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Imagerie Nucléaire, méthode de référence?

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A READER'S GUIDE

Your Choices in Heart Scans

Once the stethoscope was the only tool doctors had for diagnosing heart trouble. Today, using the latest X-ray, magnetic and ultrasound scanners, they can take detailed, three-dimensional and even moving pictures of that vital organ. Here's a guide to the many choices available. —By Alice Park and Cristina Scalet

ELECTROCARDIOGRAM (EKG)

How it works This oldest and most basic heart scan records the electrical impulses that regulate your heart's pumping action. It may seem unsophisticated, but any deviation from the normal rhythm pattern can alert doctors to the likelihood of damaged heart tissue and reduced blood flow.

Limitations While it can indicate signs of trouble, an EKG provides no visual scan of the heart and cannot identify precisely what ails the organ or where in the heart the problem lies.

NUCLEAR STRESS TESTING

How it works Doctors inject a radioactive substance into the blood, then use gamma ray cameras to see how the blood moves through the heart. The test shows how well the heart is doing at keeping itself saturated with oxygen-rich blood. The test is often done twice, to check cardiac performance at rest and under physical stress.

Limitations Carrying out two scans can take as long as five hours. The test also exposes the patient to small amounts of radiation.

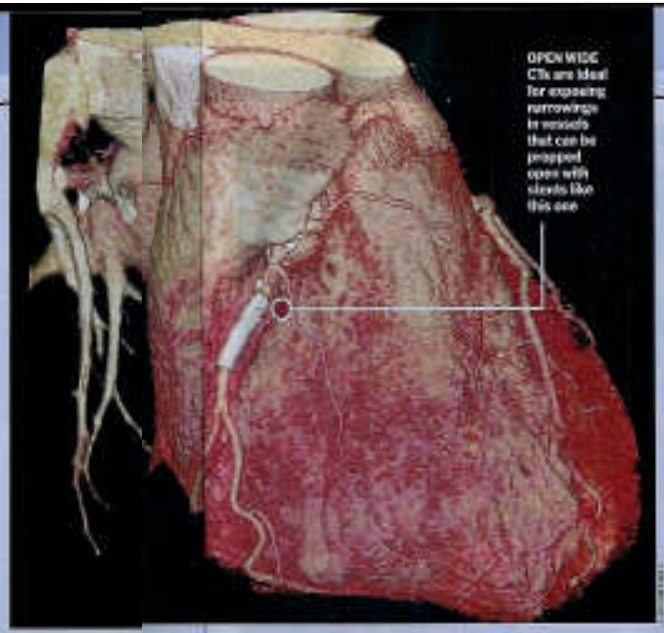
FLOW CHART The heart at left is getting enough blood; dark spots on the heart at right indicate inadequate fluid

ECHOCARDIOGRAM (ECHO)

How it works Harmless ultrasound waves, similar to the ones used to take sonograms of a fetus, are directed at the chest and bounce off the heart's walls and valves. A computer analyzes these rebounding waves and calculates the size, shape and movement of structures inside the heart. Doctors often take two echoes—one of the heart at rest and another of the heart under stress (e.g., after the patient exercises on a treadmill or after technicians have injected a drug to make the heart race). Comparison of the two images helps pinpoint abnormal valves or areas that are not receiving enough blood.

Limitations Ultrasound does not produce images with high enough resolution to see heart arteries and can highlight only the biggest changes in structures like the heart chambers.

LEAKY SEAL An echo detects a valve (arrow) that doesn't properly isolate the chambers of the heart



OPEN WIDE CTs are ideal for exposing narrowings in vessels that can be propped open with stents like this one

CT SCAN

How it works This test combines rapid X-ray scanning with multiple computer tomography (CT) to produce the most detailed images available of the heart's arteries without surgery. Patients receive an injection of contrast dye to highlight the blood vessels, and X rays create images of the heart in slices. A computer assembles the slices into an image of the heart that reveals calcium and fat-filled plaques lodged in the arteries.

Limitations CT scans involve radiation exposure, a particular concern for children. Those who are overweight or have stents or extensive calcium deposits won't generate useful images, since fat can distort X rays and the beams cannot penetrate metal or calcium.

CALCIUM PLUG Bulging regions along the arteries (circled) indicate accumulated calcium plaques that stand out on CT scans

BYPASS A powerful CT scanner provides a detailed look at two vein grafts (at arrows) inserted to detour blood around arterial blockages

BLOCKED FLOW A constricted stretch of artery (arrow) that could reduce blood flow to the rest of the heart

CORONARY ANGIOGRAM

How it works This procedure is the gold standard for viewing the arteries that nourish the heart. Doctors insert a catheter through an artery in the leg and snake it up toward the heart. They then send a special dye through the tube that highlights the arteries under X rays and exposes any blockages.

Limitations Because they're invasive, angiograms have some risks: catheters can tear artery walls, requiring surgical repair. In 1% of cases, serious complications, including death, may occur. Afterward, patients must lie still for four to six hours until the blood vessel in the leg seals.

PET/CT SCAN

How it works A hybrid of positron emission tomography and CT, this scan provides structural and functional information about the heart in a single scan. Doctors use the CT to physically locate narrowed regions along arteries, then apply PET to isolate parts of the heart muscle, such as the areas circled, that are deprived of blood flow as a result.

Limitations PET technology is expensive, and the latest machines are not widely available. The test also involves some radiation exposure.

MAGNETIC RESONANCE IMAGING (MRI)

How it works Powerful magnets create a field that sets the nuclei of atoms in heart cells vibrating. The oscillating atoms emit radio signals, which are converted by a computer into either still or moving 3-D images. The arrow at left points to a plaque-filled spot in the artery; the scan also reveals the layer of fat that envelops most hearts.

Limitations Because of the intense magnetic field, patients with pacemakers, stents or other metal implants can't get an MRI. These scans cannot pick up calcium deposits, which could signal dangerously narrowed vessels.

For additional images of the heart, both moving and still, go to time.com

Les challengers à la médecine nucléaire

- techniques
  - Echocardiographie
  - TDM-MB
  - IRM
- objectifs
  - Perfusion myocardique
  - Fonction VG
  - Viabilité myocardique

Détection ischémie myocardique en aval sténose coronaire. TSMP effort

Table 1. Diagnostic accuracy of exercise MPS for the detection of ≥50% coronary stenosis defined angiographically

Author, year [ref.]	No.	Tracer	Analysis	MI excluded	Quality	Sens (%)	Spec (%)	Acc (%)
Tamaki, 1984 [11]	104	^{201}Tl	Q	Both[a]	2	98	91	96
DePasquale, 1988 [12]	210	^{201}Tl	Q	Both[a]	2	95	74	92
Fintel, 1989 [13]	135	^{201}Tl	V	No	2	83	–	–
Iskandrian, 1989 [14]	193	^{201}Tl	V	Yes	2	86	62	79
Maddahi, 1989 [15]	110	^{201}Tl	Q	Both[a]	3	95	56	88
Mahmarian, 1990 [16]	296	^{201}Tl	Q	Both[a]	3	87	87	87
Van Train, 1990 [17]	242	^{201}Tl	Q	Both[a]	2	94	43	85
Coyne, 1991 [18]	100	^{201}Tl	V	No	2	81	74	77
Quinones, 1992 [19]	112	^{201}Tl	V	Yes	1	77	81	78
Chae, 1993 [20]	243	^{201}Tl	V	No	3	71	63	69
Grover-McKay, 1994 [21]	18	^{201}Tl	V	No	1	91	86	89
Tamaki, 1994 [22]	25	^{201}Tl	V	No	1	95	33	88
Ho, 1997 [23]	51	^{201}Tl	V	Both[a]	3	76	77	76
Kiat, 1990 [24]	53	MIBI	Q	Both[a]	2	94	80	92
Pozzoli, 1991 [25]	75	MIBI	V	No	1	84	88	85
Solot, 1993 [26]	78	MIBI	V	No	2	96	74	90
Marwick, 1994 [27]	86	MIBI	V	Yes	2	73	70	72
Van Train, 1994 [28]	124	MIBI	Q	Both[a]	2	89	36	81
Tamaki, 1994 [22]	26	Tetro	V	No	1	96	67	92
Heo, 1994 [29]	23	Tetro	V	No	2	87	–	–
Benoit, 1996 [30]	30	Tetro	V	Yes	2	81	89	83
Shanoudy, 1998 [31]	26	Tetro	V	No	2	96	–	–

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Détection ischémie myocardique en aval sténose coronaire. TSMP dipyridamole

Table 2. Diagnostic accuracy of dipyridamole MPS for the detection of ≥50% (or ≥70%[a]) coronary stenosis defined angiographically

Author, year [ref.]	No.	Tracer	Analysis	MI excluded	Quality	Sens (%)	Spec (%)	Acc (%)
Francisco, 1982 [32][a]	75	^{201}Tl	Q	No	2	90	96	92
Huikuri, 1988 [33][a]	93	^{201}Tl	V	No	2	96	75	94
Go, 1990 [34]	202	^{201}Tl	V	Both[b]	3	76	80	77
Mendelson, 1992 [35][a]	79	201Tl	V	Both[b]	2	90	–	–
Cramer, 1994 [36]	38	^{201}Tl	V	No	3	90	71	87
Grover-McKay, 1994 [21]	18	^{201}Tl	V	Unknown	1	91	100	94
Ho, 1995 [37]	54	^{201}Tl	V	No	3	98	73	93
Watanabe, 1997 [38]	53	^{201}Tl	V	Yes	2	80	72	77
Tartagni, 1991 [39]	30	^{201}Tl; MIBI	V	No	2	100	75	97
Miller, 1997 [40]	244	MIBI	V	Both[b]	2	91	28	81
Schillaci, 1997 [41]	40	MIBI	V	Yes	1	95	72	85
Soman, 1997 [42]	27	MIBI	V	No	3	90	66	89
Ogilby, 1998 [43]	26	MIBI	V	No	2	90	100	92
Santoro, 1998 [44][a]	60	MIBI	V	Yes	3	97	89	93
He, 1997 [45]	64	Tetro	V	No	2	85	54	80

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Détection ischémie myocardique en aval sténose coronaire. TSMP adénosine

Table 3. Diagnostic accuracy of adenosine MPS for the detection of ≥50% coronary stenosis defined angiographically

Author, year [ref.]	No.	Tracer	Analysis	MI excluded	Quality	Sens (%)	Spec (%)	Acc (%)
Nguyen, 1990 [46]	60	^{201}Tl	V	No	2	92	100	93
Verani, 1990 [47]	45	^{201}Tl	Q	No	2	83	94	87
Coyne, 1991 [18]	100	^{201}Tl	V	Both[b]	2	83	76	79
Nishimura, 1991 [48]	101	^{201}Tl	V	Both[b]	3	84	84	84
Allman, 1992 [49]	76	^{201}Tl	Q	Yes	3	85	38	80
Pennell, 1995 [50]	226	^{201}Tl	V	No	3	96	78	92
Mohiuddin, 1996 [51]	202	^{201}Tl	Q	No	3	90	86	89
Amanullah, 1993 [52]	40	MIBI	V	No	2	94	100	95
Marwick, 1993 [53]	97	MIBI	V	Yes	2	86	71	80
Jamil, 1999 [54]	32	MIBI	V	No	2	75	–	–
Kapur, 2002 [55][a]	2,560	^{201}Tl, MIBI, Tetro	V	Yes	2	91	87	91

Underwood & al. Eur JNM & Mol Im. 2004;31 :261 –291

Détection ischémie myocardique en aval sténose coronaire. TSMP dobutamine

Table 4. Diagnostic accuracy of dobutamine MPS for the detection of ≥50% (or ≥70%[a]) coronary stenosis defined angiographically

Author, year [ref.]	No.	Tracer	Analysis	MI excluded	Quality	Sens (%)	Spec (%)	Acc (%)
Pennell, 1991 [56]	50	^{201}Tl	V	No	2	97	80	94
Warner, 1993 [57]	16	^{201}Tl	V	No	2	93	100	94
Hays, 1993 [58]	67	^{201}Tl	Q	No	2	86	90	87
Huang, 1997 [59]	93	^{201}Tl	Q	No	3	90	81	87
Huang, 1998 [60]	110	^{201}Tl	V	Yes	3	82	82	82
Caner, 1997 [61]	29	^{201}Tl; MIBI	V	Uncertain	3	89	70	83
Gunalp, 1993 [62]	27	MIBI	V	Yes	2	94	89	93
Forster, 1993 [63]	21	MIBI	V	Yes	3	83	89	86
Marwick, 1993 [53]	97	MIBI	V	Yes	2	80	74	77
Marwick, 1993 [64]	217	MIBI	Q	Yes	3	76	67	73
Mairesse, 1994 [65]	129	MIBI	V	Yes	3	76	65	72
Marwick, 1994 [27]	82	MIBI	V	Yes	2	65	68	66
Senior, 1994 [66]	61	MIBI	V	No	3	95	71	88
Di Bello, 1996 [67]	45	MIBI	V	Yes	3	87	86	87
Iftihar, 1996 [68]	38	MIBI	V	No	2	79	90	82
Kisacik, 1996 [69]	69	MIBI	V	No	3	96	64	86
Slavich, 1996 [70]	46	MIBI	V	Yes	?	82	83	83
San Roman, 1998 [71]	92	MIBI	Q	Yes	3	87	70	82
Santoro, 1998 [44][a]	60	MIBI	Q	Yes	3	91	81	87
Elhendy, 1998 [72]	70	MIBI	V	No	?	64	72	67

Underwood & al. Eur JNM & Mol Im. 2004;31 :261 –291

Valeur Pronostique de la TSMP coronariens connus (1)

Table 6. Prognostic value of MPS in definite or suspected CHD (adapted from reference [111])

Year	Author [ref.]	No.	Agent	Abnormal MPS (%)	Mean F/U (m)	HE (%/yr)	HE with abnormal MPS (%/yr)	HE with normal MPS (%/yr)	RR
2001	Galassi [113]	459	Tetro	77	37	2.5	3.0	0.9	3.25
1999	Vanzetto [114]	1,137	^{201}Tl	66	72	1.5	2.0	0.6	3.53
1998	Hachamovitch [108]	5,183	MIBI/^{201}Tl	43	21.4	3.0	5.9	0.8	7.50
1998	Olmos [115]	225	^{201}Tl	49	44.4	1.8	2.7	0.9	2.86
1998	Alkeylani [116]	1,086	MIBI	62	27.6	3.4	5.0	0.6	8.92
1997	Snader [117]	3,400	^{201}Tl	21	~24	1.6 (ACM)	~3.8 (ACM)	~1.0 (ACM)	3.75
1997	Boyne [118]	229	MIBI	32	19.2	2.2	5.1	0.8	6.23
1997	Geleijnse [119]	392	MIBI	67	22	6.0	8.7	0.8	10.67
1995	Heller [120]	512	MIBI	58	12.8	4.6	6.9	1.3	5.29
1994	Machecourt [121]	1,926	^{201}Tl	63	33	2.0	2.9	0.5	6.23
1994	Kamal [122]	177	^{201}Tl	83	22	4.3	5.2	0	–
1994	Stratmann [123]	534	MIBI	66	13	10.1	14.3	1.6	9.12
1994	Stratmann [124]	521	MIBI	60	13	4.2	6.7	0.5	14.60

ACM, All-cause mortality; HE, hard event (cardiac death or non-fatal MI); RR, relative risk; other abbreviations as defined in Table 1 and list of abbreviations

Underwood & al. Eur JNM & Mol Im. 2004;31 :261 –291

Valeur Pronostique de la TSMP Douleurs thoraciques (2)

Table 7. Prognostic value of normal MPS in patients presenting with stable chest pain (adapted from reference [111])

Year	Author [ref.]	No.	Agent	Normal MPS (%)	Mean F/U (months)	HE with normal MPS (% per yr)
2001	Galassi [113]	459	Tetro	23	37	0.9
2000	Groutars [125]	236	Tetro/^{201}Tl	100	25	0.4
1999	Gibbons [126]	4,473	^{201}Tl/MIBI	100	36	0.6
1999	Soman [127]	473	MIBI	100	30	0.2
1999	Vanzetto [114]	1,137	^{201}Tl	34	72	0.6
1998	Hachamovitch [108]	5,183	MIBI/^{201}Tl	57	21.4	0.8
1998	Olmos [115]	225	^{201}Tl	51	44.4	0.9
1998	Alkeylani [116]	1,086	MIBI	38	27.6	0.6
1997	Snader [117]	3,400	^{201}Tl	79	~24	~1.0 (ACM)
1997	Boyne [118]	229	MIBI	68	19.2	0.8
1997	Geleijnse [119]	392	MIBI	33	22	0.8
1995	Heller [120]	512	MIBI	42	12.8	1.3
1994	Machecourt [121]	1,926	^{201}Tl	37	33	0.5
1994	Kamal [122]	177	^{201}Tl	17	22	0
1994	Stratmann [123]	534	MIBI	34	13	1.6
1994	Stratmann [124]	521	MIBI	40	13	0.5
	Total	20,963		53	28.3	0.7

ACM, All-cause mortality; HE, hard event (cardiac death or non-fatal MI); RR, relative risk; other abbreviations as defined in Table 1 and list of abbreviations

Underwood & al. Eur JNM & Mol Im. 2004;31 :261 –291

Valeur Pronostique de la TSMP Pré opératoire(3)

Table 8. MPI for preoperative assessment of cardiac risk (adapted from reference [134])

Year	Author [ref.]	No.	Infarction incidence (%)	Mortality (%)	PPV	NPV
Vascular surgery						
1985	Boucher [135]	46	16 (35)	3 (6%)	19% (3/16)	100% (32/32)
1987	Cutler [136]	116	54 (47)	11 (10%)	20% (11/54)	100% (60/60)
1988	Fleisher [137]	67	15 (22)	3 (4%)	20% (3/15)	100% (56/56)
1988	Jacobs [138]	48	14 (31)	2 (4%)	14%(2/14)	100% (34/34)
1989	Eagle [139]	300	82 (41)	15 (8%)	18% (13/82)	98% (81/82)
1990	McFalls [140]	95	34 (36)	7 (7%)	8% (3/34)	96% (44/46)
1990	Younis [141]	111	48 (36)	8 (7%)	13% (6/48)	100% (51/51)
1991	Mangano [142]	60	22 (37)	3 (5%)	5% (1/22)	95% (19/20)
1991	Sharma [143]	68	n/a	4 (6%)	n/a	100% (21/21)
1991	Walther [144]	25	15 (58)	3 (12%)	20% (3/15)	100% (11/11)
1992	Hendel [145]	327	167 (51)	28 (9%)	14% (23/167)	98% (97/98)
1992	Lette [146]	355	181 (45)	30 (8%)	17% (28/161)	98% (169/183)
1992	Markou [147]	65	45 (69)	5 (8%)	11% (5/45)	100% (20/20)
1993	Brown [148]	391	77 (20)	12 (3%)	13% (10/77)	98% (120/121)
1993	Kownator [149]	170	67 (39)	5 (3%)	4% (3/67)	98% (64/65)
1994	Kaw [150]	437	168 (38)	22 (5%)	4% (7/160)	96% (196/203)
1994	Ley [151]	237	110 (46)	17 (7%)	11% (12/110)	100% (87/87)
1995	Koutelou [152]	105	42 (40%)	3 (3%)	6% (3/47)	100% (49/49)
1995	Marshall [153]	117	55 (47%)	12 (10%)	16% (8/55)	97% (33/34)
1997	Van Domburg [154]	142	48 (34%)	9 (6%)	n/a	n/a
Non-vascular surgery						
1990	Camp [155]	40	8 (20)	6 (15%)	67% (6/9)	100% (23/23)
1991	Iqbal [156]	91	11 (41)	9 (11%)	27% (3/11)	100% (20/20)
1992	Culey [157]	100	36 (36)	4 (4%)	8% (3/36)	98% (62/64)
1992	Shaw [158]	60	28 (47)	6 (10%)	21% (6/28)	100% (19/19)
1993	Tabas [159]	35	15 (28)	6 (11%)	27% (4/15)	100% (32/32)
1994	Younis [160]	161	58 (31)	15 (9%)	18% (8/58)	98% (87/89)
1996	Shahesmaeili [161]	229	67 (29%)	10 (4%)	6% (4/67)	99% (81/82)
	Weighted average	3,718		246 (7%)	12.1% (186/1,547)	98.6% (1,548/1,571)

MI, Myocardial infarction; NPV, negative predictive value; PPV, positive predictive value; n/a, not available

Underwood & al. Eur JNM & Mol Im. 2004;31 :261 –291

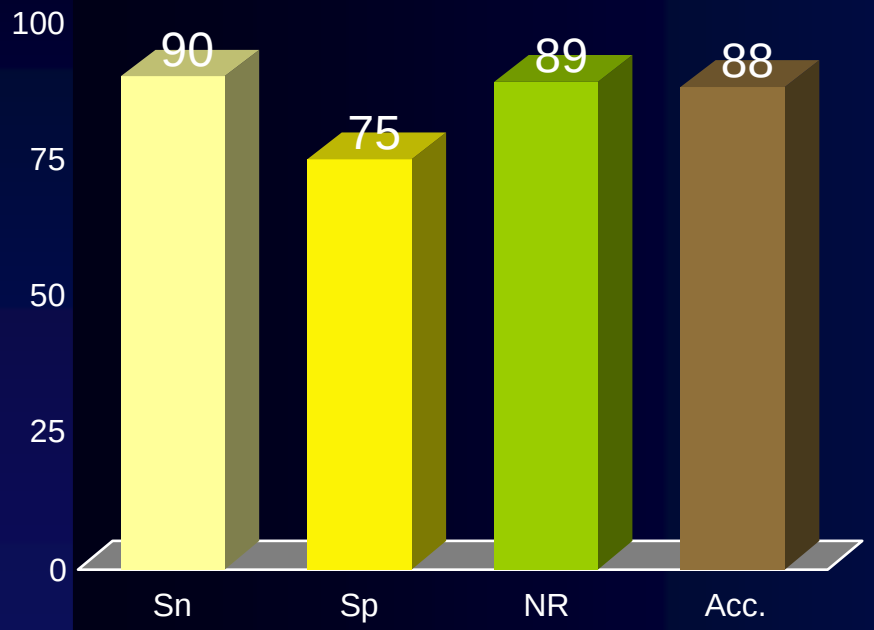
Valeur Pronostique de la TSMP (4)

Diabétique asymptomatique

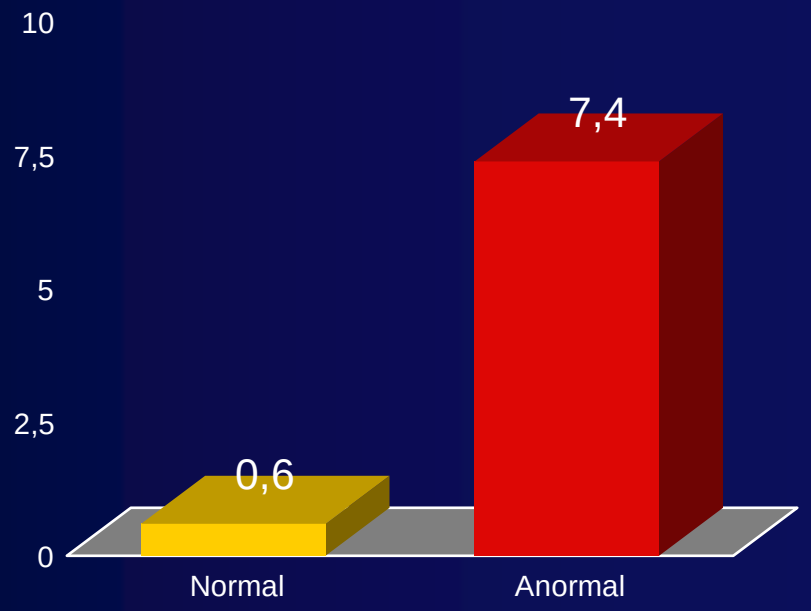
Study	Publications	Yr	# pts	F-Up (m)	
Rubler	Am J Cardiol	1987	123	36	
Brown	Am J Cardiol	1989	36	24	Renal failure
Lane	Am J Cardiol	1989	101	< 1	Vascular surg.
Camp	Am J Cardiol	1990	40	< 1	Renal failure
Koistinen	Br Heart J	1990	33	-	
Holley	Am J Med	1991	150	< 1	renal transpl.
Marwick	Transpl	1992	150	-	renal transpl.
Paillole	Diabetologica	1995	59	-	
Vanzetto	Diab Care	1999	158	24	high risk
Kang	Am Heart J	1999	1271	24	
Penfornis	Diabet Med	2001	56	-	versus DES
Kumar	Nucl Med Com	2001	43	-	
Giri	Circulation	2002	929	30	
Faglia	Diabetes care	2002	735	60	
De Lorenzo	Am J Cardiol	2002	180	36	
Berman	JACC	2003	589	27	
MiSAD	Diabetes Care	2003	97	24	
Vanzetto	AHA	2003	756	18	
Miller	Am H J	2004	1738	-	
Pooled data	-	-	**7244**	**36**	

Validation Clinique de la TSMP

Valeur Diagnostique
79 ˇtudes - 9000 pts



Valeur Pronostique
60 ˇtudes - 30 000 pts



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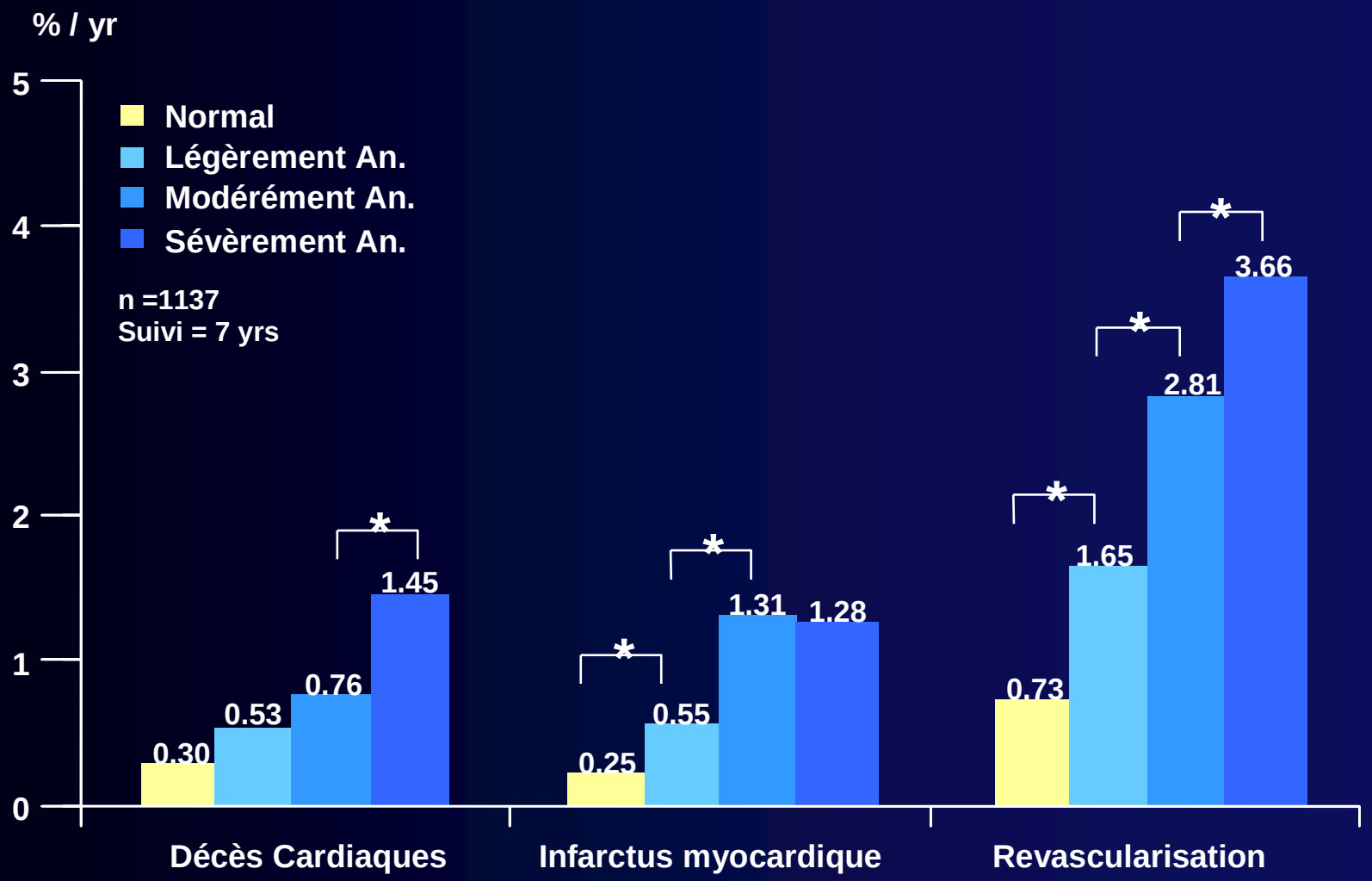
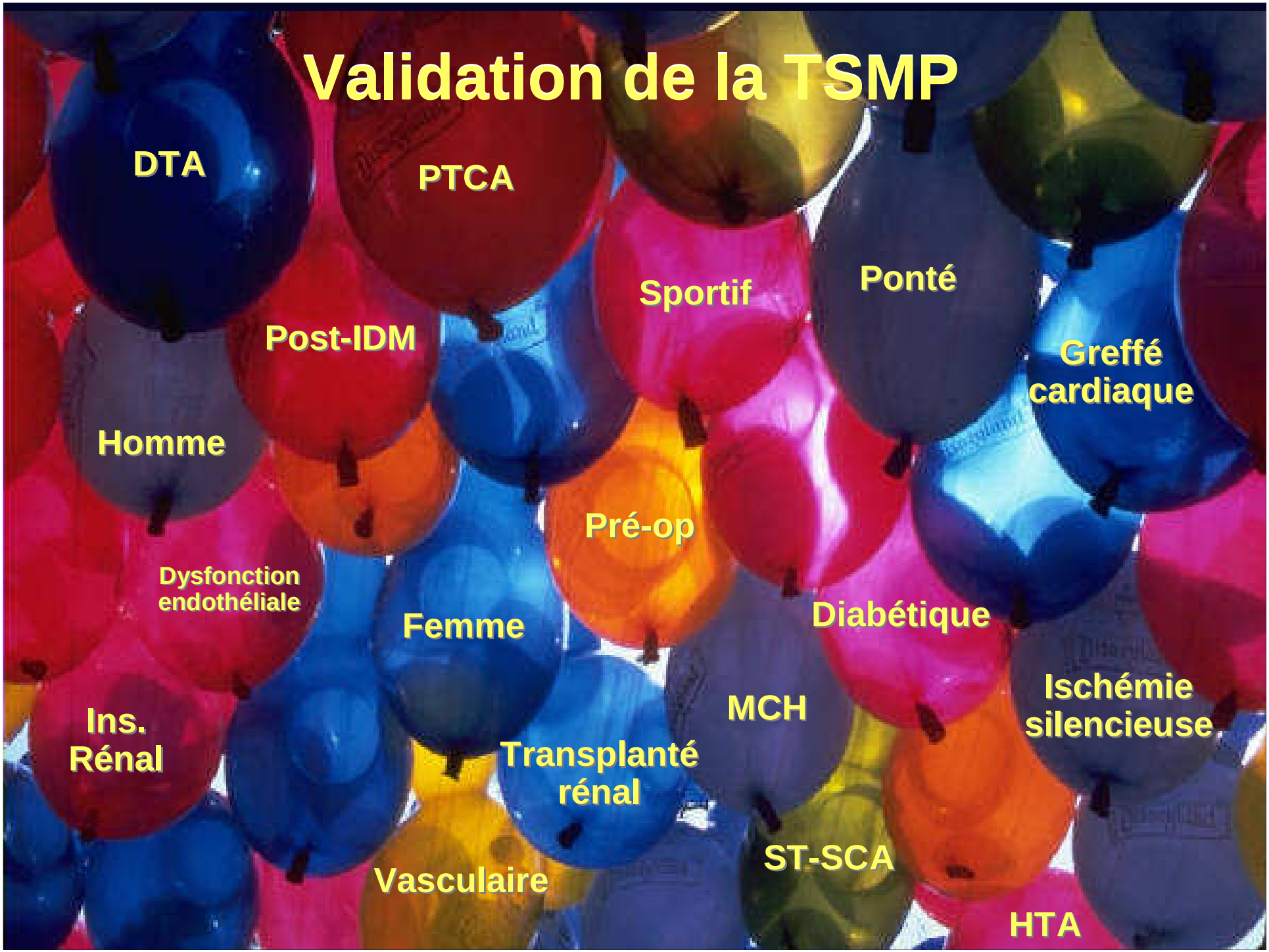
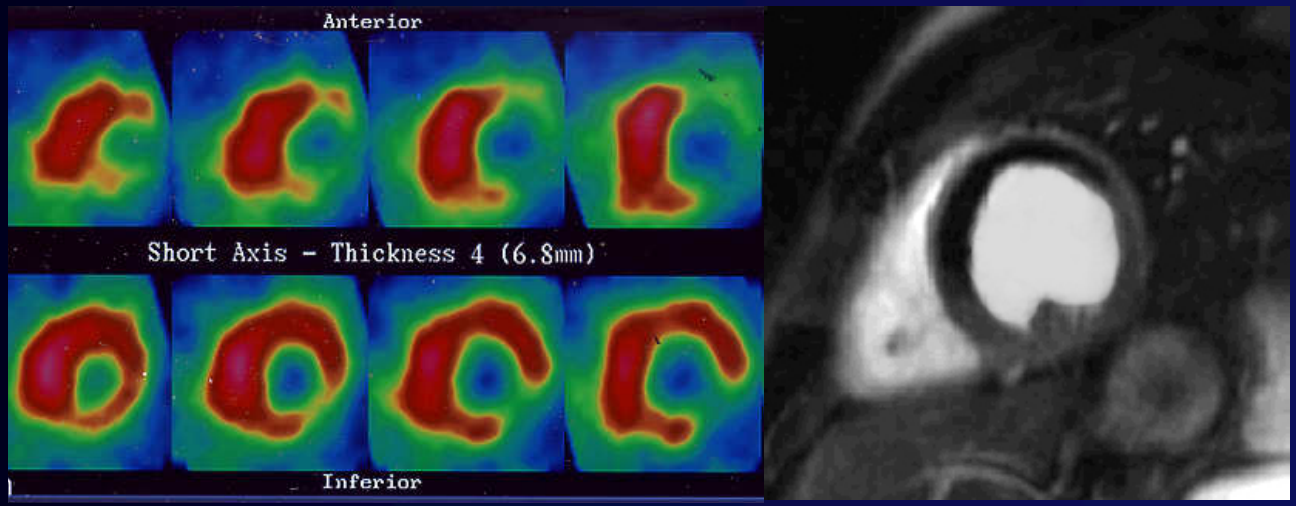
Valeur Pronostique de la TSMP (5)



Vanzetto et al. Circ 1999


Validation de la TSMP
DTA
PTCA
Sportif
Ponté
Post-IDM
Greffé cardiaque
Homme
Pré-op
Dysfonction endothéliale
Femme
Diabétique
Ischémie silencieuse
MCH
Ins. Rénal
Transplanté rénal
ST-SCA
Vasculaire
HTA

Ischémie myocardique
DES, ECM,IRM, Scanner



Valeur Diagnostique de l'ESD et ischémie

Table 3. Selected Studies Outlining the Accuracy of Exercise Echocardiography*

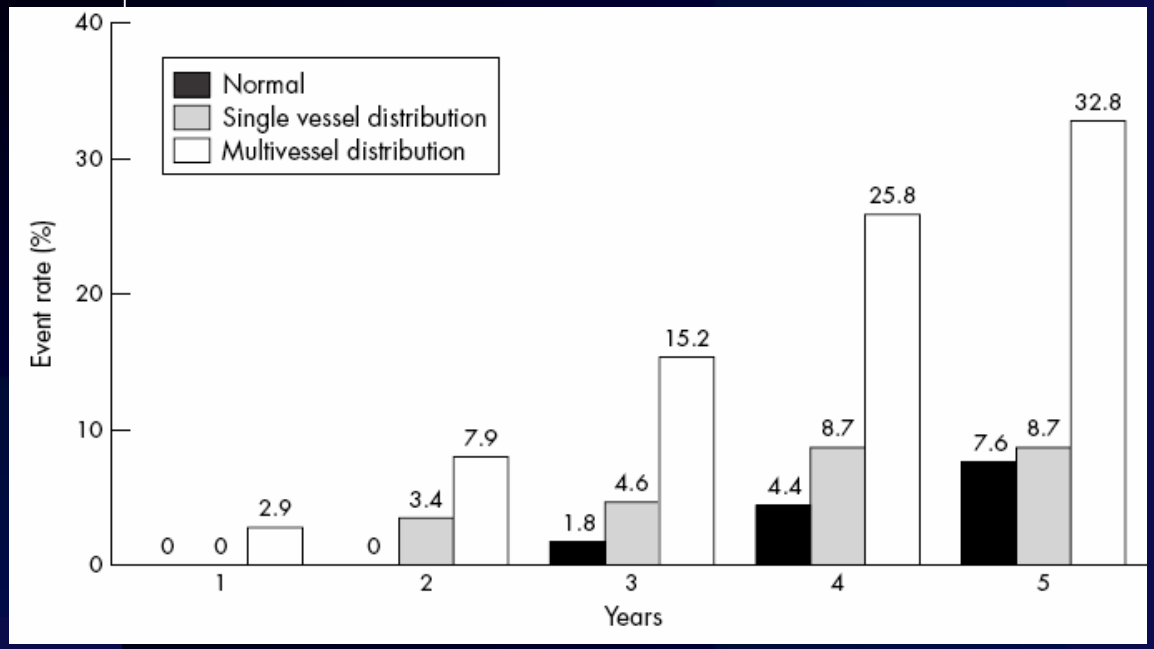
Author (Ref.)	Year	Exercise	Significant CAD	Total No. of Patients	Sensitivity (%)	Sensitivity for 1-VD (%)	Sensitivity for MVD (%)	Specificity (%)	PPV (%)	NPV (%)	Overall Accuracy (%)
Armstrong et al. (4)	1987	TME	50%	123	88	81	93	86	97	61	88
Crouse et al. (5)	1991	TME	50%	228	97	92	100	64	90	87	89
Marwick et al. (6)	1992	TME	50%	150	84	79	96	86	95	63	85
Quinones et al. (7)	1992	TME	50%	112	74	59	89	88	96	51	78
Hecht et al. (8)	1993	SBE	50%	180	93	84	100	86	95	79	91
Roger et al. (9)	1994	TME	50%	150	91	—	—	—	—	—	—
Beleslin et al. (10)	1994	TME	50%	136	88	88	91	82	97	50	88
Roger et al. (11)	1995	TME	50%	127	88	—	—	72	93	60	—
Marwick et al. (12)	1995	TME	50%	161	80	75	85	81	71	91	81
Marwick et al. (13)	1995	TME	>50%	147	71	63	80	91	85	81	82
Luotolahti et al. (14)	1996	UBE	50%	118	94	94	93	70	97	50	92
Roger et al. (15)	1997	TME	50%	340	78	—	—	41	79	40	69
Segar et al. (17)	1992	DSE (5–30)	50%	88	95	—	—	82	94	86	92
Marcovitz et al. (18)	1992	DSE (5–30)	50%	141	96	95	98	66	91	84	89
McNeill et al. (19)	1992	DASE (10–40)	50%	80	70	—	—	88	89	67	78
Marwick et al. (20)	1993	DSE (5–40)	50%	217	72	66	77	83	89	61	76
Previtali et al. (21)	1993	DSE (5–40)	50%	80	79	63	91	83	92	61	80
Takeuchi et al. (22)	1993	DSE (5–30)	50%	120	85	73	97	93	95	80	88

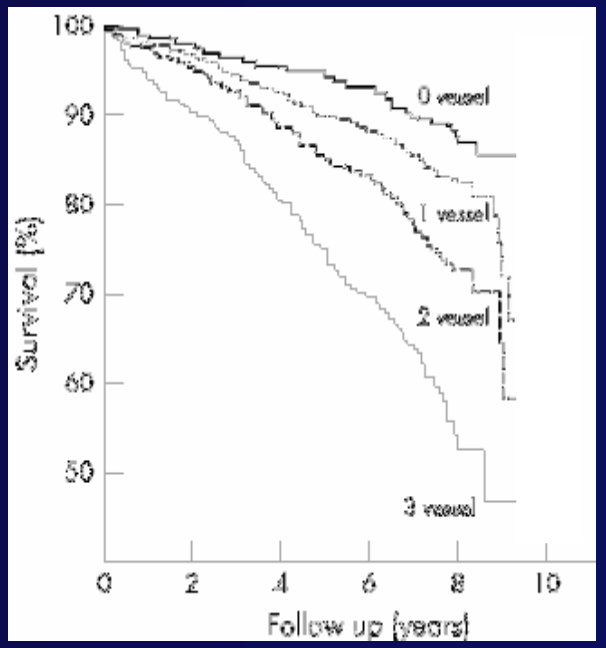
*Modified with permission from the American College of Cardiology Foundation and American Heart Association (2).
DASE = dobutamine-atropine stress echocardiography; DSE = dobutamine stress echocardiography; other abbreviations as in Table 3.

	Exercice	Dobutamine
Etudes	15	28
Patients	1849	2246
Sensibilité	84 %	80 %
Spécificité	82 %	84 %
Accuracy	83 %	82 %

Schuijf & al. Heart 2005;91 :1110 –1117

Valeur Pronostique de l'ESD



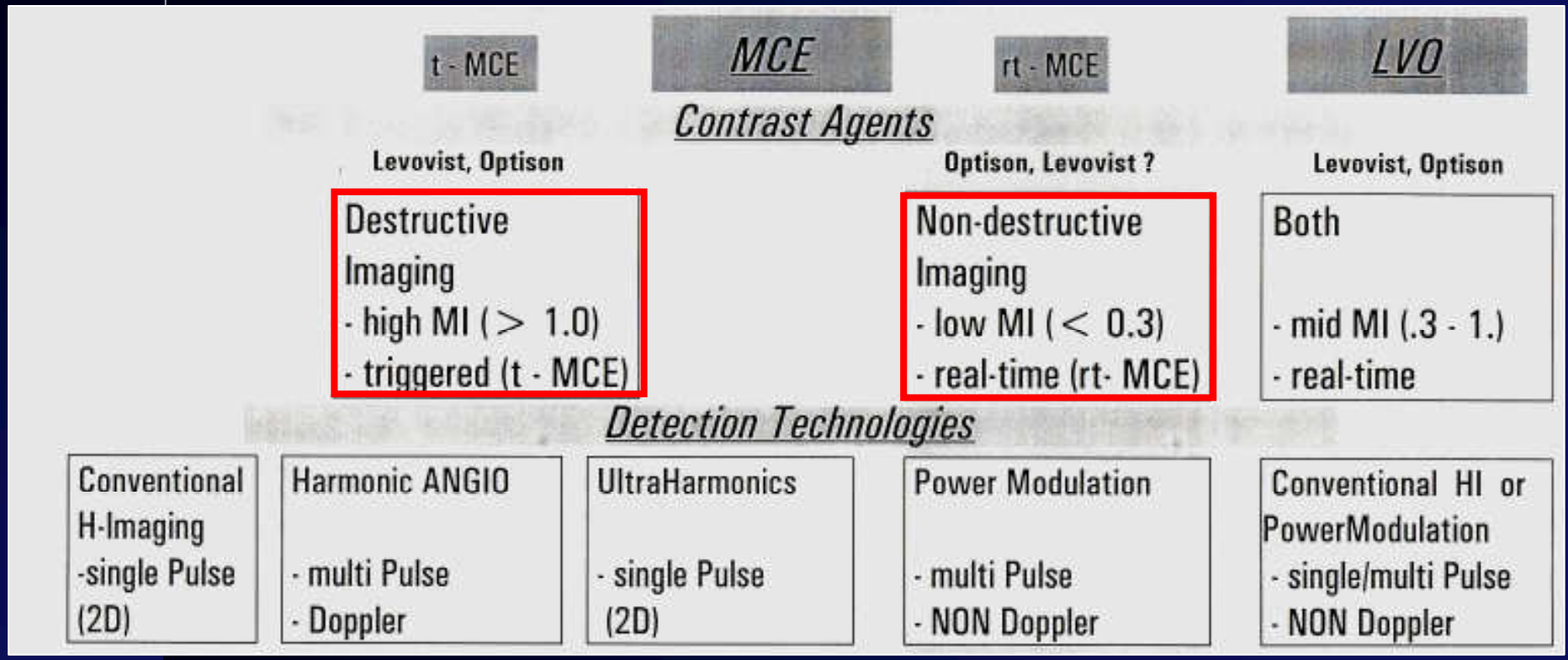


10 Etudes, 27 000 patients
ESD normale : †CV annuelle ± 1.0% / an
ESD patho : †CV annuelle x 2-5

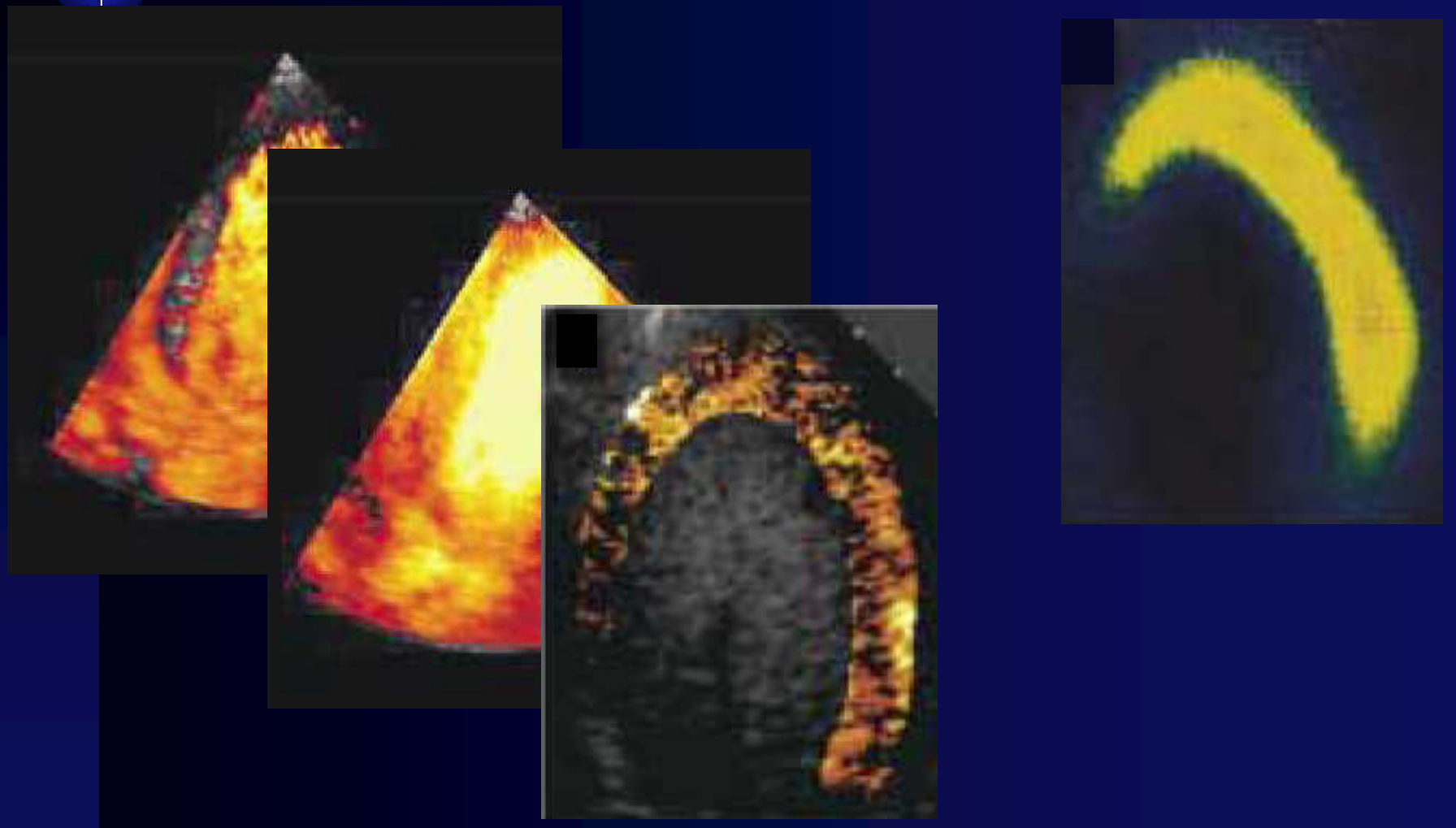
VPN < isotopes

Senior & al. Heart 2005;91:27 –36

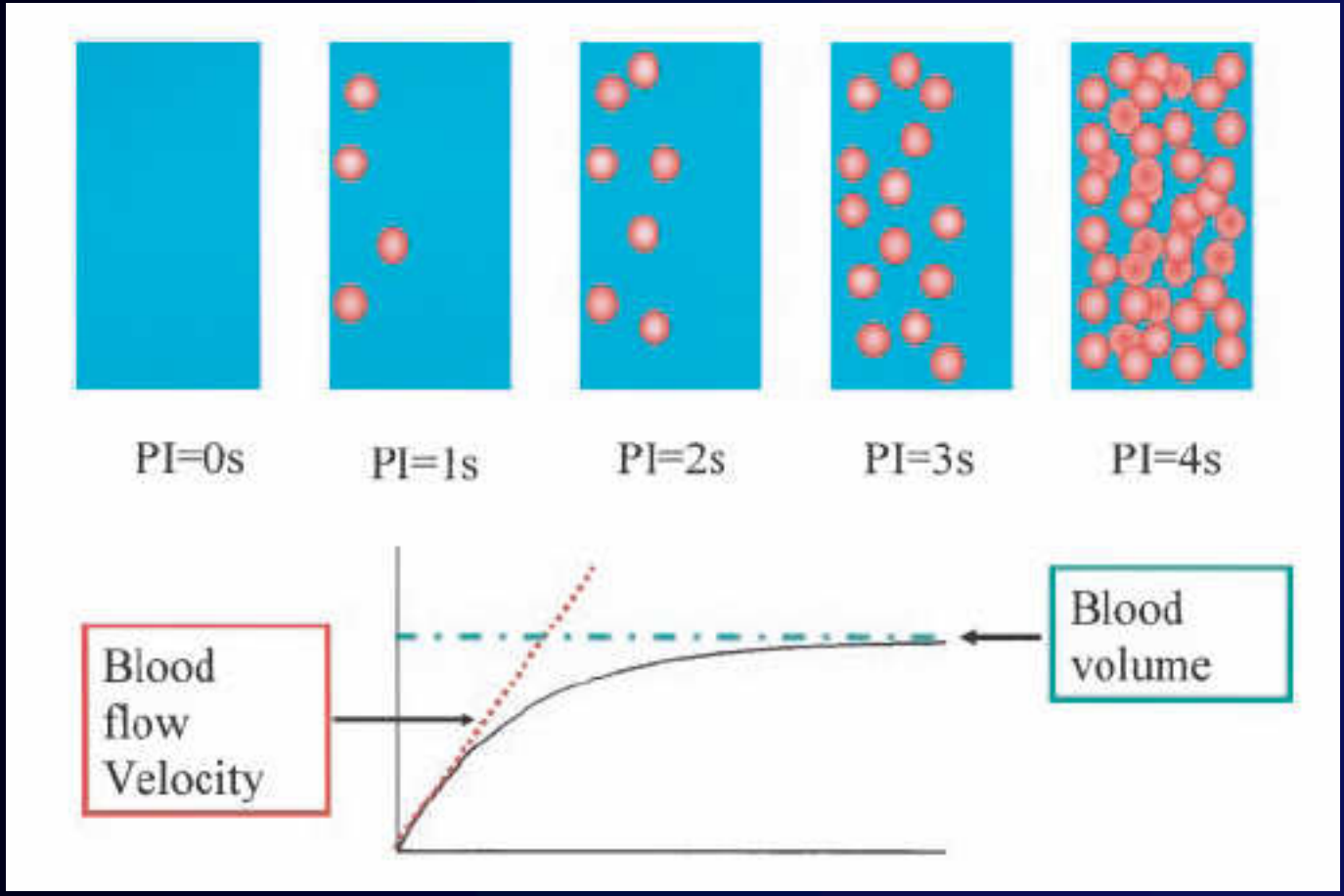
Perfusion : ECM



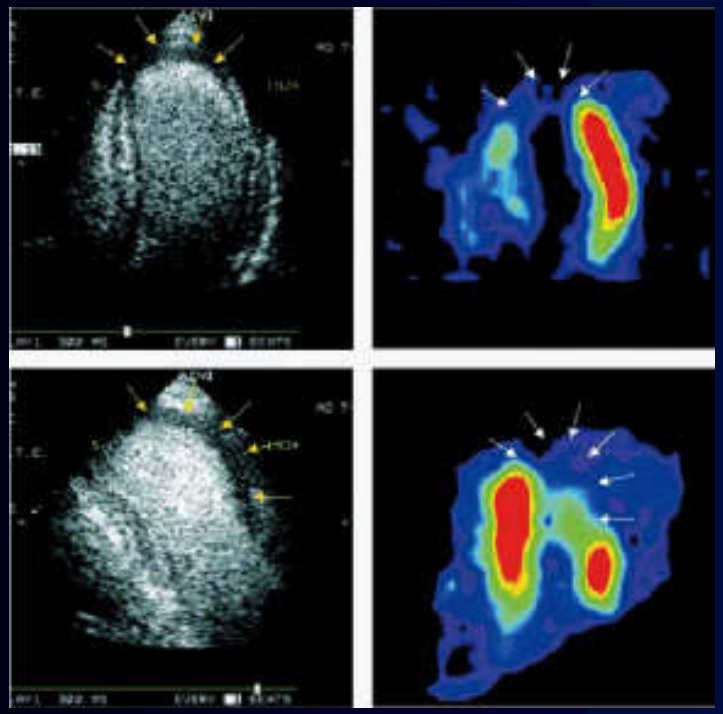
Perfusion : ECM



Perfusion : ECM



Perfusion : ECM



- 7 études cliniques
- 245 patients
- Comparaison coronarographie
- Sensibilité 89%
- ☐Spécificité 63%

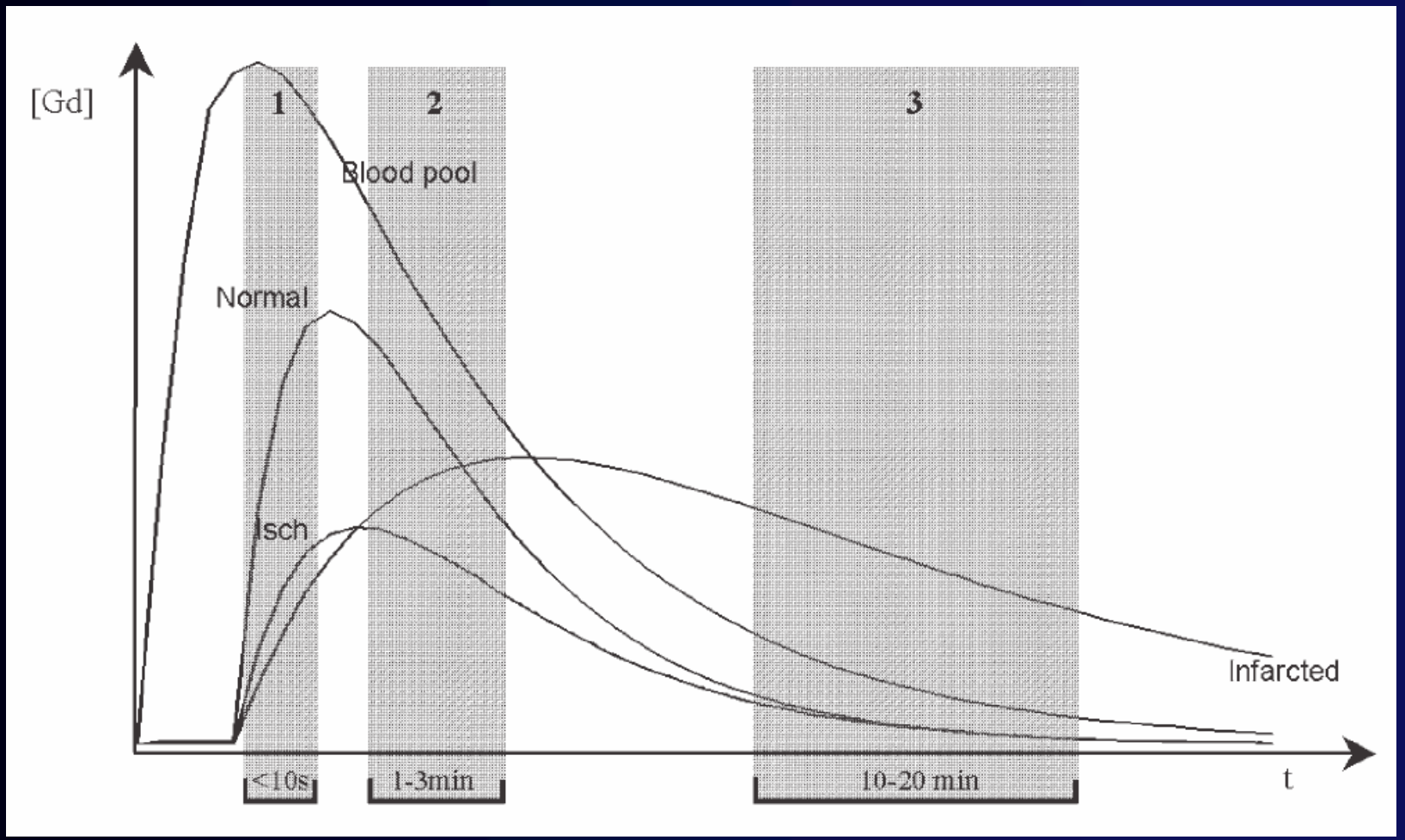
- Concordance TSMP
  - Brute 62%
  - "Corrigée" 82%

Schuijf & al. Heart 2005;91 :1110 –1117

Perfusion : ECM

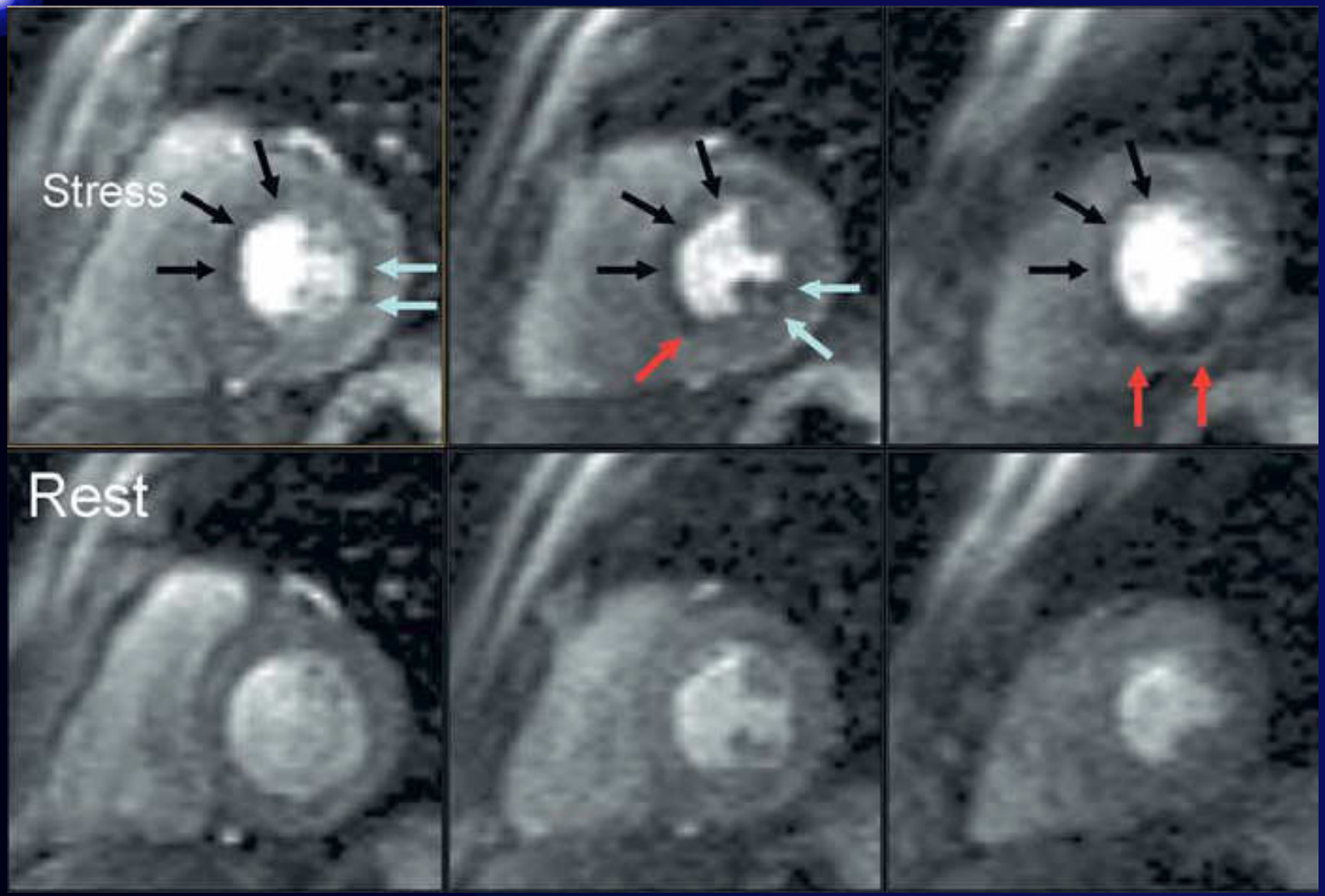
- Avantages
  - Pas d'irradiation
  - Pas d'injection de contraste iodé
  - Disponibilité
  - Accessible au cardiologue
  - Etude anatomique et fonctionnelle cardiaque
- Inconvénients
  - Temps médecin (post-traitement)
  - Courbe d'apprentissage ++
  - Disponibilité des produits de contrastes de 3ème génératon
  - Echogénicité
  - Artéfacts (shadowing, blooming, wall motion artifarcts)
  - Pas de validation pronostique
  - Cotation

Perfusion : IRM Gadolinium



Prasad & al. Eur J Radiol 2005;15 :B42-B47

Perfusion : IRM



Prasad & al. Eur J Radiol 2005;15 :B42-B47

Perfusion : IRM

- IRM de perfusion et Δc de coronaropathie :
  - 17 études
  - 502 patients (dipyridamole ou adénosine)
  - Sensibilité 84 - 93%
  - Spécificité 63 - 85%

Schuijf & al. Heart 2005;91 :1110 –1117

Perfusion : IRM

- Avantages
  - Pas d'irradiation
  - Pas d'injection de contraste iodé
  - Résolution spatiale
  - Combinaison possible avec IRM dobutamine
- Inconvénients
  - Temps médecin (quantification)
  - Disponibilité
  - Courbe d'apprentissage ++
  - Accessibilité au patient
  - Contre-indication au champs magnétiques
  - Pas de validation pronostique

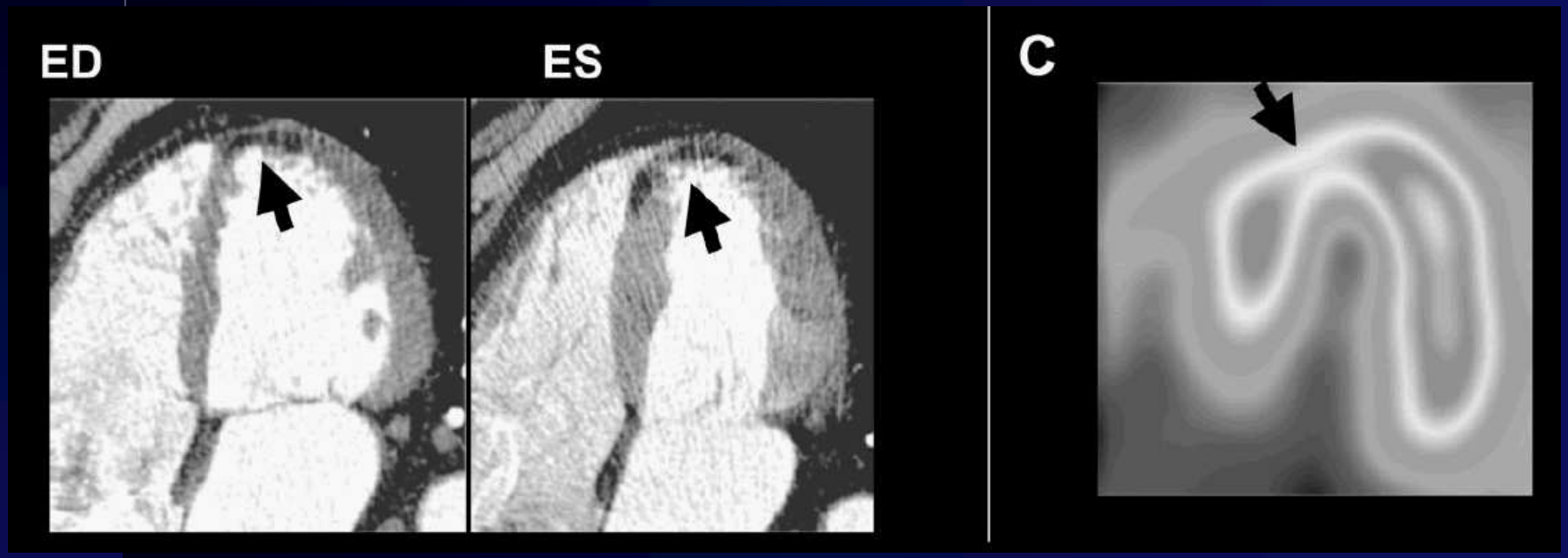
Perfusion : IRM

"Unfortunately, MRI is still limited to highly specialised centres and acquisition protocols are still time consuming, making the technique currently unsuitable for evaluation of larger populations.

No MRI studies with integration of systolic wall motion and perfusion to detect CAD are currently available.".

Schuijf & al. Heart 2005;91 :1110 –1117

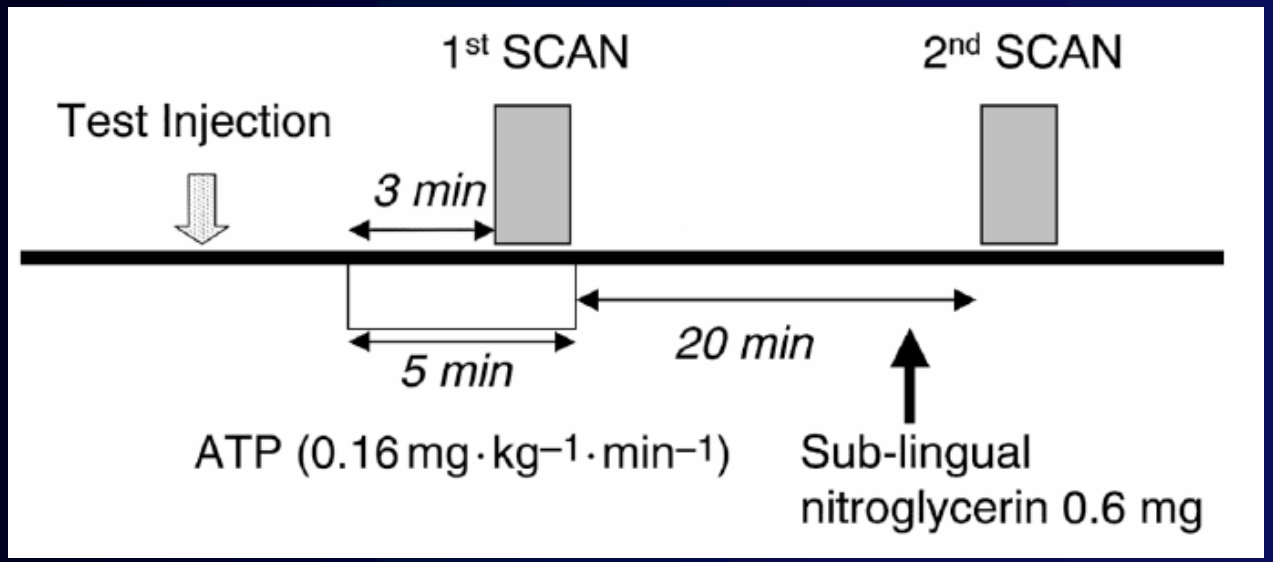
Perfusion : TDM-MB



Koyama & al. JMRI 2004; 19: 800 – 815

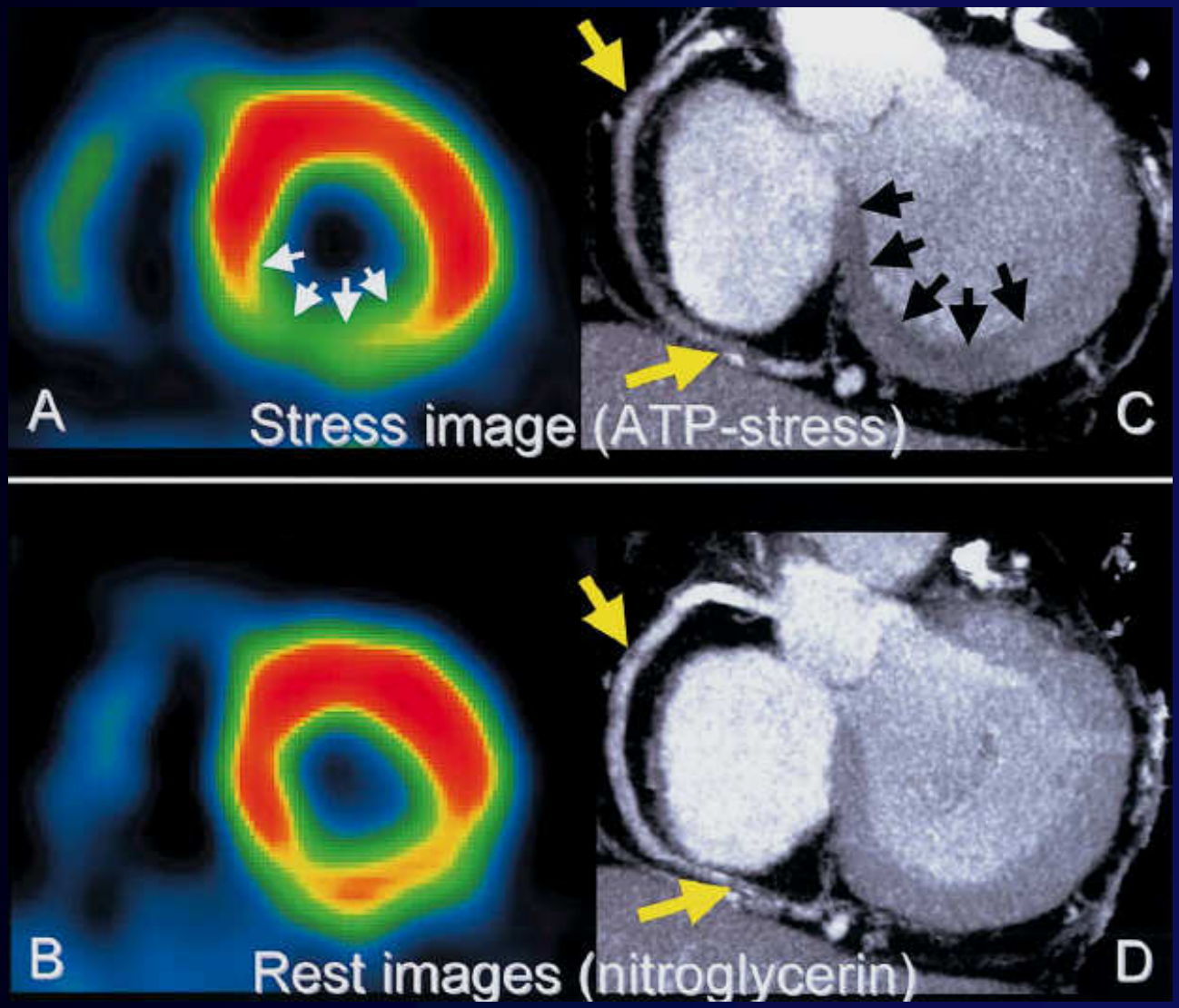
Perfusion : TDM-MB

- 84 patients
- TDM 16 barettes
- 50 mg aténolol (< 65 bpm)



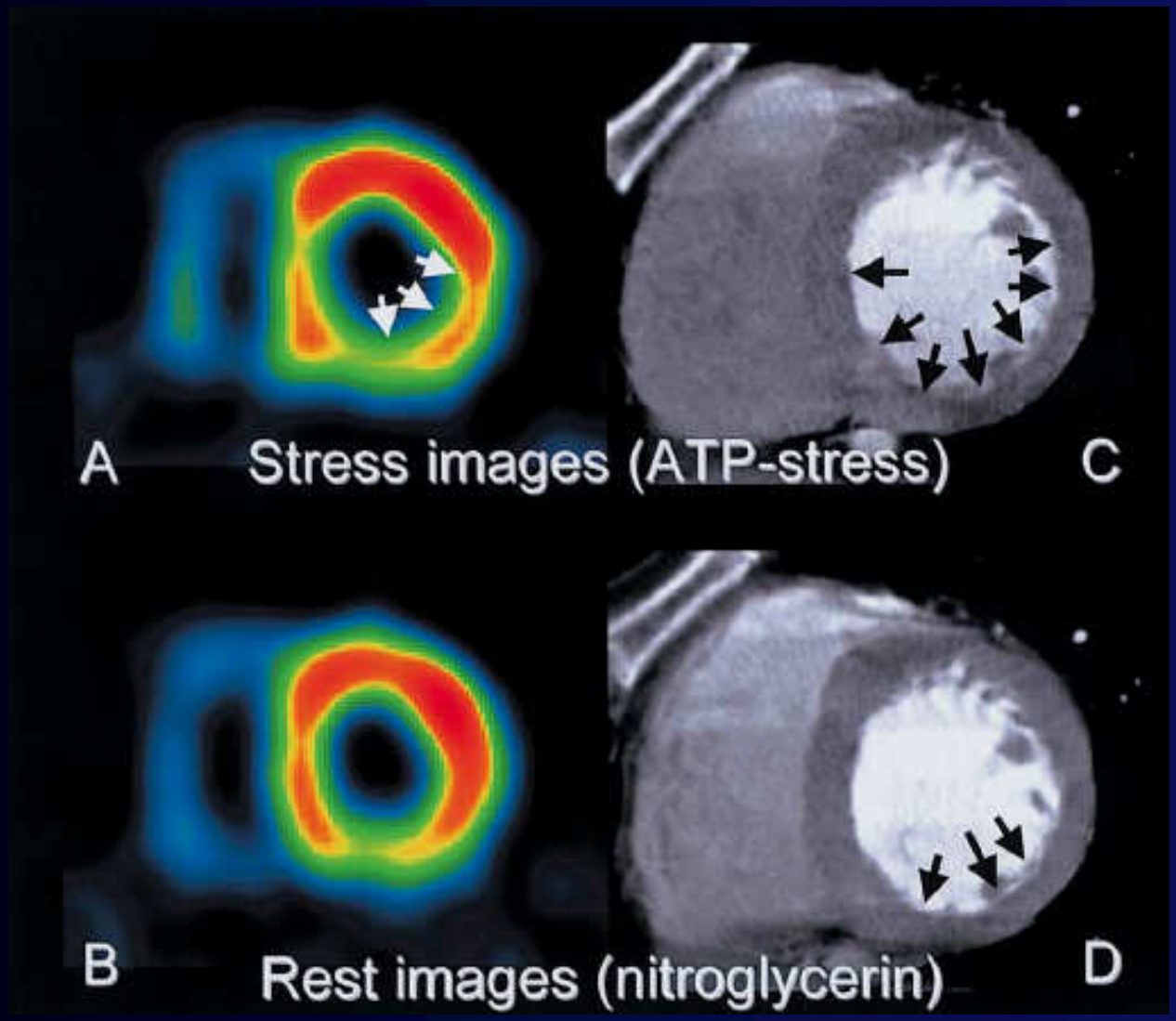
Kurata & al. Circ J 2005; 69: 550 – 557

Perfusion : TDM-MB



Kurata & al. Circ J 2005; 69: 550 – 557

Perfusion : TDM-MB



Kurata & al. Circ J 2005; 69: 550 – 557

Perfusion : TDM-MB

- Concordance TDM-MB / TSMP = 83%

Table 1 Agreement Between Perfusion CT and MPS

	MPS positive	*MPS negative*
Perfusion CT positive	*21*	*5*
Perfusion CT negative	*1*	*9*

Perfusion CT positive and negative = CE-MSCT described a hypo-perfusion area (HPA) and no-HPA in stress images; MPS positive and negative; stress thallium-201 myocardial perfusion scintigraphy described the presence and absence of redistribution visually noted in the 4-h images. The assessment by perfusion CT was significantly concordant with that by MPS (30/36, $p<0.05$).

Kurata & al. Circ J 2005; 69: 550 – 557

Perfusion : TDM-MB

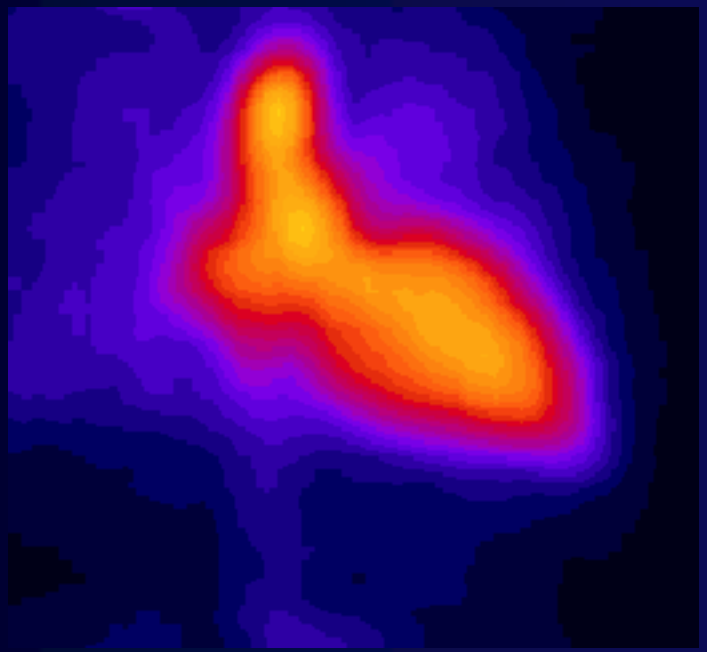
Our results showed that the ATP stress CE-MSCT can describe both myocardial ischemia induced by the ATP and coronary artery stenosis.

Although the coronary artery stenosis could be assessed with stress images, rest images are of higher image quality and seem to be more feasible at present.

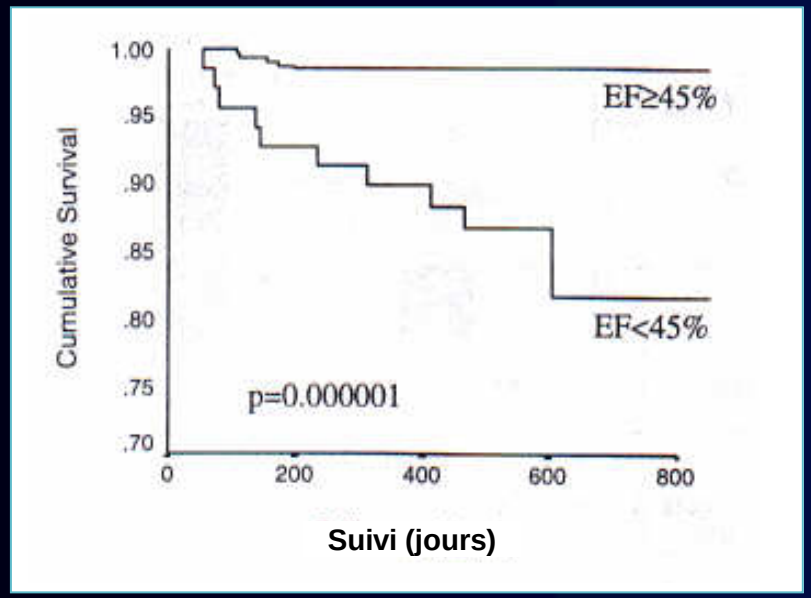
In a clinical setting, ATP stress CE-MSCT is a potential alternative to stress MPS in the evaluation of patients with CAD.

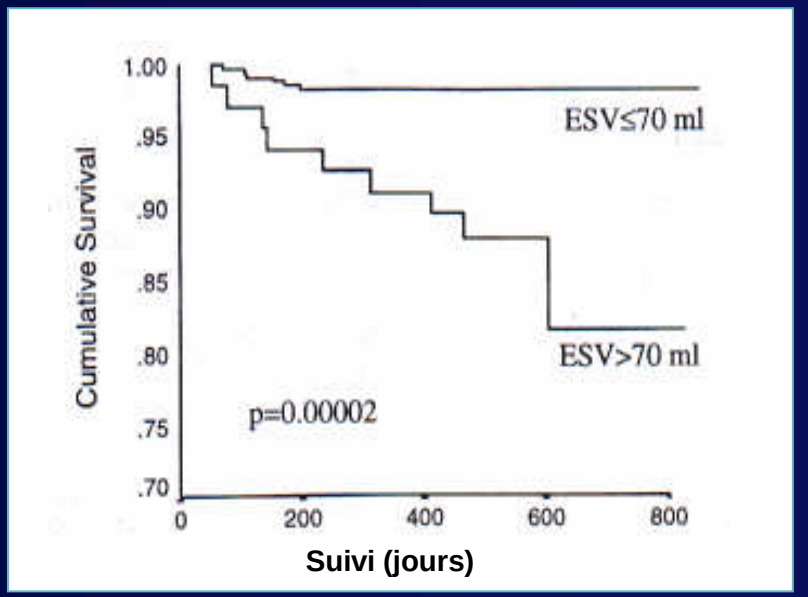
Kurata & al. Circ J 2005; 69: 550 – 557

Fonction Ventriculaire Gauche



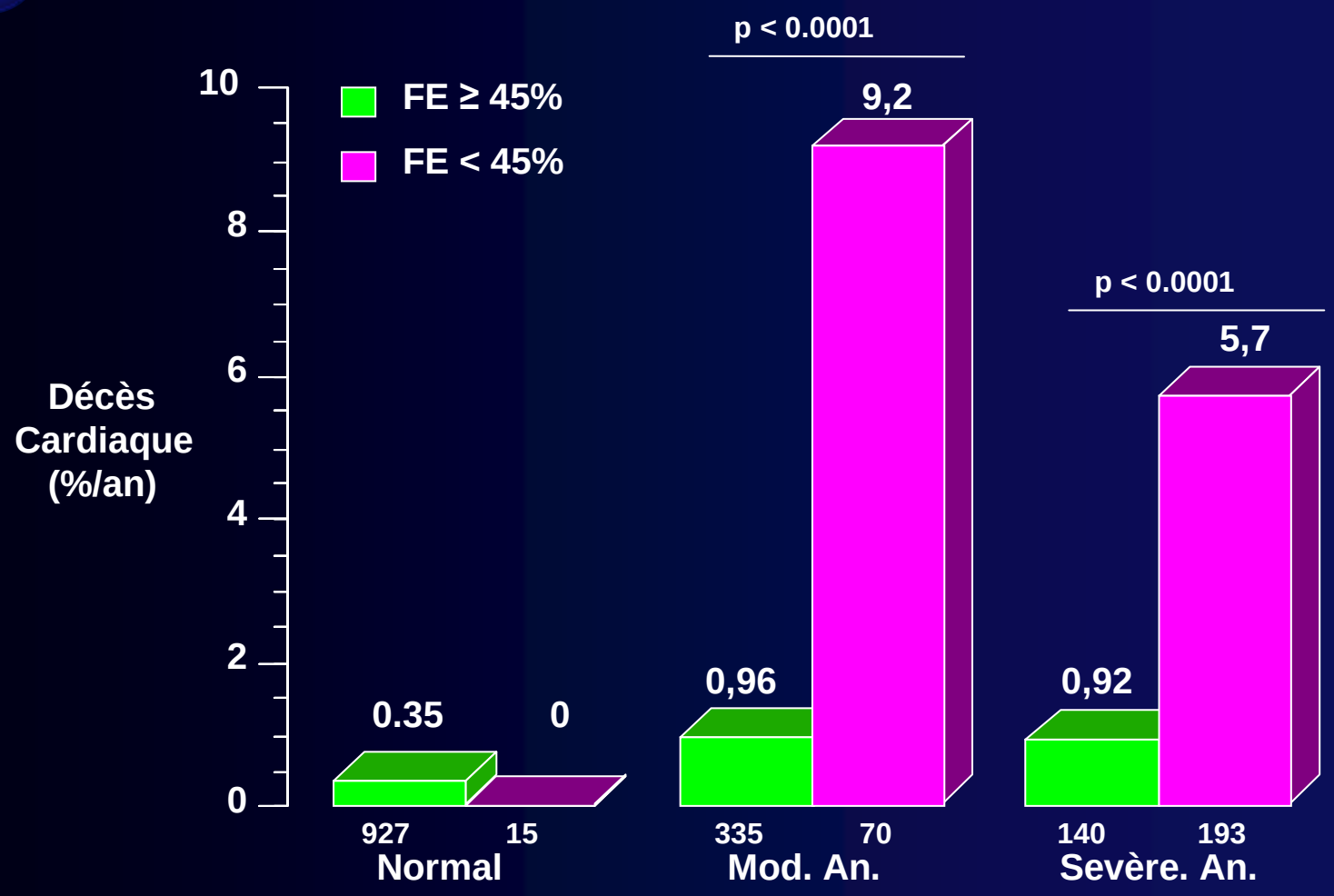
FEVG : G-SPECT





Sharir & al. Circulation 1999 ; 100 : 1035-42

FEVG : G-SPECT

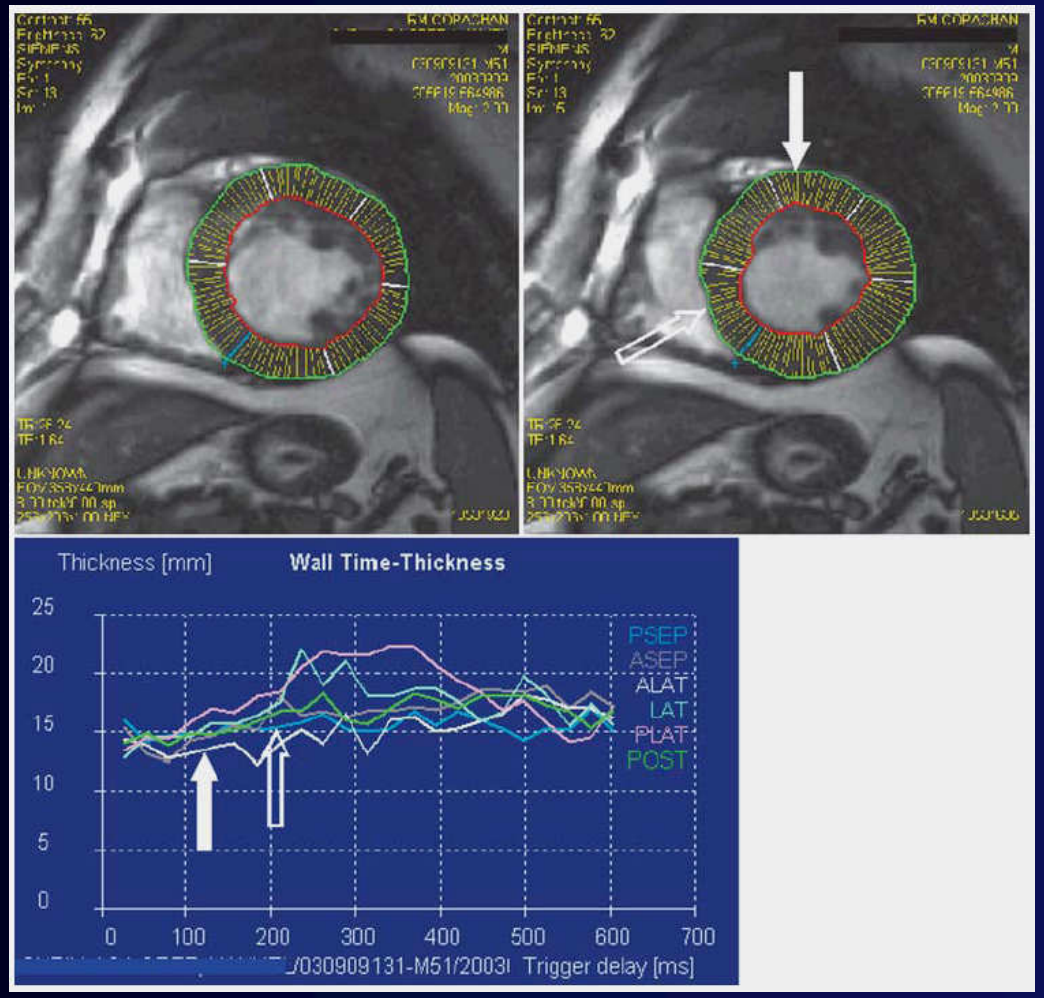


Sharir & al. Circulation 1999 ; 100 : 1035-42

FEVG : IRM

- Etat d'équilibre
- Excellente définition endocarde / épicarde
- Absence de assomption géométrique
- Etude :
  - Des volumes TD et TS VG
  - De la FE globale
  - De la cinétique régionale
  - De l'épaississement segmentaire
- Méthode de référence

FEVG : IRM



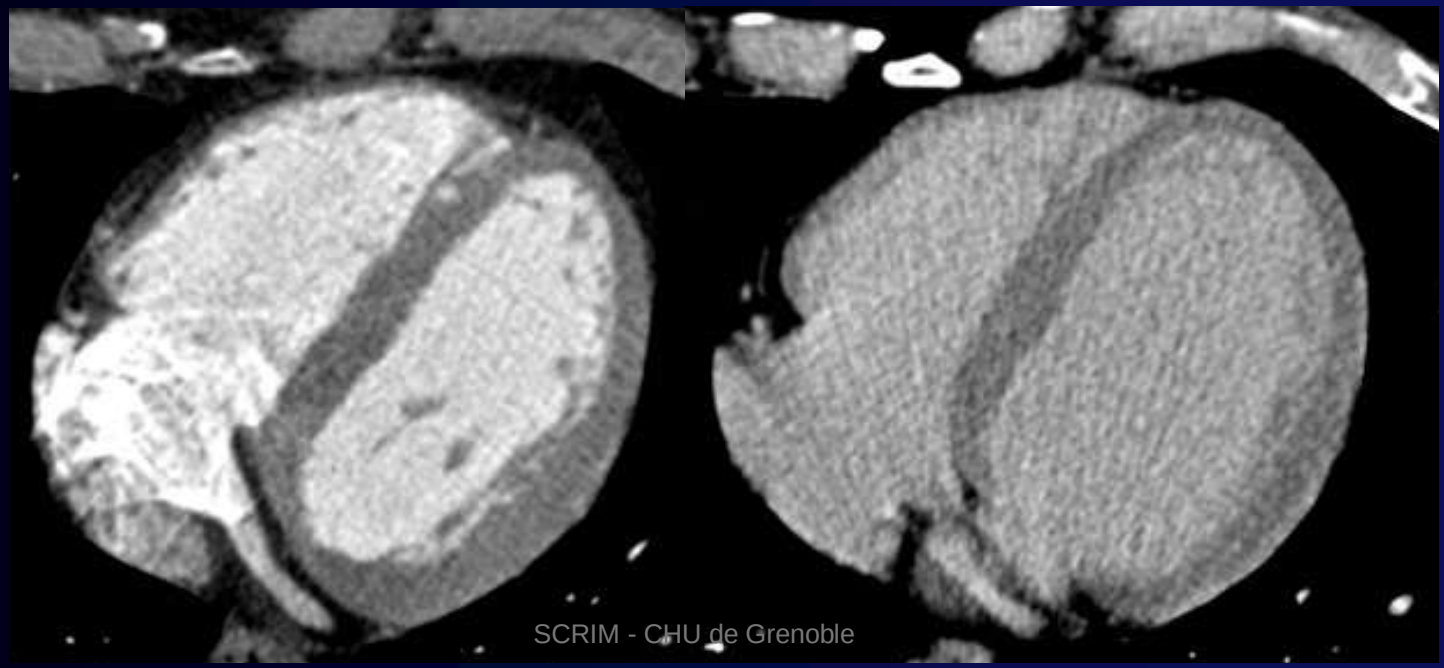
Pons-Llado & al. Eur Rad J 2005; 15: B23 – B32

FEVG : Stress- IRM

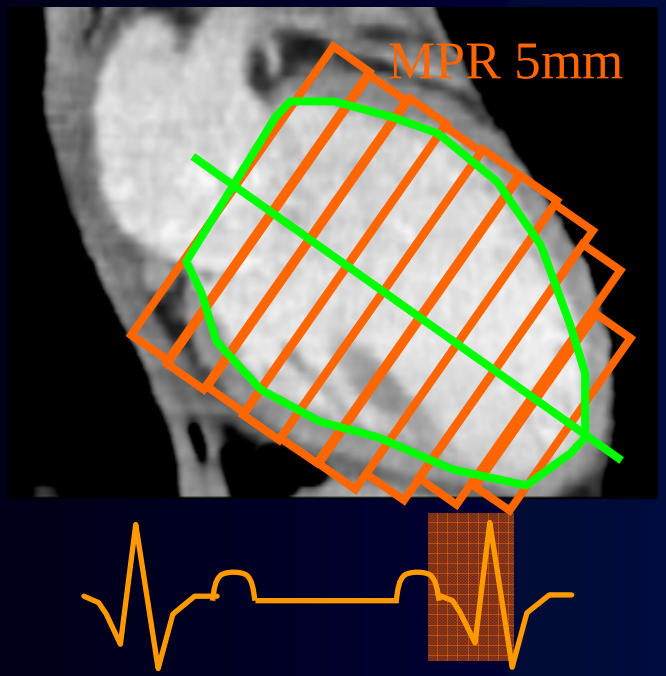
- IRM de stress et Δc de coronaropathie :
  - 10 études
  - 654 patients (dobutamine)
  - Sensibilité 89 %
  - Spécificité 84 %

Kuijpers & al. Eur J Radiol 2005;15:b48-b51

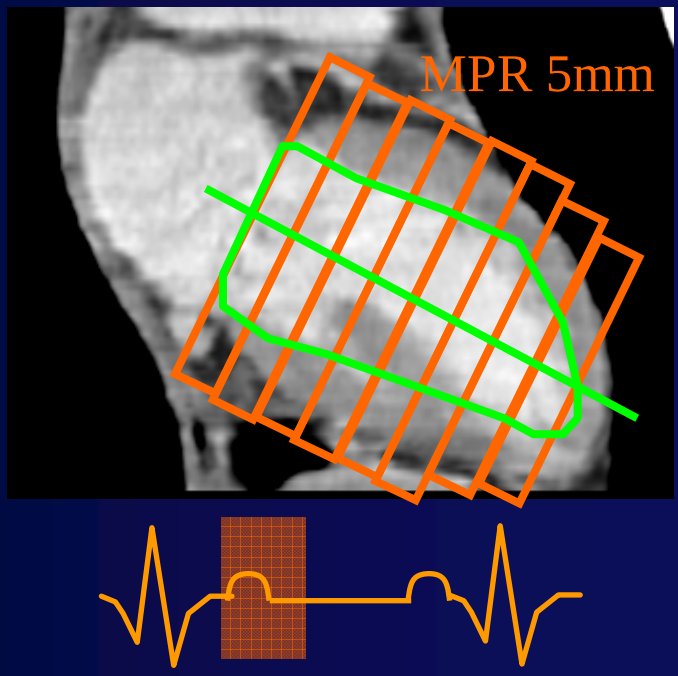
FEVG : TDM-MB



FEVG : TDM-MB

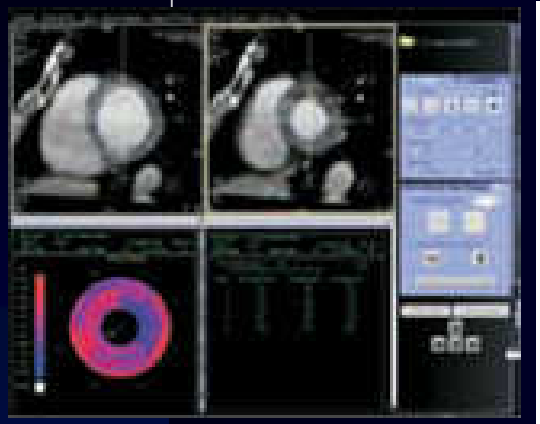


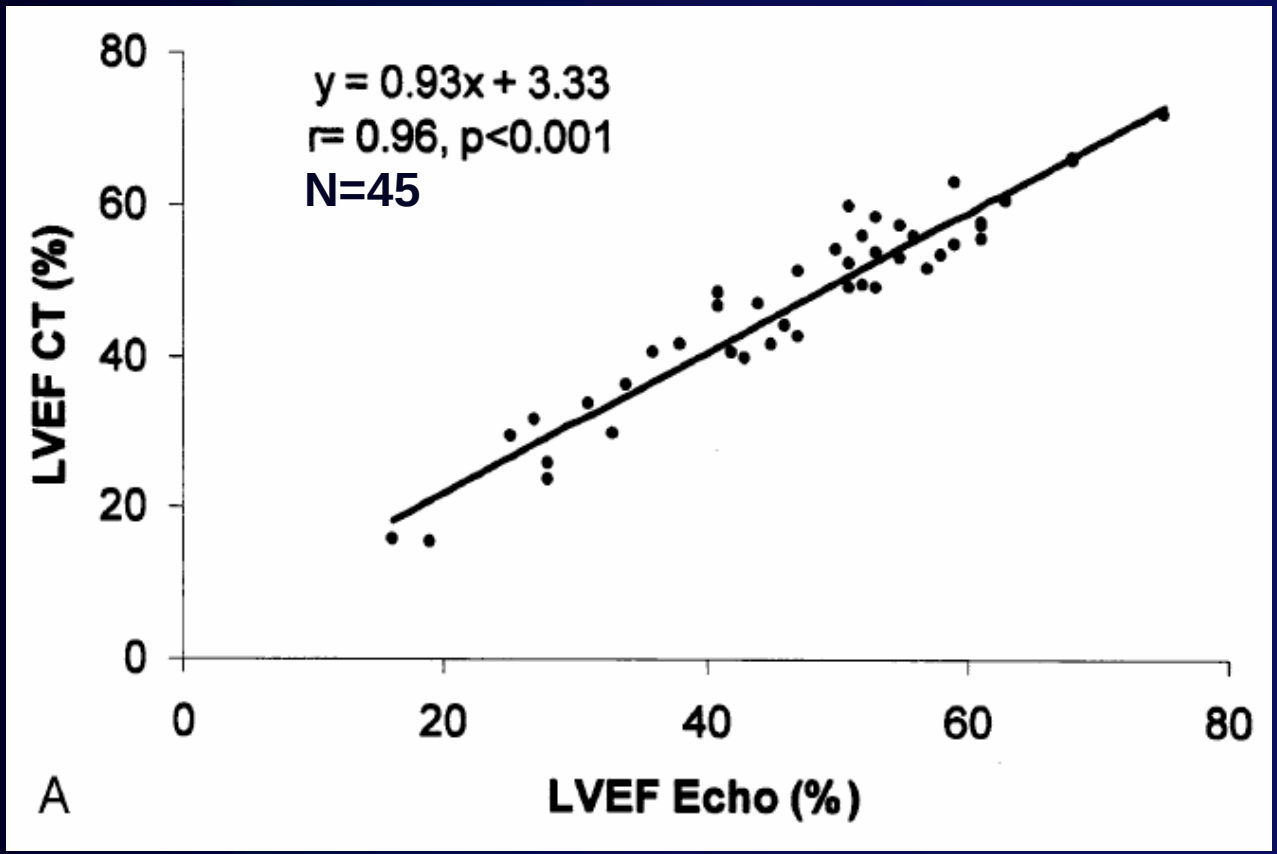
End-Diastole R-150ms



End-Systole R+150ms

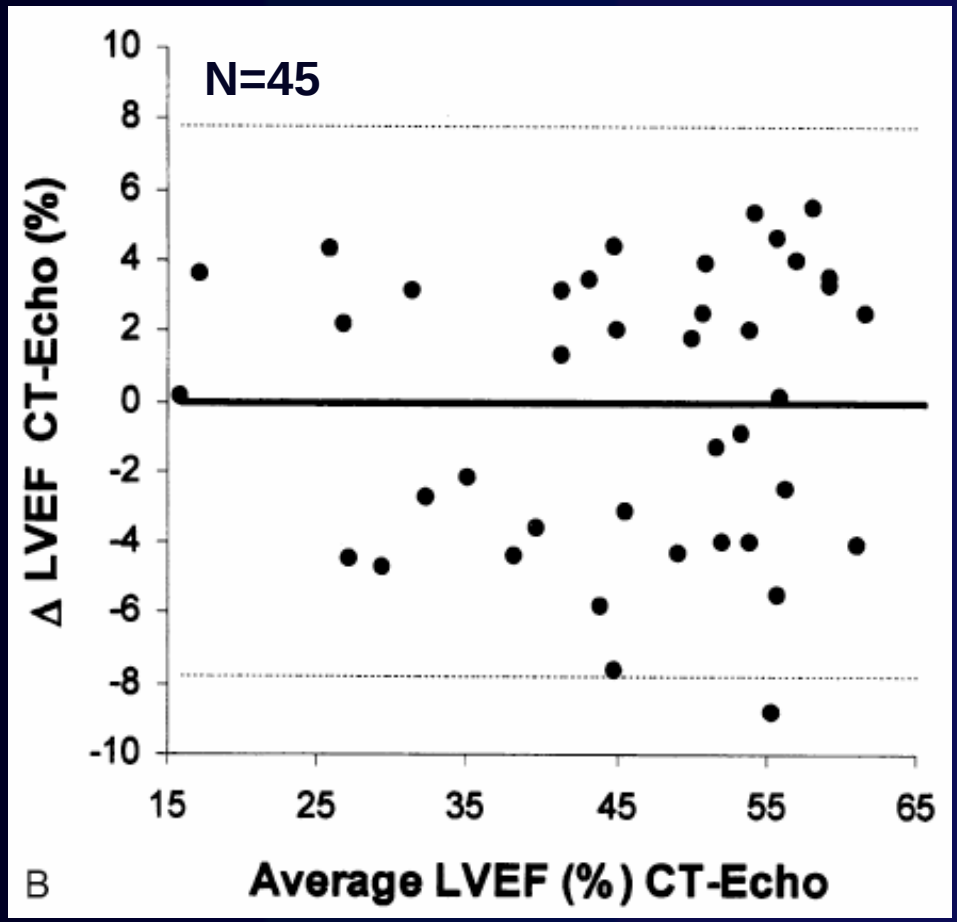
FEVG TDM-MB





Schuijf & al. Am J Cardiol 2005;95:571-574

FEVG TDM-MB



Schuijf & al. Am J Cardiol 2005;95:571-574

Définition clinique

Viabilité

- Présence au sein d'un myocarde **ischémique et hypokinétique**…
- d'une quantité de cardiomyocytes " survivants" suffisante…
- pour permettre une amélioration de la **contractilité ventriculaire gauche** segmentaire et globale…
- après **revascularisation** par ACT ou PAC.

Physiopathologie

- **Myocarde hibernant** (Hibernating myocardium)

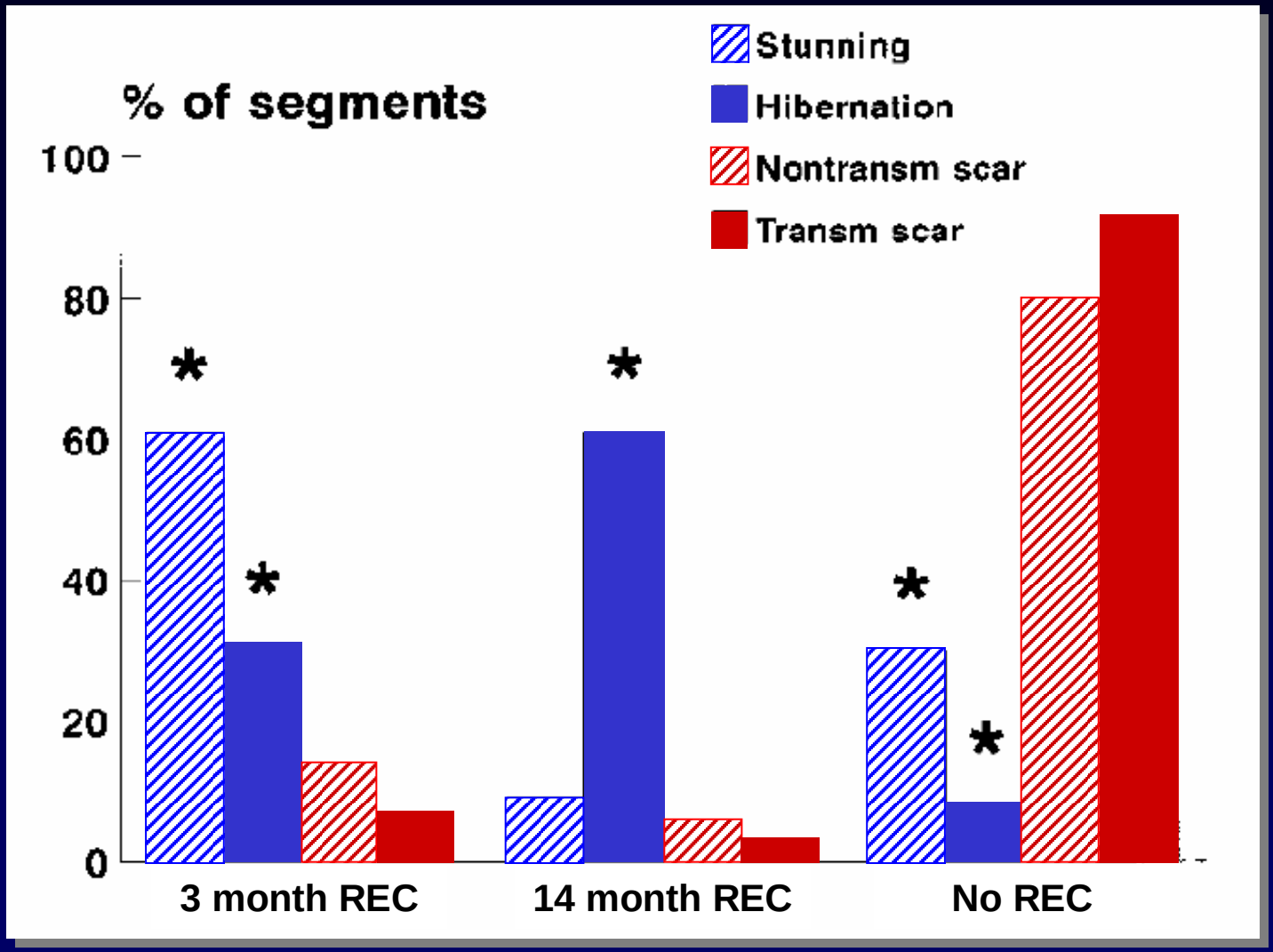
  Myocarde **hypocinétique et hypoperfusé (?)**
  Condition ischémique
  Réversibilité après revascularisation myocardique

- **Myocarde sidéré** (Stunned myocardium)

  Myocarde **hypocinétique mais normoperfusé**
  Conséquence d'une séquence ischémie - reperfusion
  Réversibilité spontanée

- **Hibernation chronique / sidération itérative / ischémie**

Délai de récupération post-opératoire



Bax & al. Circulation 2001;104:I-314-I-318

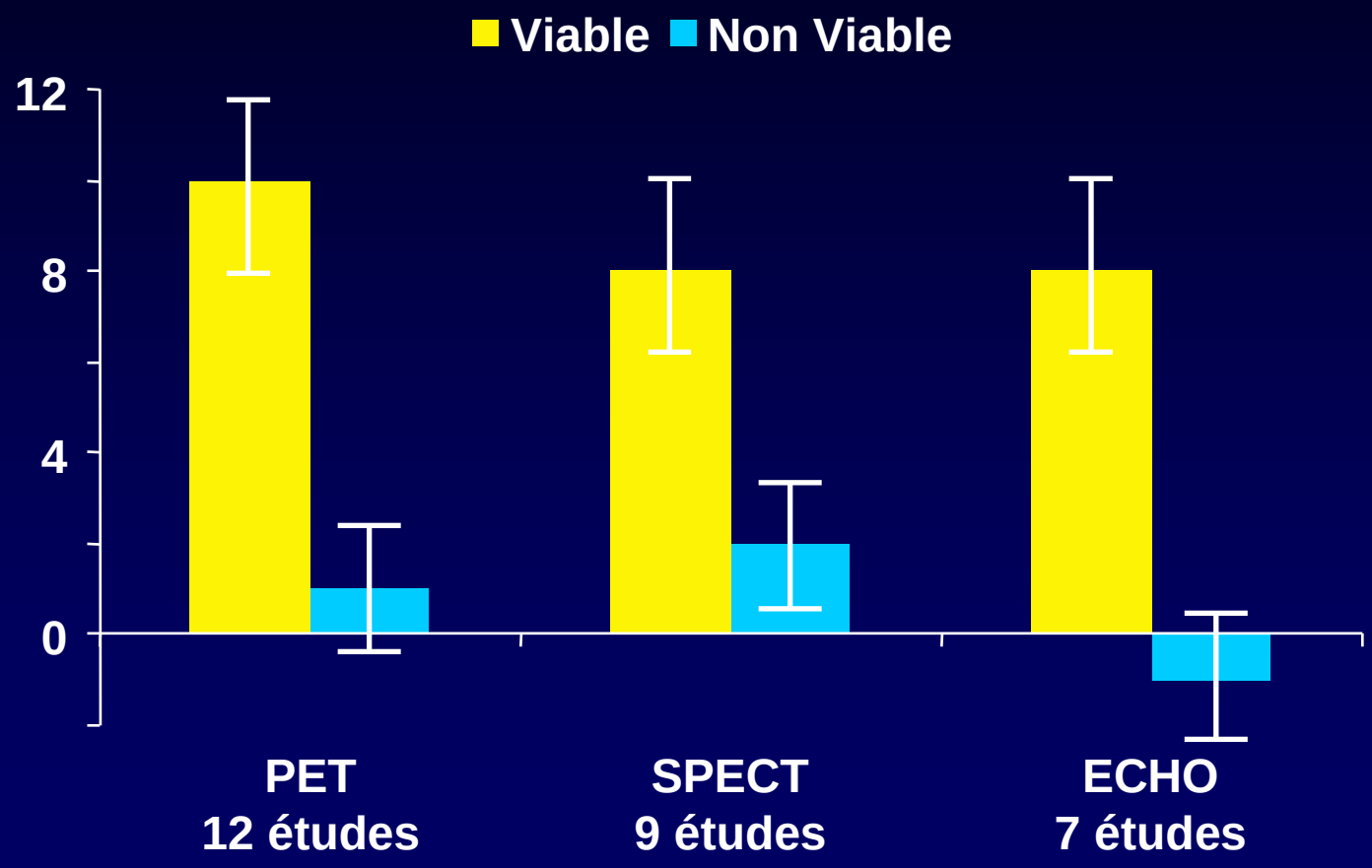
Situation clinique

Cardiopathie ischémique
Atteinte pluritronculaire
Altération de la FEVG
Insuffisance cardiaque

Viabilité myocardique

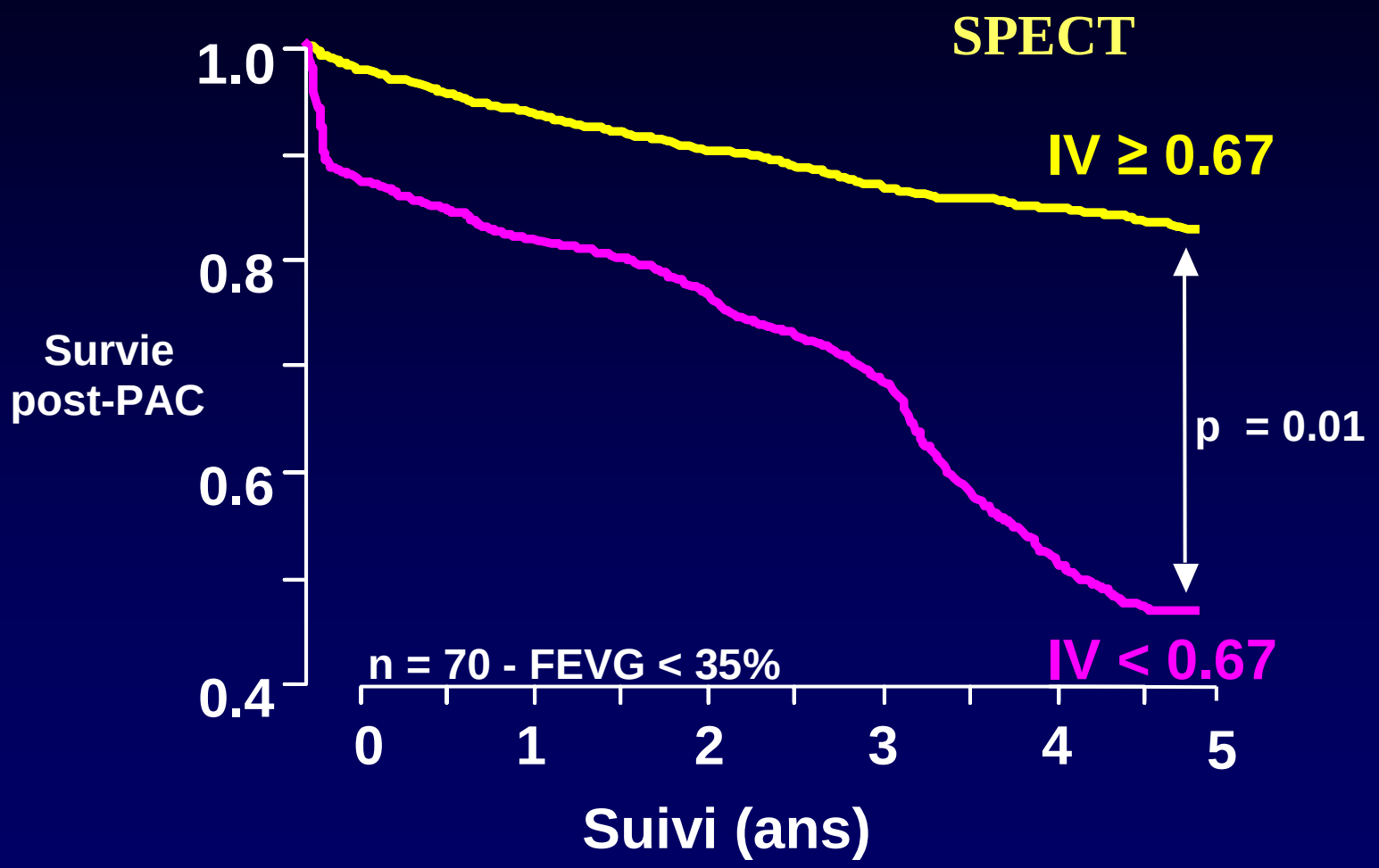
- Amélioration de la fonction VG après revascularisation?
- Amélioration du pronostic fonctionnel et vital?

Evolution de la récupération FEVG & viabilité (1)



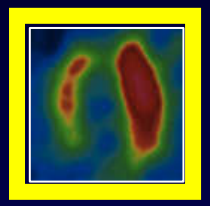
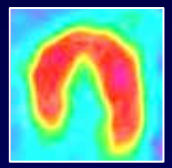
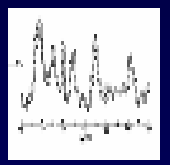
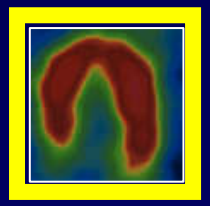
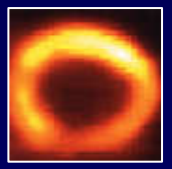
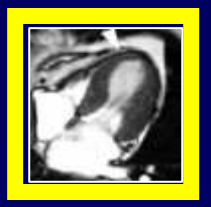
Underwood & al. & al. Eur Heart J 2004;25:815

Viabilité myocardique & pronostic (2)

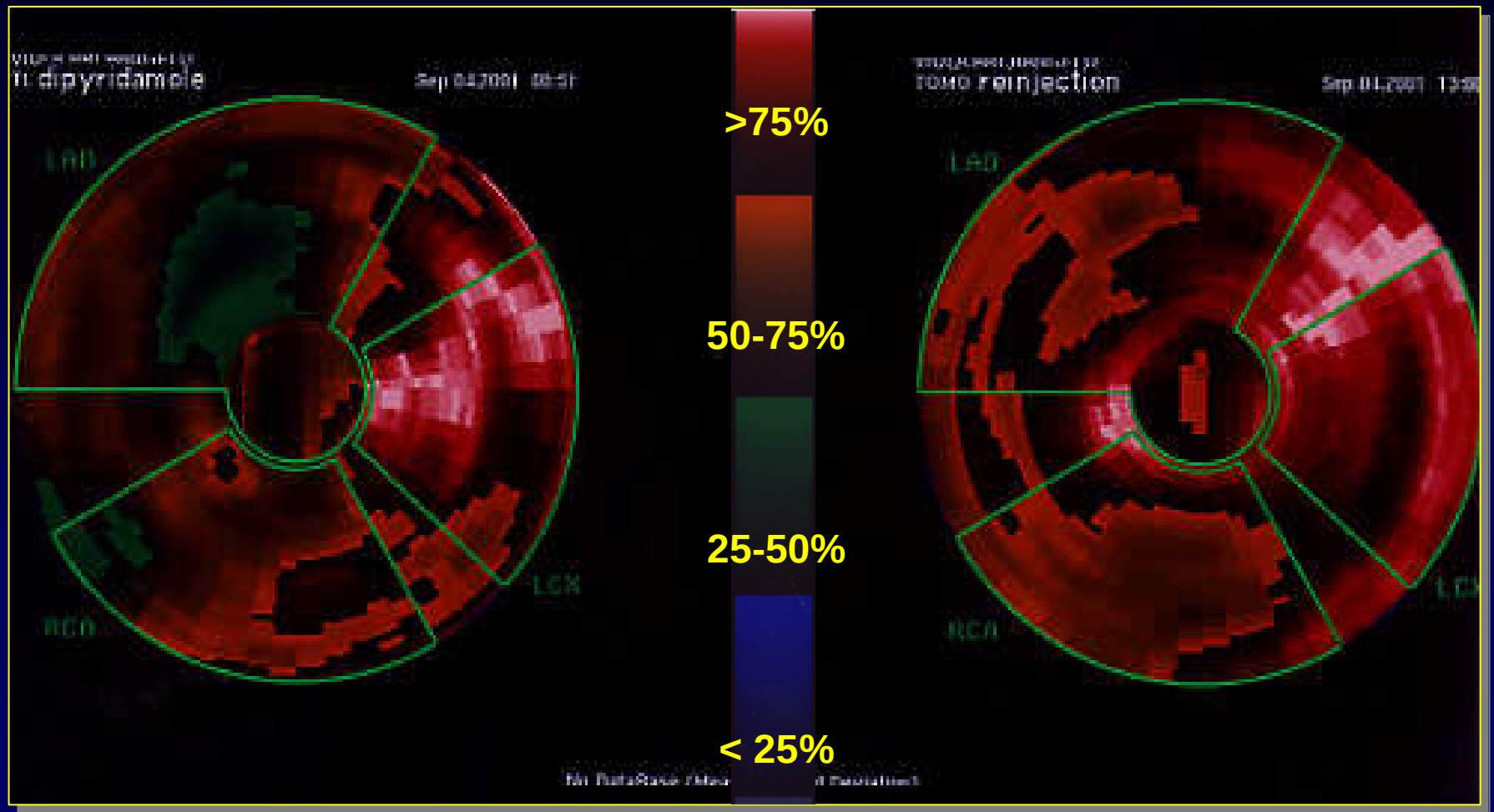


Pagley & al. Circulation 1997

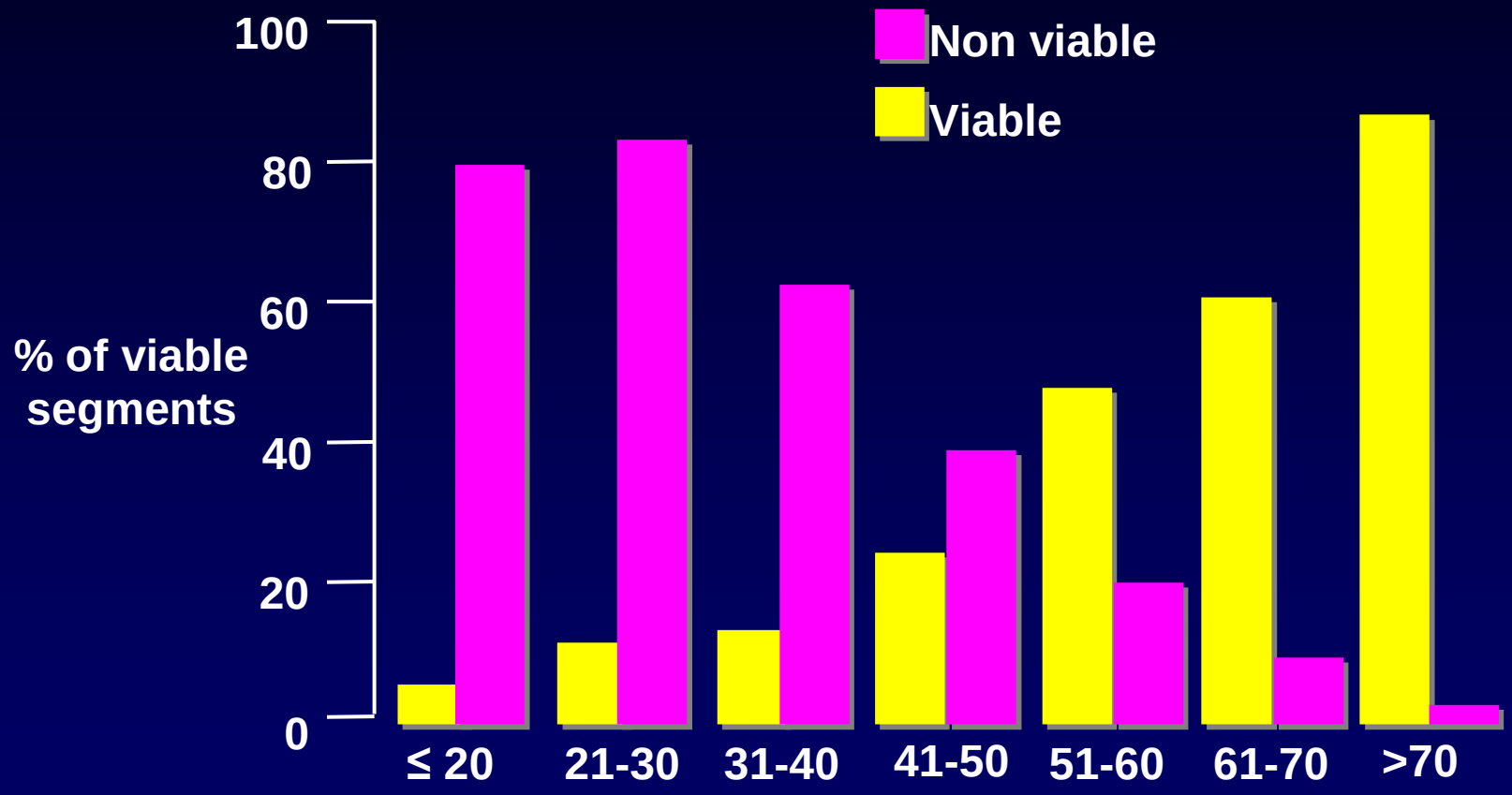
Détection de la viabilité myocardique

	SPECT	TEP	IRM	ECHO
« scar »				
Métab.				
Débit				
Fonction		?		

Quantification

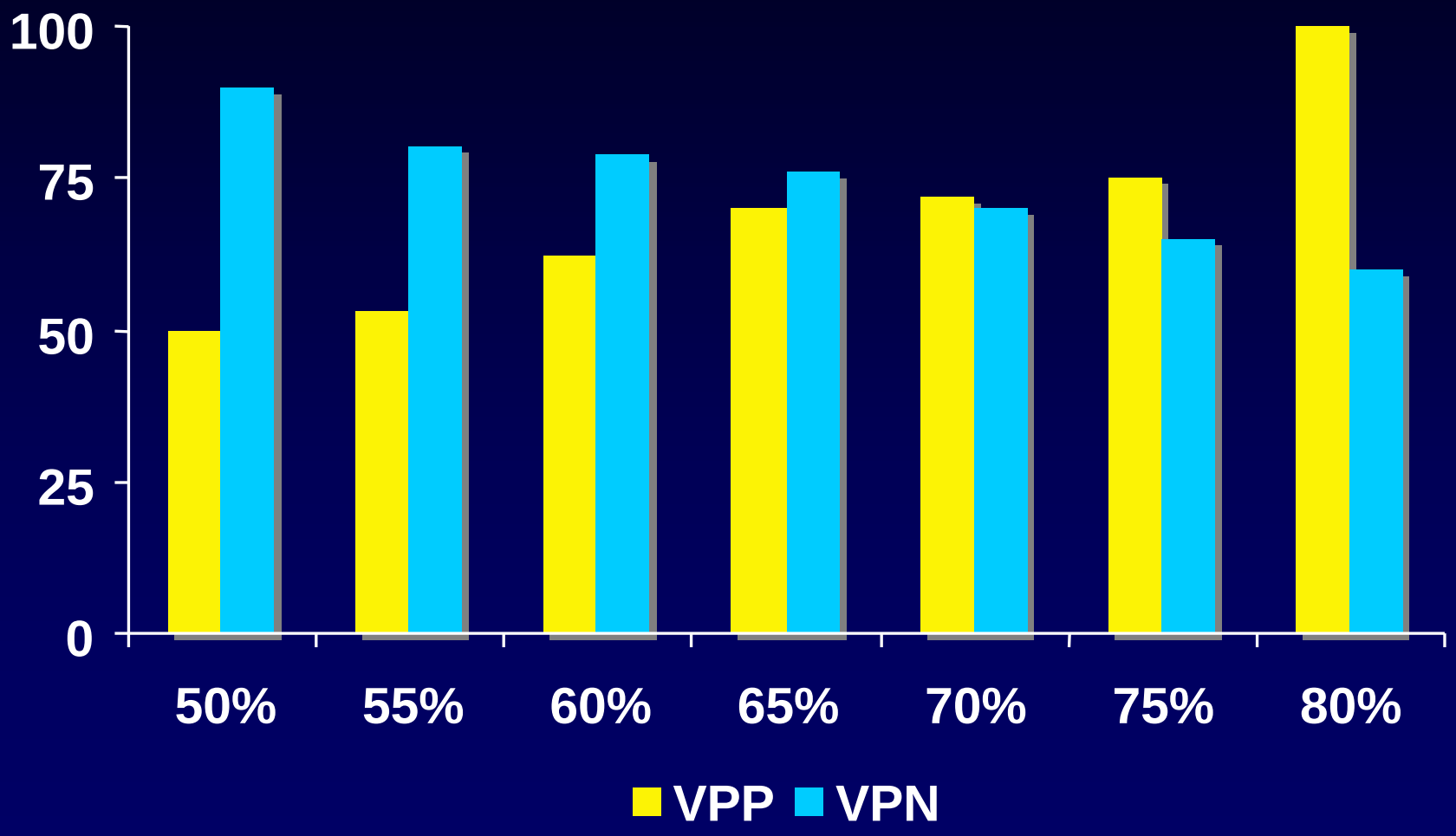


Le choix du critère diagnostique
MIBI - SPECT



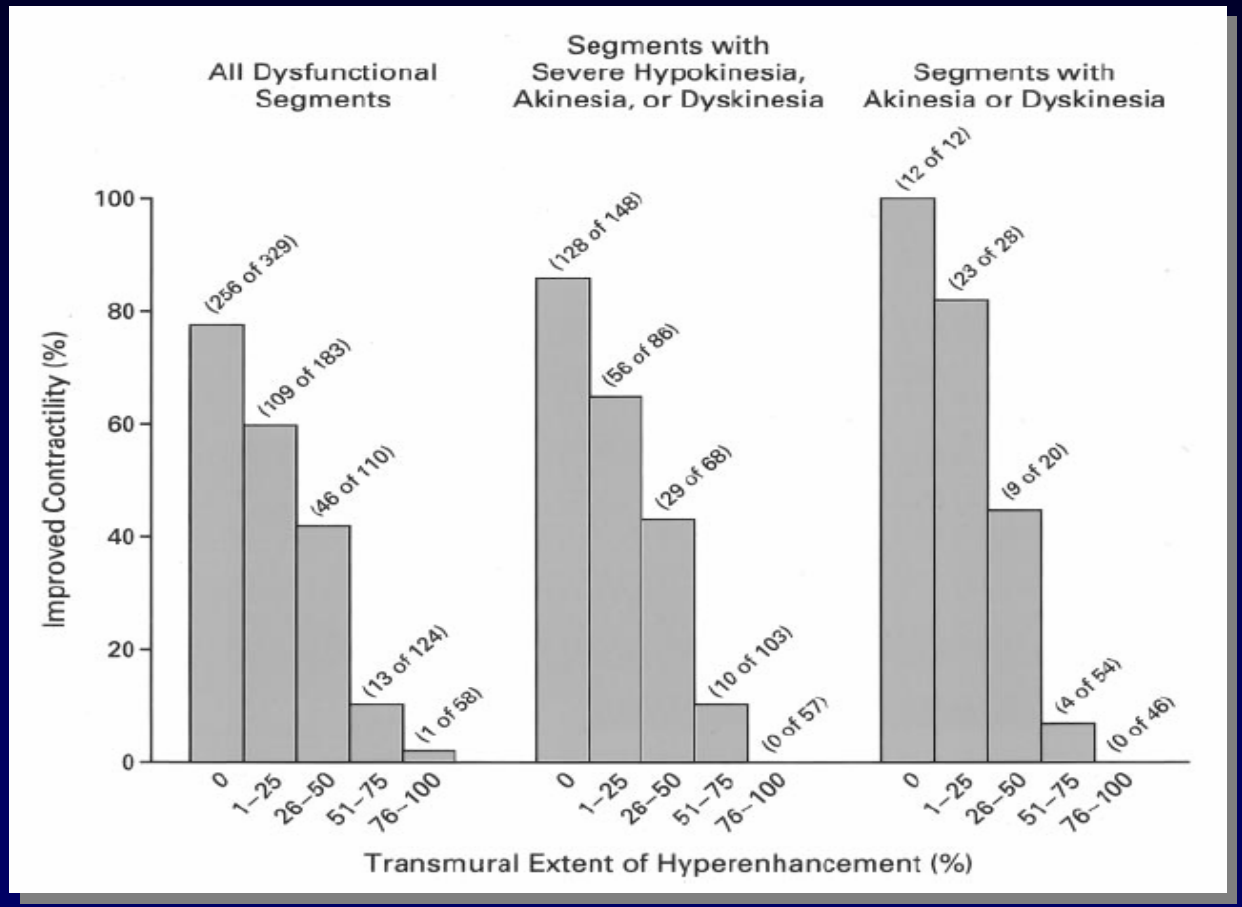
Bonow Circulation 1996

Le choix du critère diagnostique
Tl - SPECT



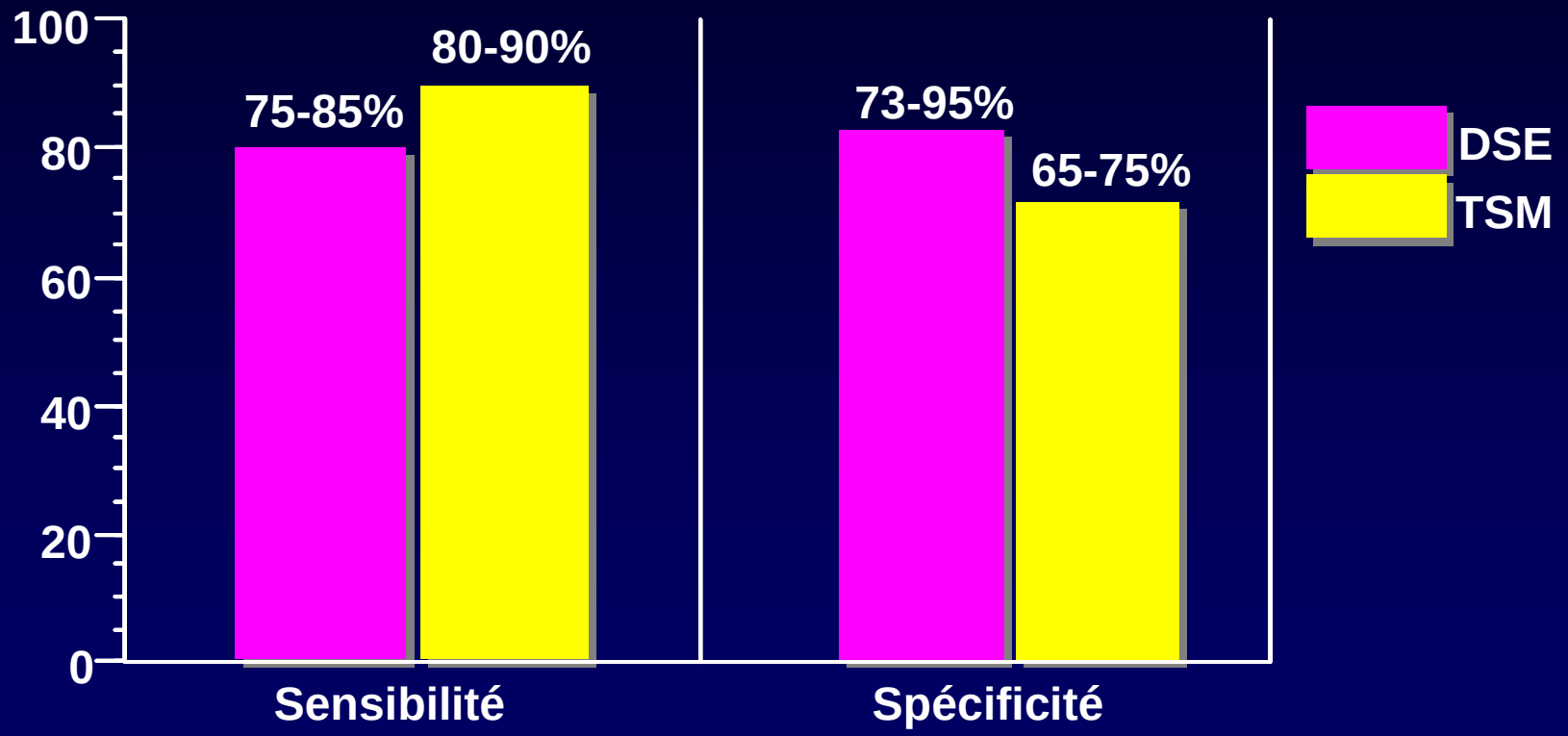
Vanzetto et al. AHA 1998

Le choix du critère diagnostique
Stress-écho

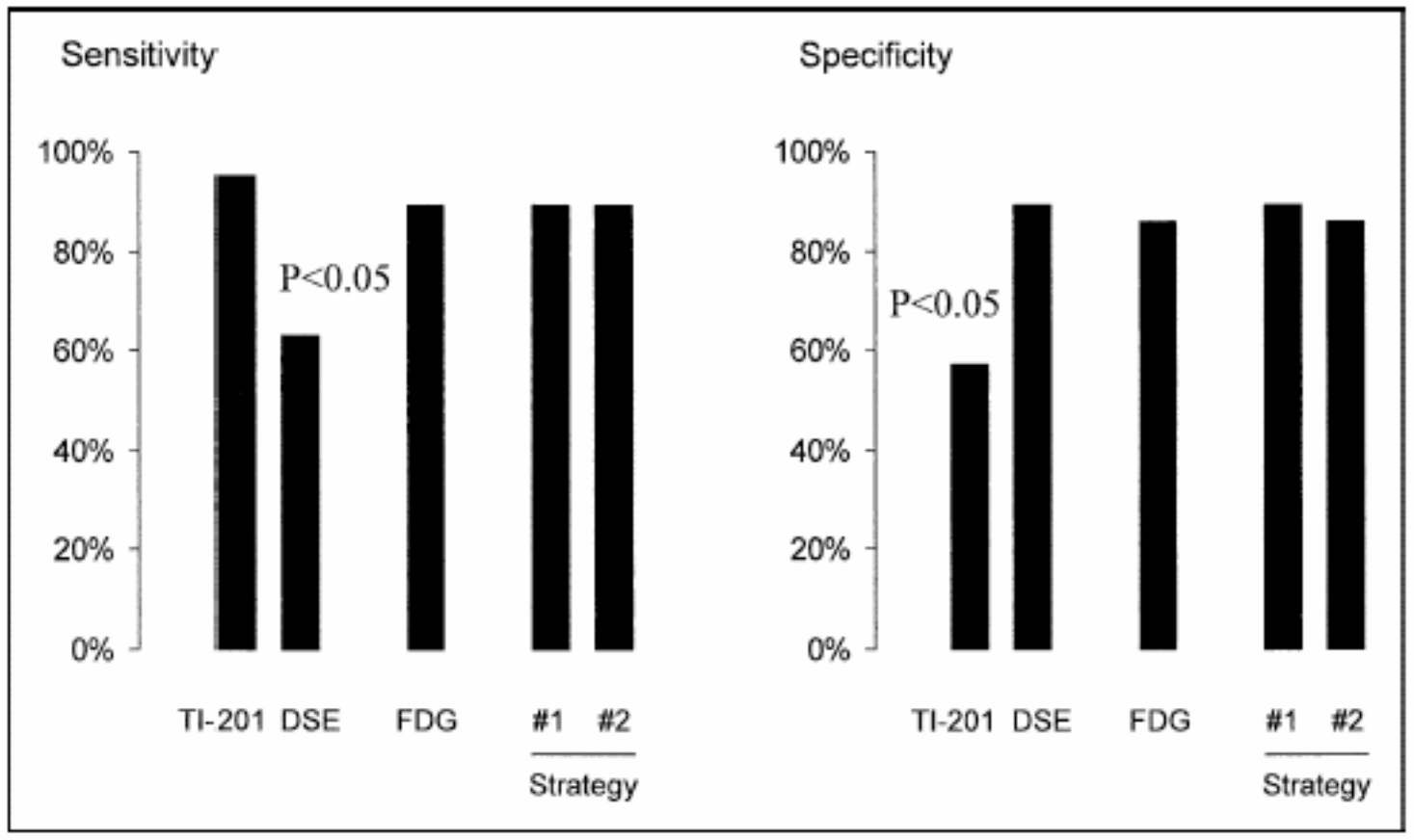


Choi et al Circulation 2001; 104:1101

Prédiction de la récupération fonctionnelle VG
Comparaison isotopes-écho de stress

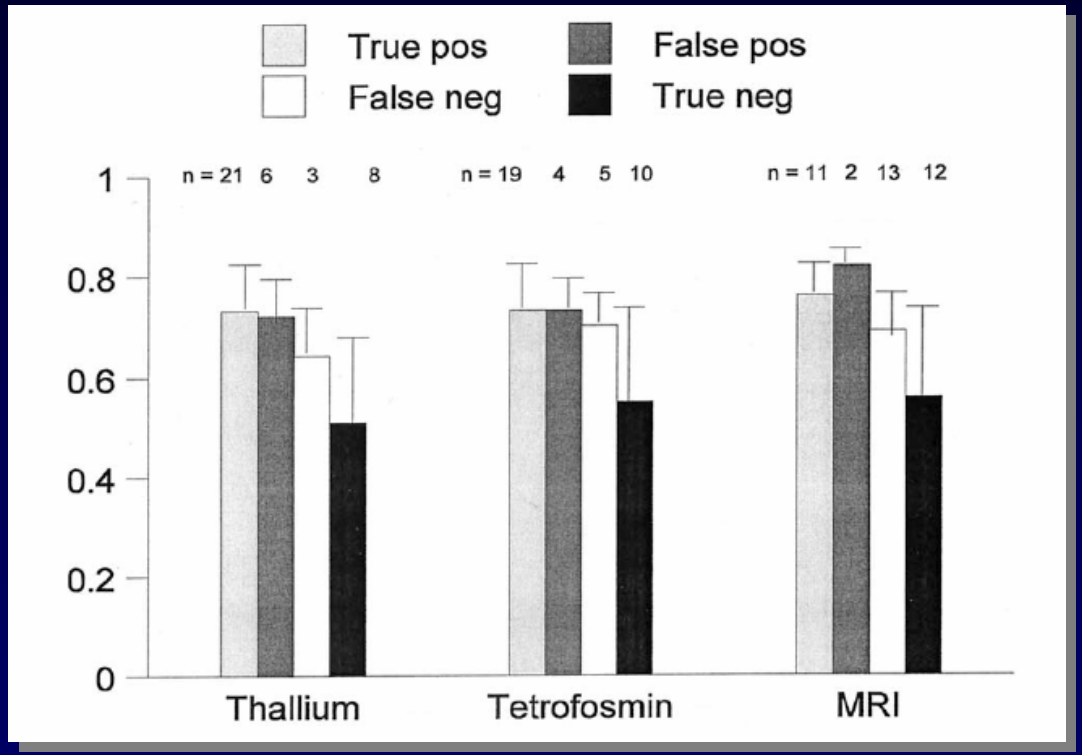


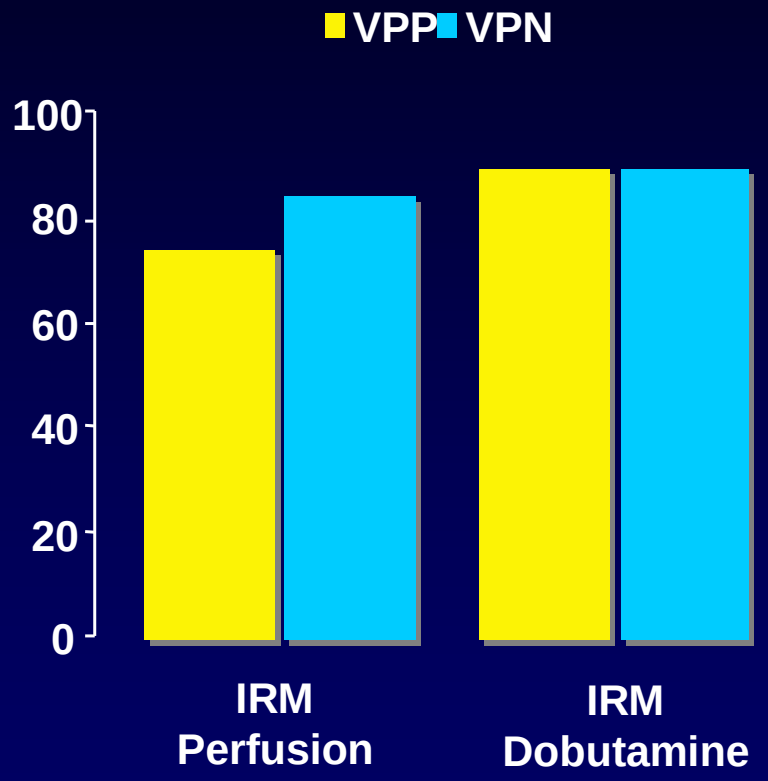
Performance des Tests Conventionnels



Bax & al. Am J Cardiol 2003;92:1-4

Performances de l'IRM





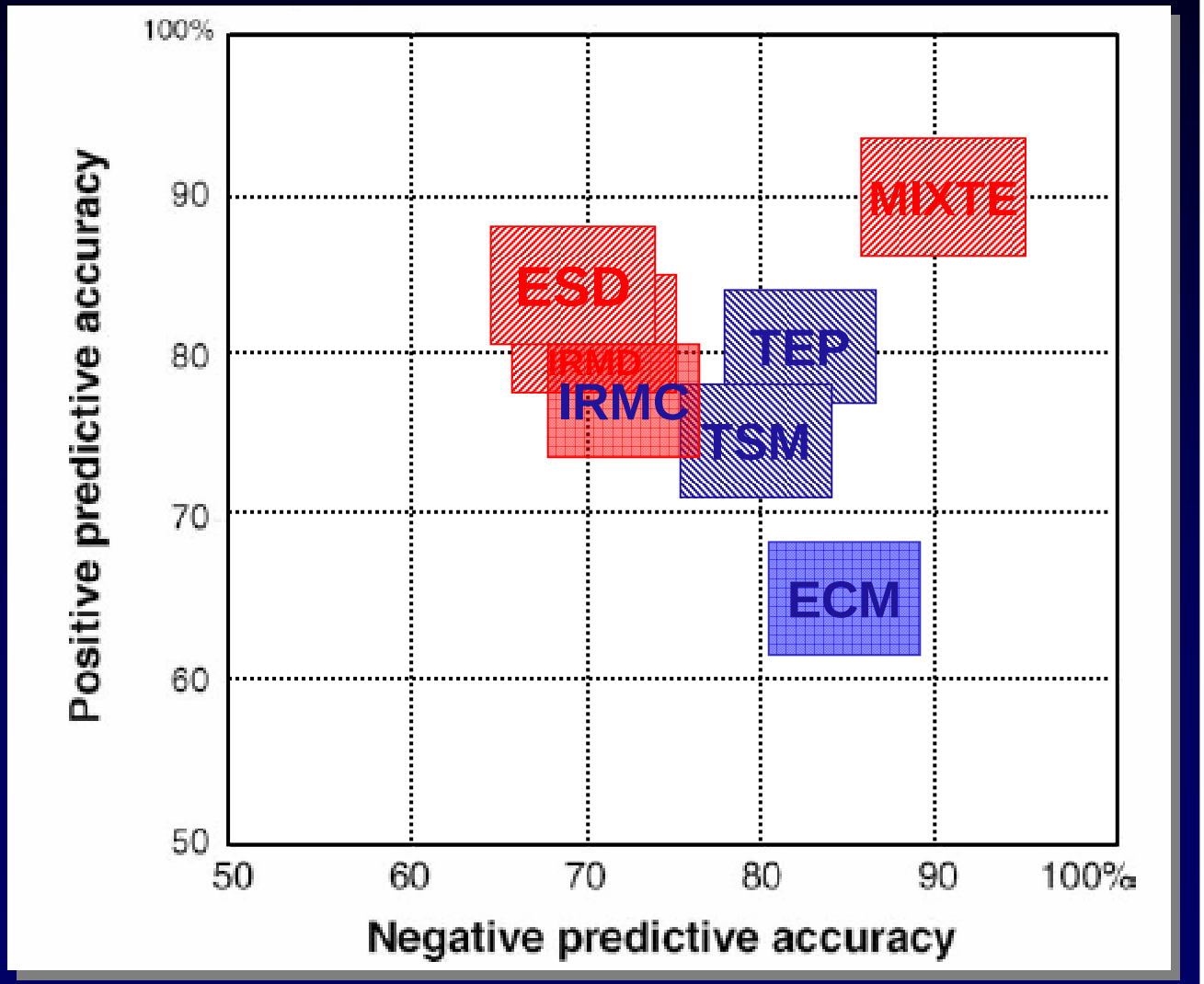
Gunning & al. JACC 2002;39:428-35

Thomson & al. L Mag Res Imag 2004;19:771

Shan & al. Circulation 2004;109:1328

Valeur prédictive des tests : En résumé

Baumgartner	*JACC*	*1998*
Bax	*Am J Cardio*	*2003*
Bax	*Circulation*	*2001*
Bax	*JACC*	*1999*
Bonow	*Circulation*	*1996*
Carrel	*Eur J CTS*	*1992*
Choi	*Circulation*	*2001*
Gropler J	*ACC*	*1992*
Gunning	*JACC*	*2002*
Klein	*Circulation*	*2002*
Kloner	*Circulation*	*1998*
Lucignani	*Eur JNM*	*1992*
Maddahi	*Circulation*	*1994*
Maddahi	*J Nucl Med*	*1994*
Meluzin	*JACC*	*1998*
Meza	*Circulation*	*1997*
Ragosta	*Circulation*	*1993*
Shan	*Circulation*	*2004*
Shimoni	*Circulation*	*2003*
Tamaki	*Am J Cardiol*	*1989*
Thomson	*Mag Res Im*	*2004*
Tillish	*NEJHM*	*1986*
Underwood	*Eur Heart J*	*2004*

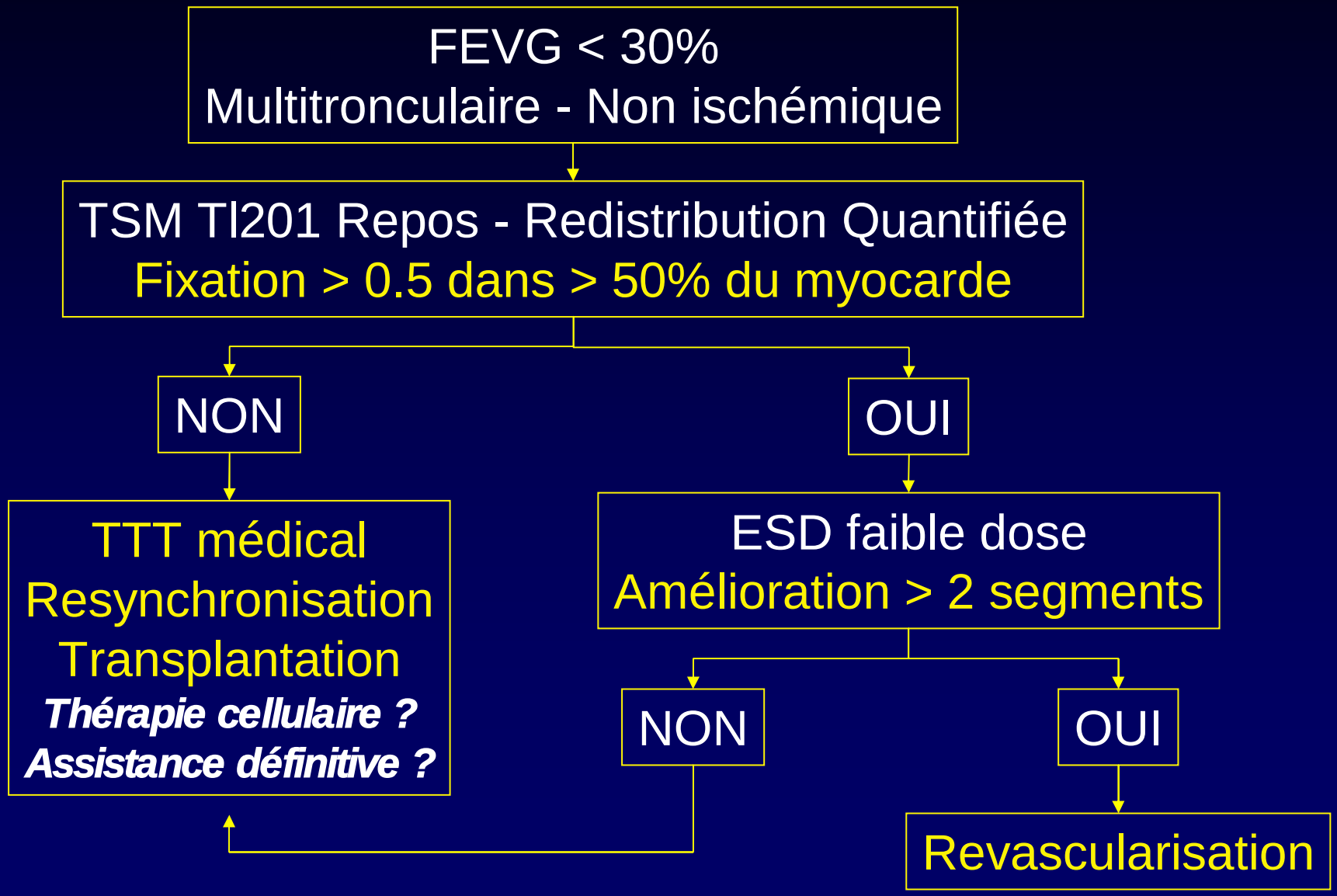


Recommandations : Classe I ACC-AHA-ESC et viabilité

- ^{18}FDG PET
- ^{201}TL SPECT
- ^{99m}Tc-MIBI SPECT
- Stress Echo
- Stress MRI
- Contrast MRI

- **La performance globale des tests de viabilité est entre 75 et 80%**
  - **Certains privilégient la VPN (TSM)**
  - **D'autres privilégient la VPP (ESD)**
  - **L'association des 2 offrent les meilleurs performances (proche de 90%)**
- **La probabilité de récupération semble très faible en cas de remodelage VG majeur (VTS > 130 - 150 ml)**

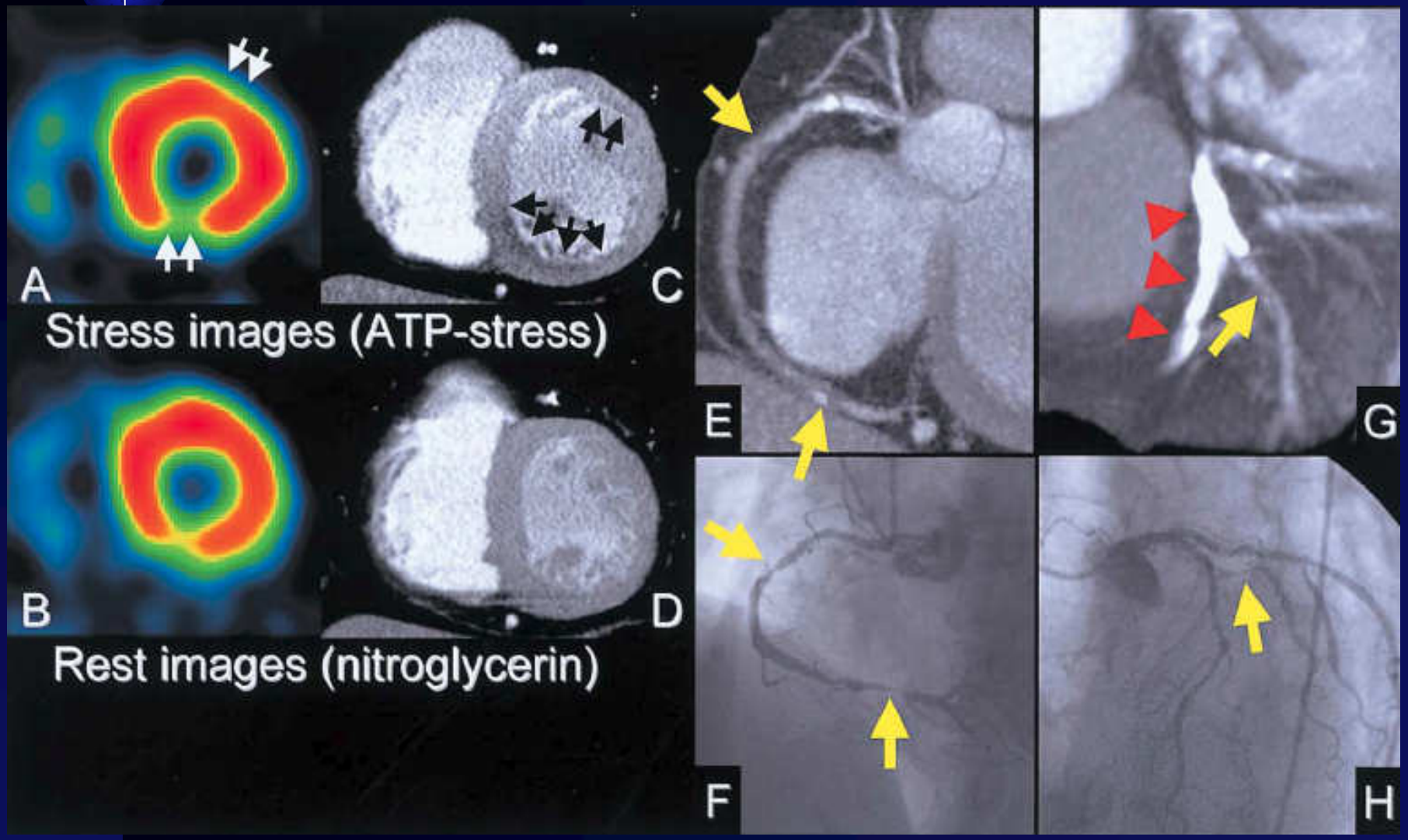
Proposition de stratégie simplifiée



L'idéal du cardiologue

- Examen largement disponible et peu couteux
- Non invasif et peu (pas ?) irradiant pour le patient et le cardiologue
- Apportant toutes les informations nécessaires à la prise de décision thérapeutique
  - Anatomie coronaire
  - Ischémie myocardique
  - Viabilité myocardique
  - Fonction ventriculaire gauche
  - Anatomie hémodynamique intra-cardiaque
  - Comorbidité & diagnostic différentiel ?

“All heart MSCT”



Kurata & al. Circ J 2005; 69: 550 – 557

Les différentes techniques en résumé

	CORO	ESD	TSM	TEP	TDM-MCB	IRM
Disponibilité (jours)	2	15	30	6	7	5
Non invasif	-	+	+	+	+	+
Irradiation (mSv)	3-8	0	15 - 30		10	0
Temps médecin (min)	20	45	10	15	30	30
Coût (€)			450	950	125	250
Coronaires	++	-	-	-	++	+
Plaque instable	-	-	?	?	++	?
Ischémie	-	+++	+++	++	+	++
Viabilité	-	++	++	+++	?	++
Fonction VG	++	++	++	?	+	+++
Anatomie	±	+++	-	-	+++	+++
Validation diagnostique*	15737	1063	2527	490	188	1194
Validation pronostique*	3154	247	423	92	9	82

Medline hits : CAD - pognosis or diagnosis