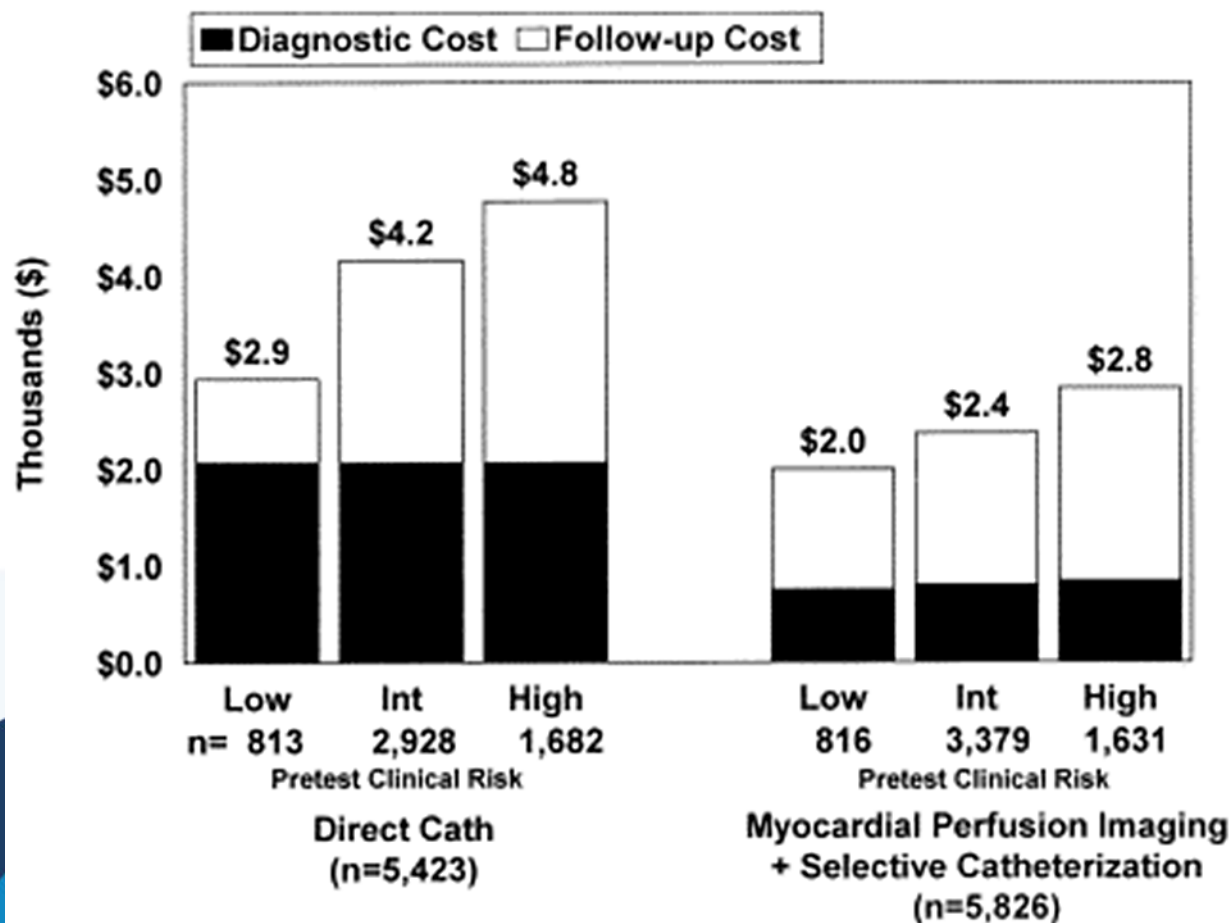
Nuclear Substudy

Shaw, Circulation, 2008



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Nuclear Custo-eficácia



CPM como
gatekeeper para
cateterismo

↓ custos 30-40%

Shaw, JACC, 1999



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Eficácia dos exames imagiológicos

NÍVEIS DE EVIDÊNCIA	NUCLEAR
1 - Qualidade técnica das imagens (resolução)	✓
2 – Acuidade, sensibilidade e especificidade	✓
3 – Avaliação prognóstica	✓
4 – Resultado tem implicações no tratamento	✓
5 – Teste reduz mortalidade / morbilidade (ensaios randomizados)	✓
6 – Custos sociais / custo-eficácia	✓

Adaptado de *The Efficacy of Diagnostic Imaging*. Fryback, Med Decis Making, 1991



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European Heart Journal (2010) 31, 2501–2555
doi:10.1093/eurheartj/ehq277

ESC/EACTS GUIDELINES



Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Developed with the special contribution of the European Association for Percutaneous Cardiovascular Interventions (EAPCI)[‡]

Chairpersons: William Wijns (Chairperson) (Belgium)*, Philippe Kolh (France), Carlos Danchin (France), Carlo Di Mario (UK), Thierry Folliguet (France), Scot Garg (The Netherlands), James Serruys (Sweden), Juhani Knuuti (Finland), Jose Luis Garcia (France), Lorenzo Menicanti (Italy), Massimo F. Piepoli (Italy), Charles Pirlet (Belgium), Andreas Reifart (Germany), Flavio L. Ribichini (Italy), Jeroen J. Bax (Netherlands), Paul Sergeant (Belgium), Patrick W. Serruys (Germany), Miguel Sousa Uva (Portugal),

	Subset of CAD by anatomy	Class ^a	Level ^b	Ref. ^c
For prognosis	Left main >50% ^d ←	I	A	30, 31, 54
	Any proximal LAD >50% ^d ←	I	A	30–37
	2VD or 3VD with impaired LV function ^d ←	I	B	30–37
	Proven large area of ischaemia (>10% LV)	I	B	13, 14, 38
	Single remaining patent vessel >50% stenosis ^d ←	I	C	—
	IVD without proximal LAD and without >10% ischaemia	II		

^aClass of recommendation.

^bLevel of evidence.

^cReferences.

^dWith documented ischaemia or FFR <0.80 for angiographic diameter stenoses 50–90%.

CAD = coronary artery disease; CHF = chronic heart failure; FFR = fractional flow reserve; LAD = left anterior descending; LV = left ventricle; OMT = optimal medical therapy; VD = vessel disease.



Nuclear

Desvantagens I

Test characteristics for investigations used in the diagnosis of stable angina

	Diagnosis of coronary artery disease	
	Sensitivity (%)	Specificity (%)
Exercise ECG	68	77
Exercise echo	80–85	84–86
Exercise myocardial perfusion	85–90	70–75
Dobutamine stress echo	40–100	62–100
Vasodilator stress echo	56–92	87–100
Vasodilator stress myocardial perfusion	83–94	64–90

Resultados subóptimos

- Viés de verificação
- Atenuação
- Movimento
- Isquémia balanceada
- Esforço submáximo
- etc



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Nuclear Desvantagens II

J Nucl Cardiol. 2007 Jul;14(4):521-8.

Underestimation of extent of ischemia by gated SPECT myocardial perfusion imaging in patients with left main coronary artery disease.

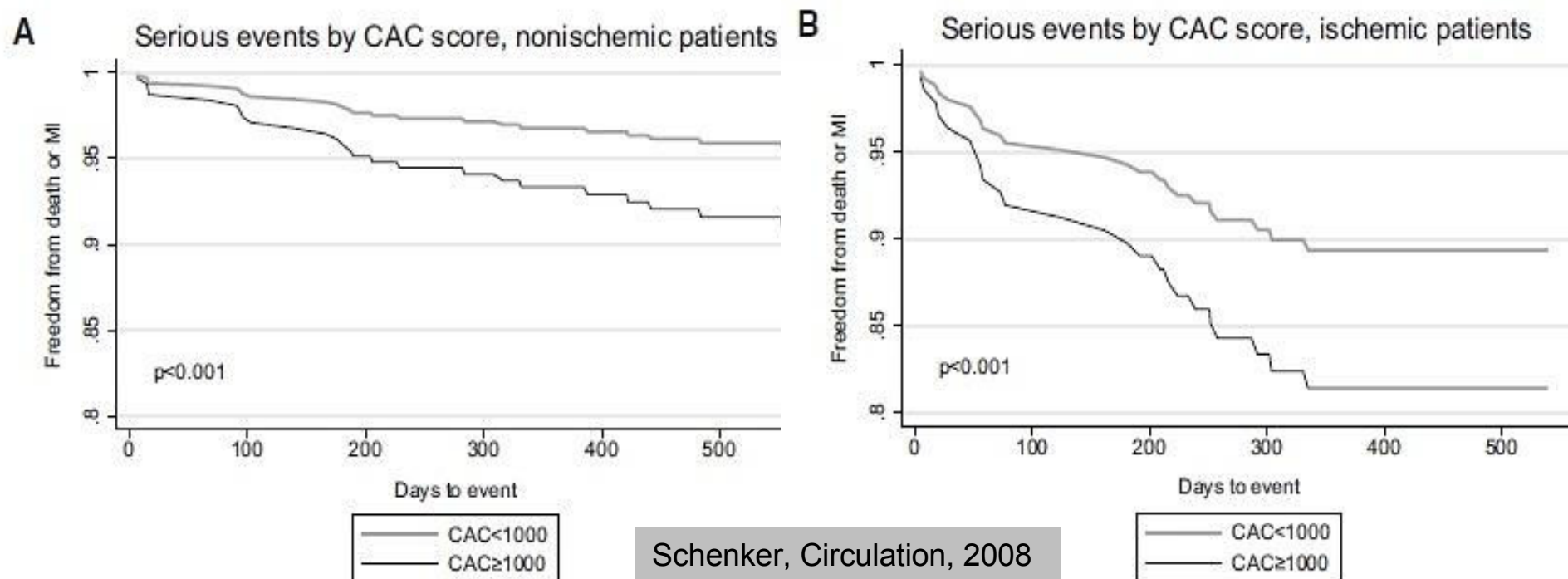
Berman DS, Kang X, Slomka PJ, Gerlach J, de Yang L, Hayes SW, Friedman JD, Thomson LE, Germano G.

Department of Imaging (Division of Nuclear Medicine), Cedars-Sinai Medical Center, Los Angeles, Calif 90048, USA. bermand@cshs.org

- A CPM pode subestimar a extensão da doença coronária
- 101 doentes com lesão do TCCE $\geq 50\%$
 - Defeito de perfusão moderado a severo em 59%
 - Ausência de defeito relevante em 15%

Nuclear Desvantagens III

- Deficiente avaliação da aterosclerose coronária





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Nuclear Desvantagens IV

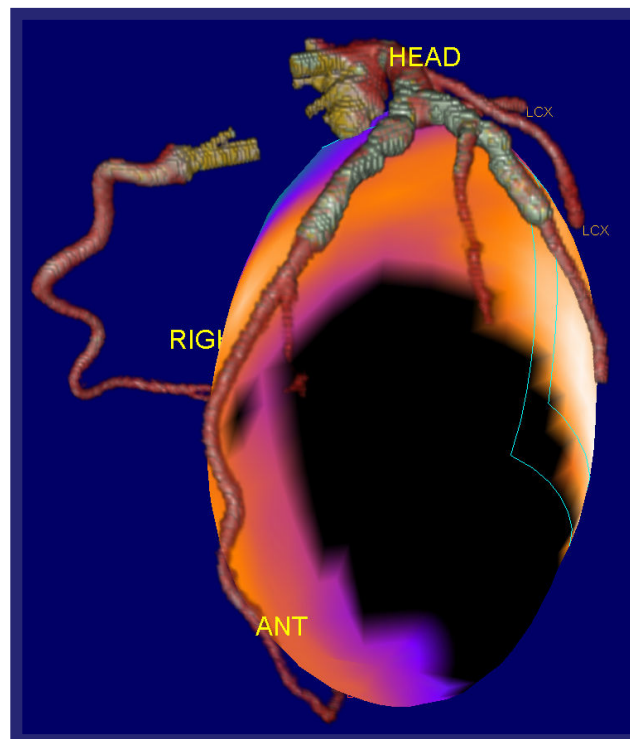
CPM	ECO stress	RM	TAC
Maior versatilidade / disponibilidade	Má janela acústica	Claustrofobia	Idade avançada
Radiação	Experiência operador	Implantes ferro-magnéticos	Colaboração doente
Custo	Múltiplos defeitos preexistentes	IR avançada	Disritmias
	Pouco disponível	Pouco acessível	Insuficiência renal
		Custo	Alergia contraste
			Radiação
			Disponibilidade limitada
			Custo



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Sistemas Híbridos

64-slice CT Scanner (5-sec acquisition of the heart)
Ultrafast SPECT (2-min acquisition of the heart)



Postgrad Med J. 2009 Nov;85(1009):606-13.

Hybrid SPECT/CT: the end of "unclear" medicine.

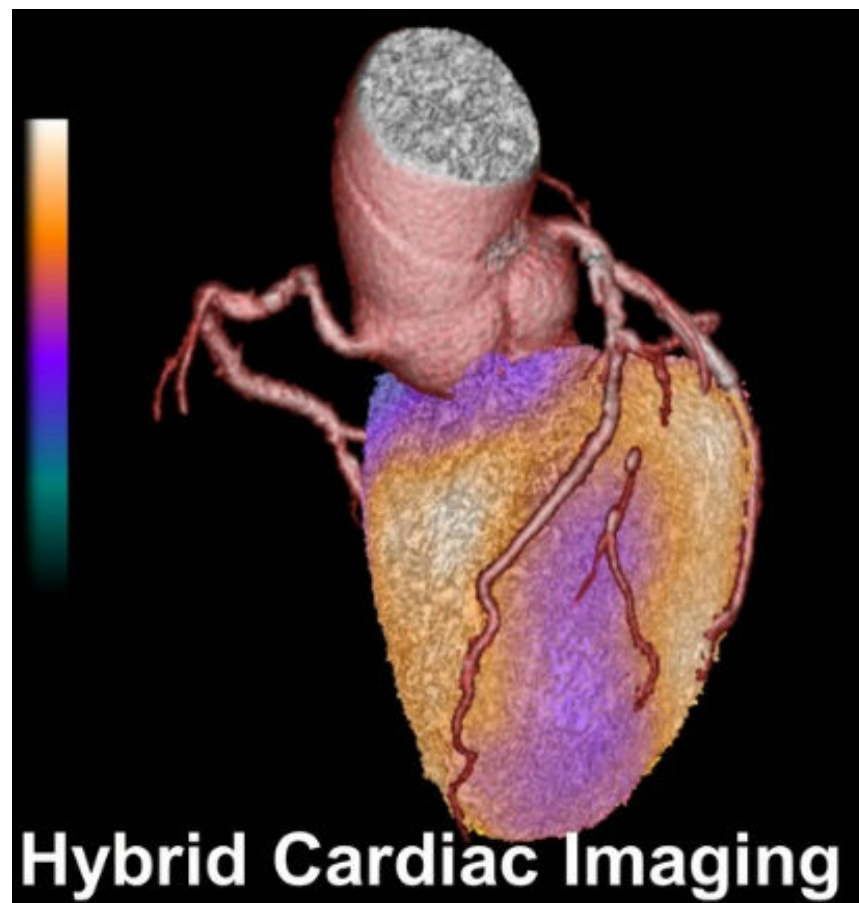
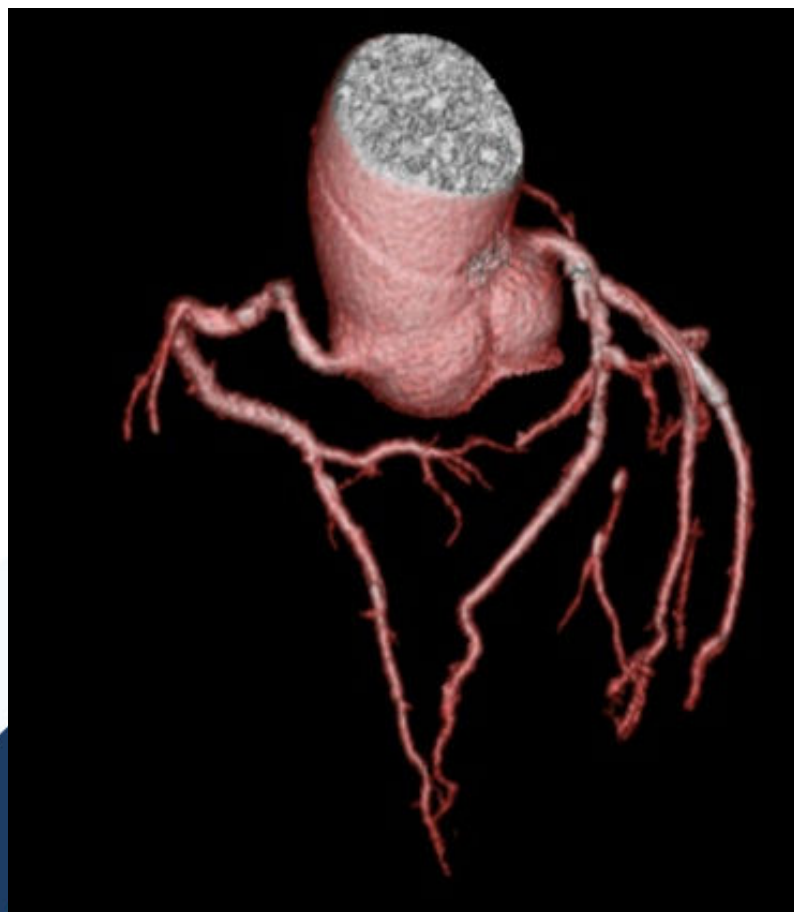
Patel CN, Chowdhury FU, Scarsbrook AF.

Department of Radiology, St James's University Hospital, Leeds, UK.



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Caso Clínico 1





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Sistemas híbridos

Acurácia

Table 1 Diagnostic accuracy of cardiac hybrid imaging (SPECT/CTCA and PET/CTCA) (Vessel-based analysis)

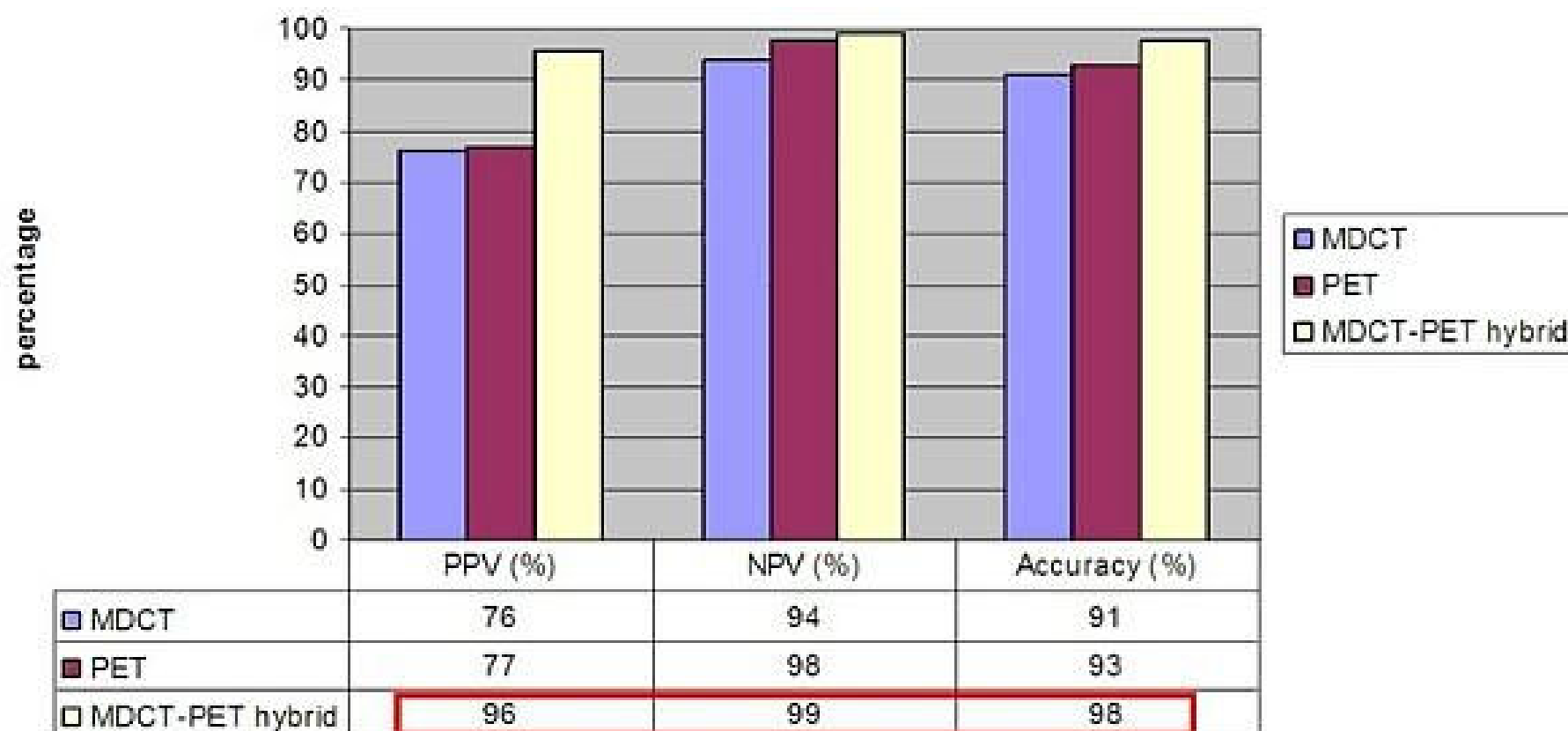
Author	Hybrid system	n	Gold standard (definition of significant CAD)	Sens	Spec	PPV	NPV
Namdar et al. ⁴²	¹³ N-NH ₃ PET/4-slice CTCA	25	Flow-limiting coronary stenoses requiring revascularization (ICA + PET)	90	98	82	99
Rispler et al. ⁴³	SPECT/16-slice CTCA	56	Flow-limiting coronary stenoses (>50% stenosis on ICA + SPECT pos.)	96	95	77	99
Groves et al. ⁴⁴	⁸² Rb PET/64-slice CTCA	33	>50% stenosis on ICA	88	100	69*	97
Sato et al. ⁴⁵	SPECT/64-slice CTCA ^a	130	>50% stenosis on ICA	94	92	85	97
Kajander et al. ⁴⁶	¹⁵ O-H ₂ O PET/64-slice CTCA	107	Flow-limiting coronary stenosis (>50% stenosis of ICA + FFR)	93	99	96	99

* VPP da TC isolada

Gaemperli, EHJ, 2011

Hybrid PET/CTA vs. ICA + FFR

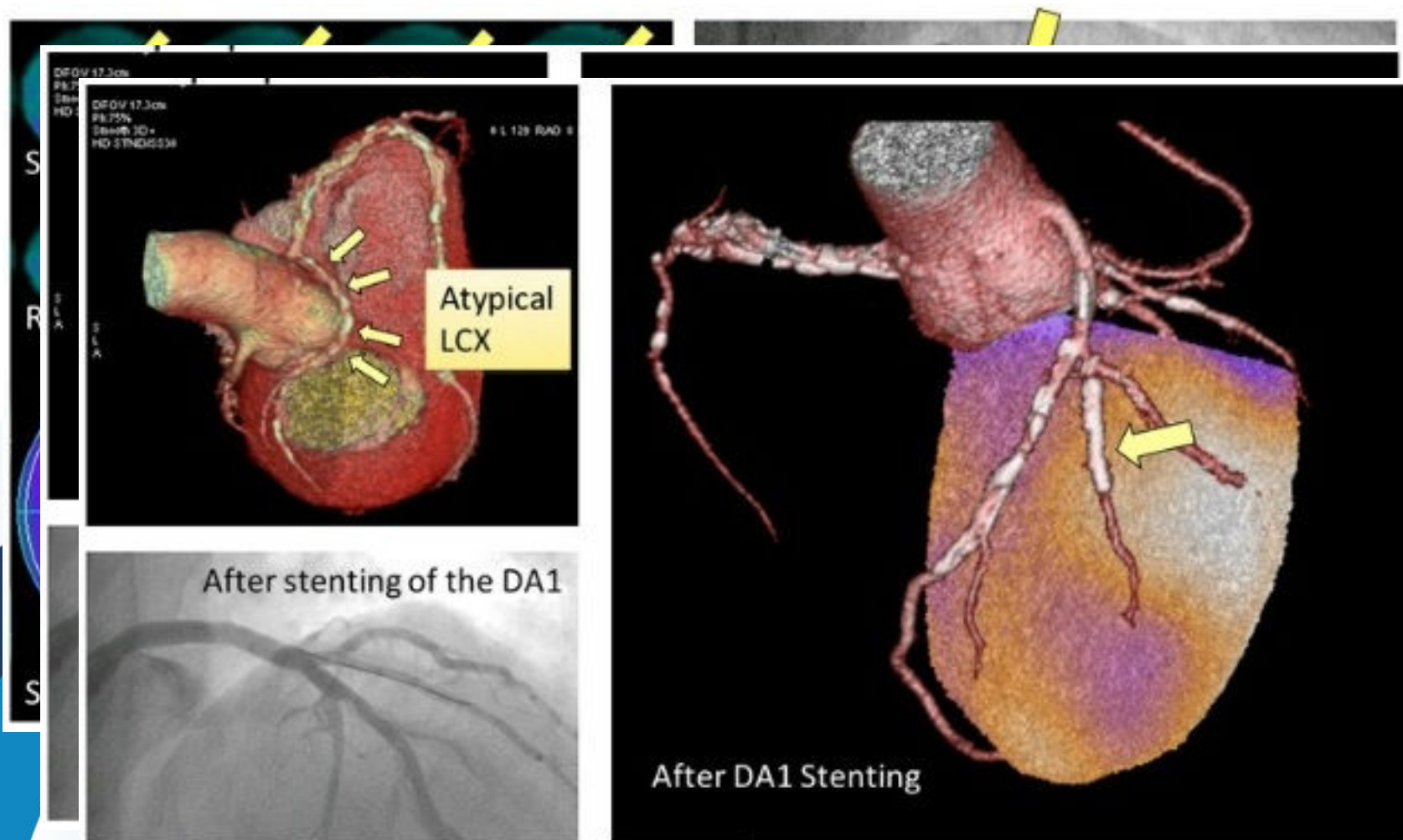
Vessel analysis in patients with intermediate likelihood of CAD, N=107





Caso Clínico 2

Homem, 50 A, redução capacidade funcional, pré-op PTA





Sistemas híbridos

Side-by-side Vs fusão

Table 2 Incremental clinical value of fused hybrid imaging compared to the side-by-side analysis

Author	Hybrid system	Patient population	Incremental value of fused hybrid imaging
Gaemperli et al. ⁴⁷	SPECT/64-slice CTCA and 3D image fusion	38 patients with ≥ 1 SPECT defects	Modification of initial interpretation in 29% of patients In equivocal lesions, haemodynamic relevance could be confirmed in 35% and excluded in 25%
Santana et al. ⁴⁸	16- and 64-slice CTCA and MPI (SPECT or ⁸² Rb PET)	50 patients with suspected CAD	Modification of initial interpretation in 28% of patients Trend towards increased sensitivity (by 17%) in patients with multivessel disease
Slomka et al. ⁴⁹	Motion-frozen SPECT/64-slice CTCA (automatic coregistration)	35 patients with suspected CAD	Improved diagnostic performance in RCA- and LCX-territories

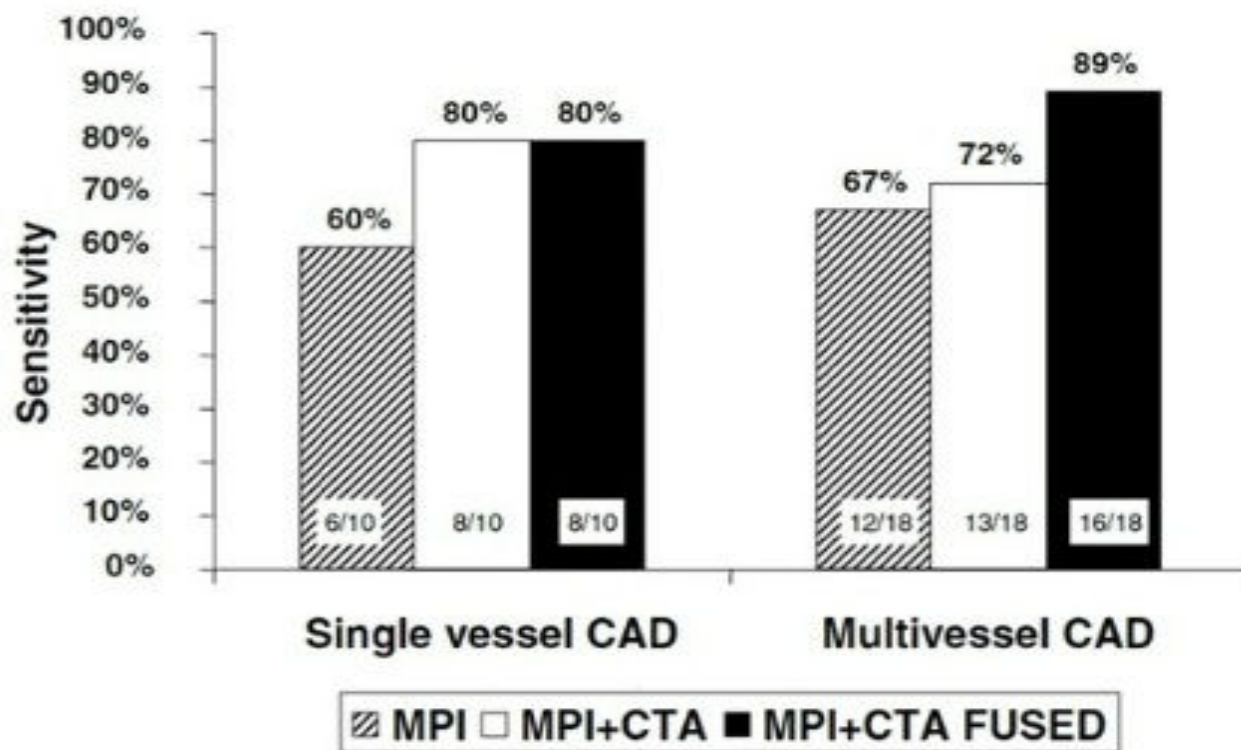


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Sistemas híbridos

Side-by-side Vs fusão

Improved diagnostic performance of Fusion Imaging compared to MPI alone *and* MPI + CTA side-by-side



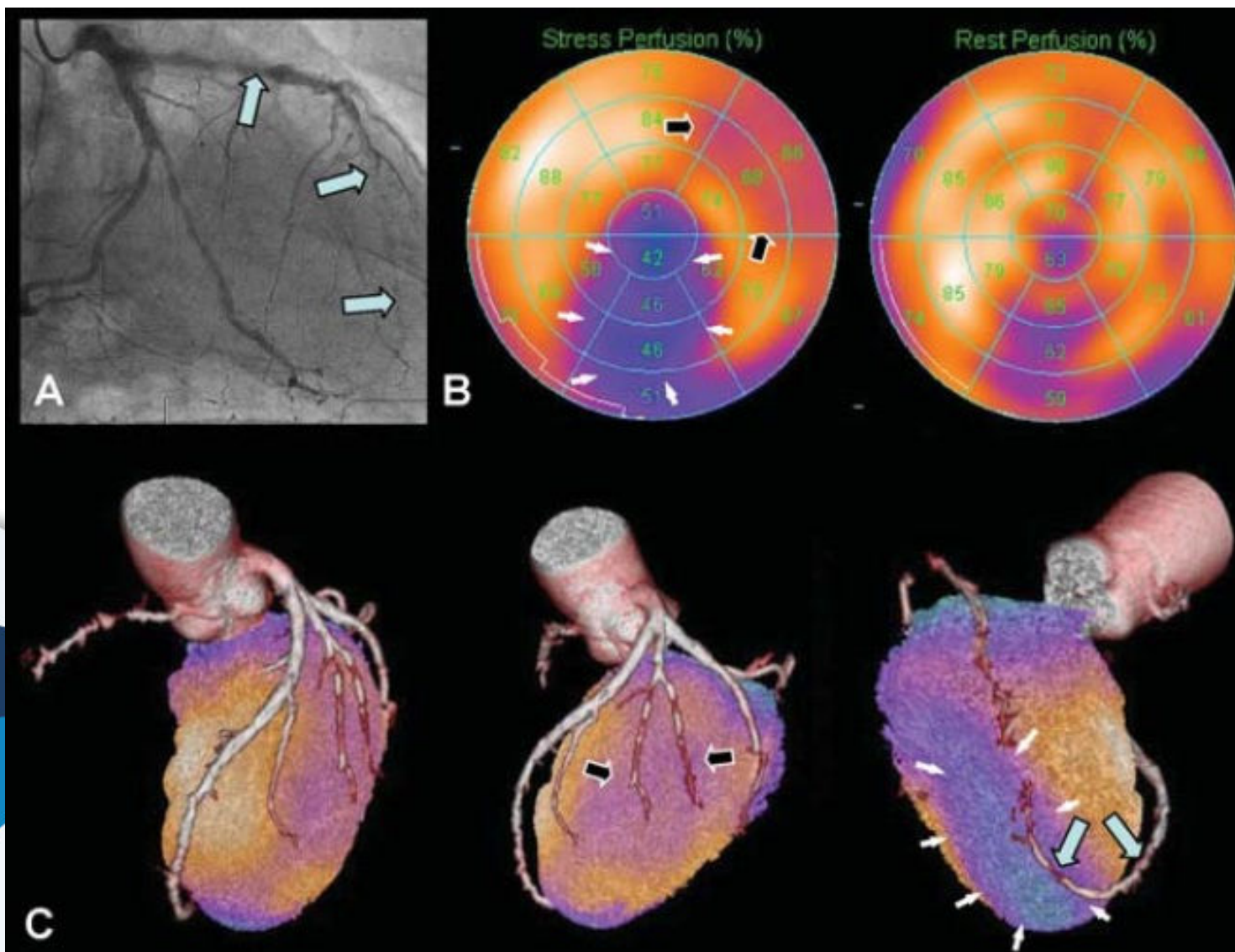
Santana, JNC, 2008



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Caso Clínico 3

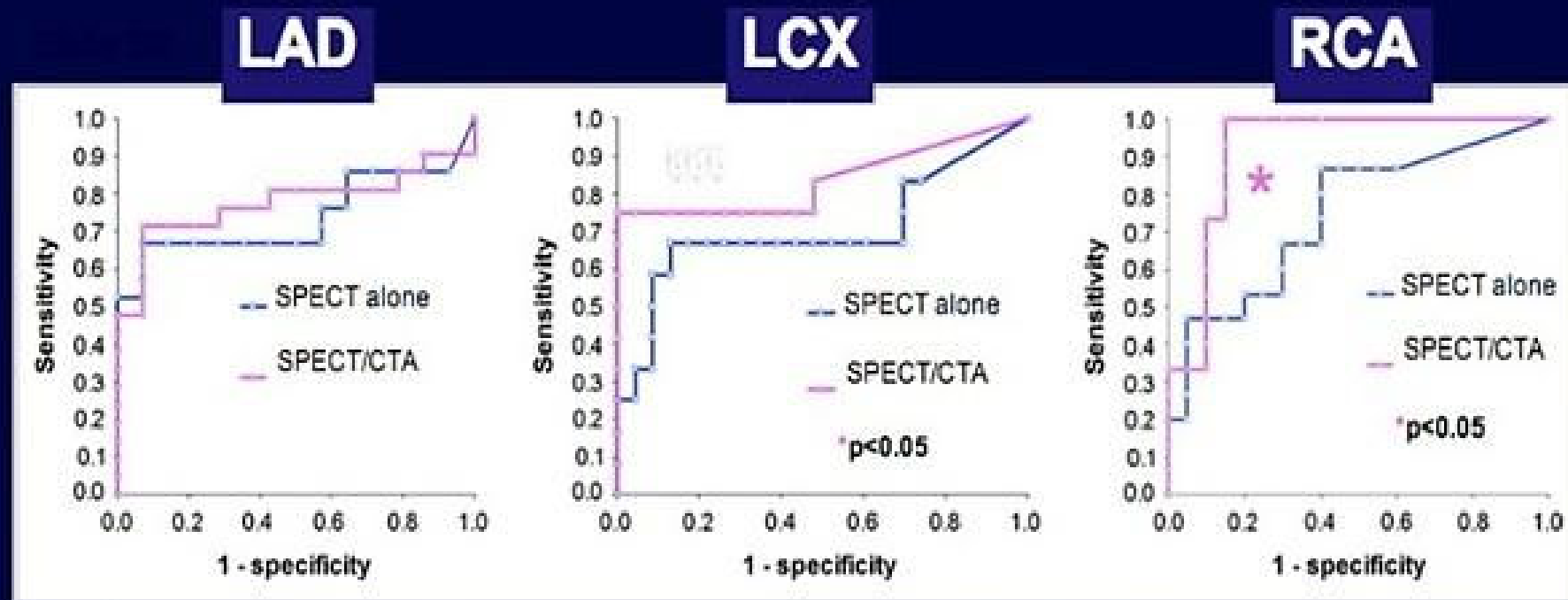
86 A, angina em repouso





Sistemas híbridos

Melhoria acurácia diagnóstica nos territórios da CD e CX

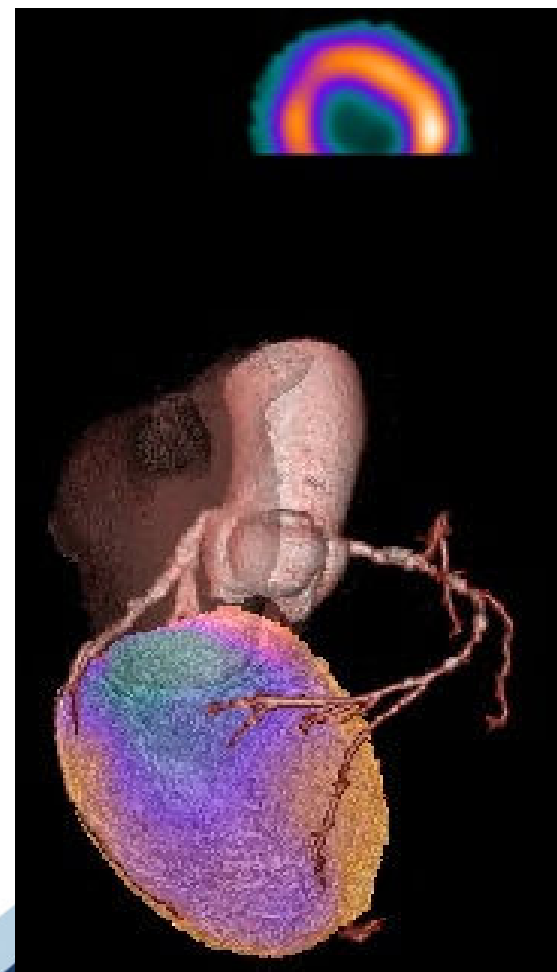


n=35pts, disease prevalence 91%, gold standard: invasive angiography. Automatic coregistration of motion-frozen SPECT with coronary CT angiography



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Isquemia inferolateral CX ou CD?

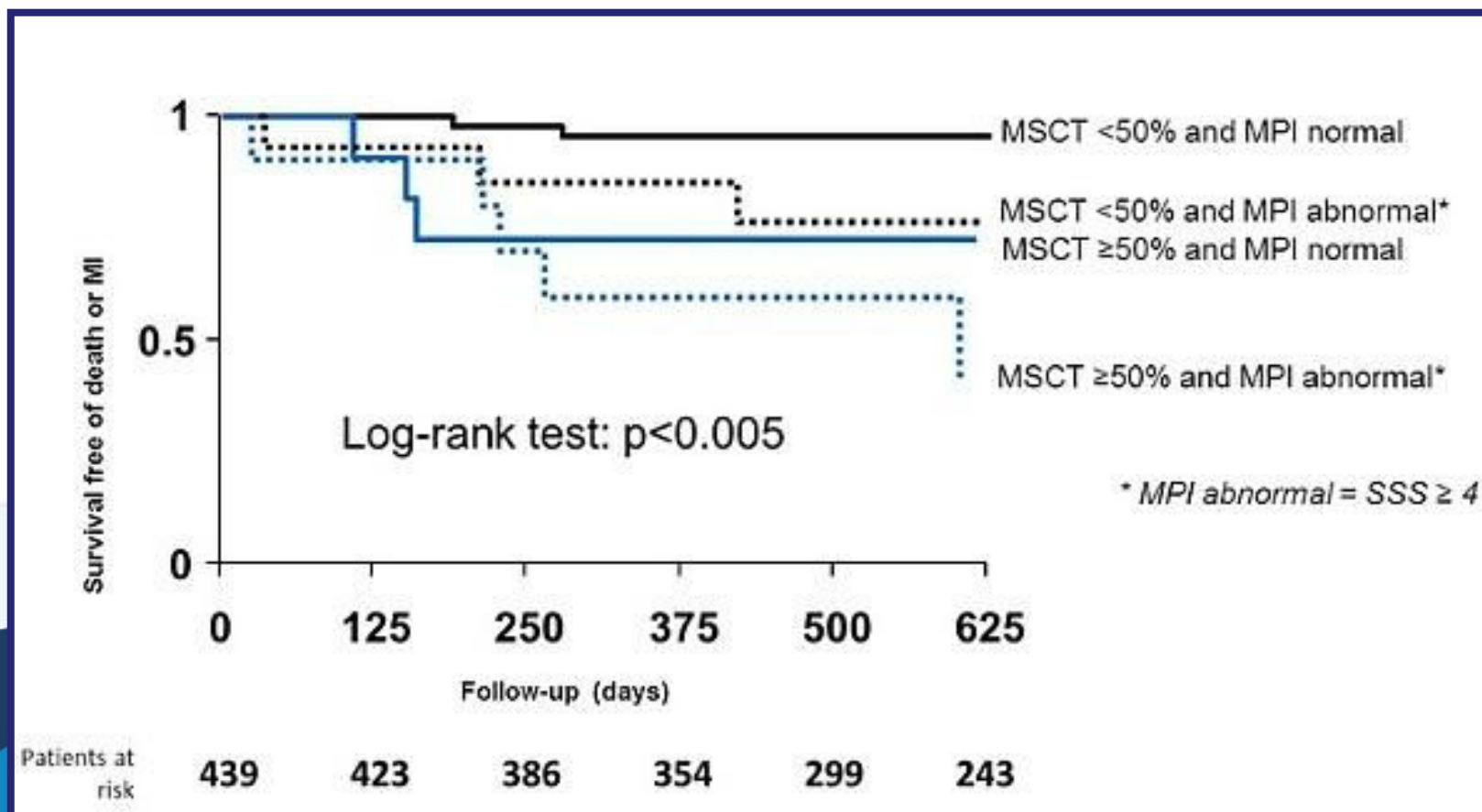




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Sistemas híbridos

Prognóstico



Van Werkhoven, JACC, 2009

Sistemas híbridos

Conclusões

- Melhora acurácia diagnóstica
 - Comparação com SPECT e TC isoladamente ou side-by-side
- Identifica lesões-alvo responsáveis pela isquémia e que necessitam de revascularização
 - Dça de CD ou CX
 - Dça multivaso
- Valor prognóstico independente

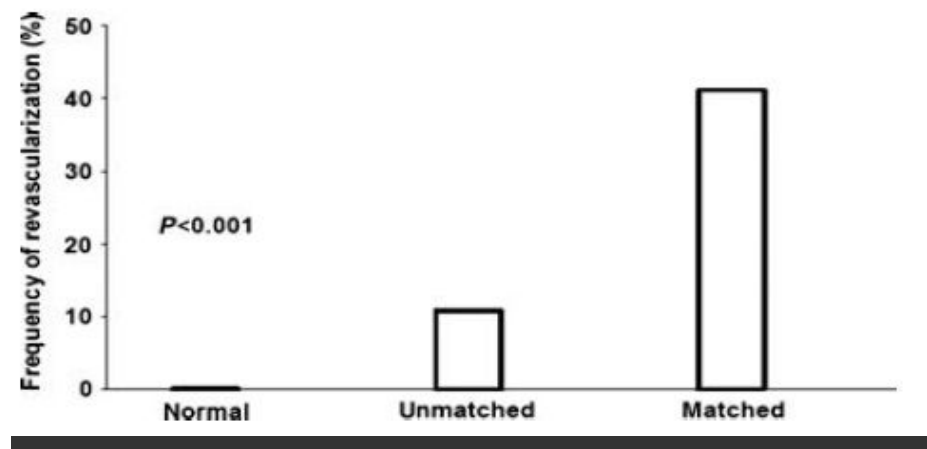
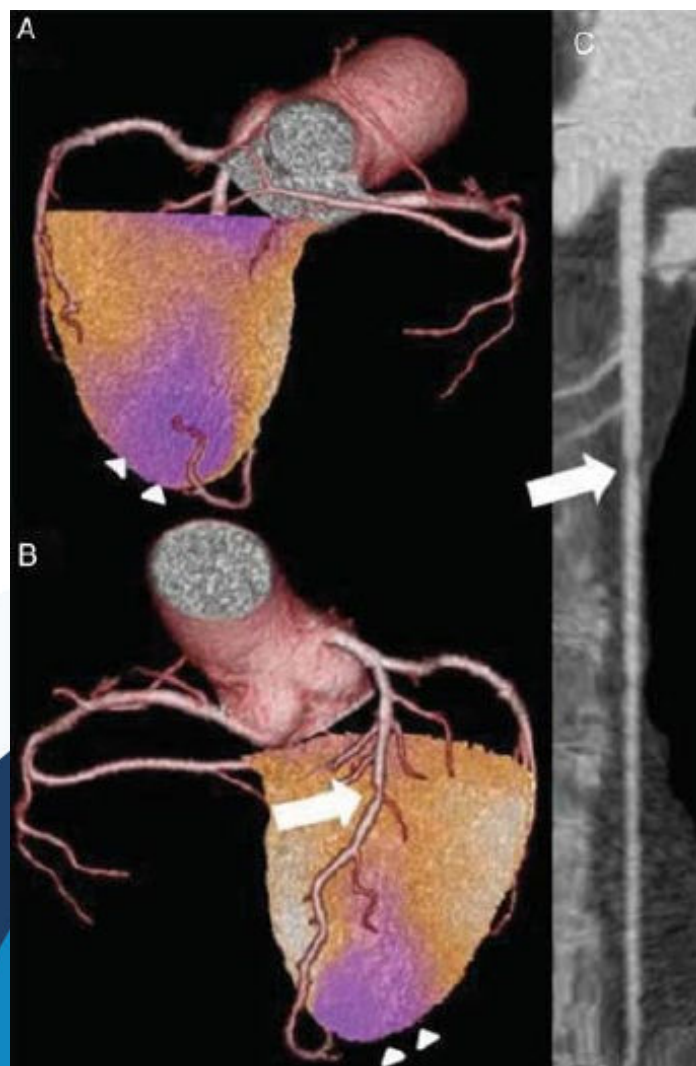


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Sistemas híbridos

Desvantagens I

Custos



n 318	Normal	Unmatch	Matched
n	193	74	51
Cateter.	0	15 (20%)	31 (61%)*
DC	-	80%	90%
Revascular.	-	8 (11%)	21 (41%)
PCI / angio	-	53%	68%

* 20 doentes com isquémia ligeira ou lesão inacessível



Sistemas híbridos

Desvantagens II

Radiação

Study	N	Protocol	Total radiation dose
Husmann et al. [40]	100	Stress-only/prospective gated CTA	5.4±0.8 mSv ^a *
Duvall et al. [25]	209	Stress-only ^{99m} Tc sestamibi 5 min	4.2 mSv
DePuey et al. [28]	160	^{99m} Tc sestamibi 14 min/12 min	6.8 mSv
Nkoulou et al. [29]	50	^{99m} Tc tetrofosmin stress/rest 5 min/5 min	4.3 mSv
Duvall et al. [26•]	131	^{99m} Tc sestamibi 5-8 min/3-5 min	5.8 mSv
Gimelli et al. [27]	137	^{99m} Tc stress/rest tetrofosmin 7 min/6 min	5.10 mSv (men) 6.12 mSv (women) ^b

*
(CTA 2.2±0.7 mSv)

Sistemas híbridos

Avanços técnicos

- Sistemas imagem dedicados SPECT / CT 64
- Melhores colimadores
 - “multiple pin-hole”, “ultra-high sens. detectors”
- Optimização geometria do scanner
 - Maior sensibilidade fotónica
- Detectores sólidos – protocolos mais curtos
 - Cadmium Zinc Telluride (CZT)
 - Iodeto de cézio (CSi)
- **Novos** algoritmos de reconstrução





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