EXERCISE TESTING IN THE ELDERLY: SAME SETUP – DIFFERENT APPROACH ?

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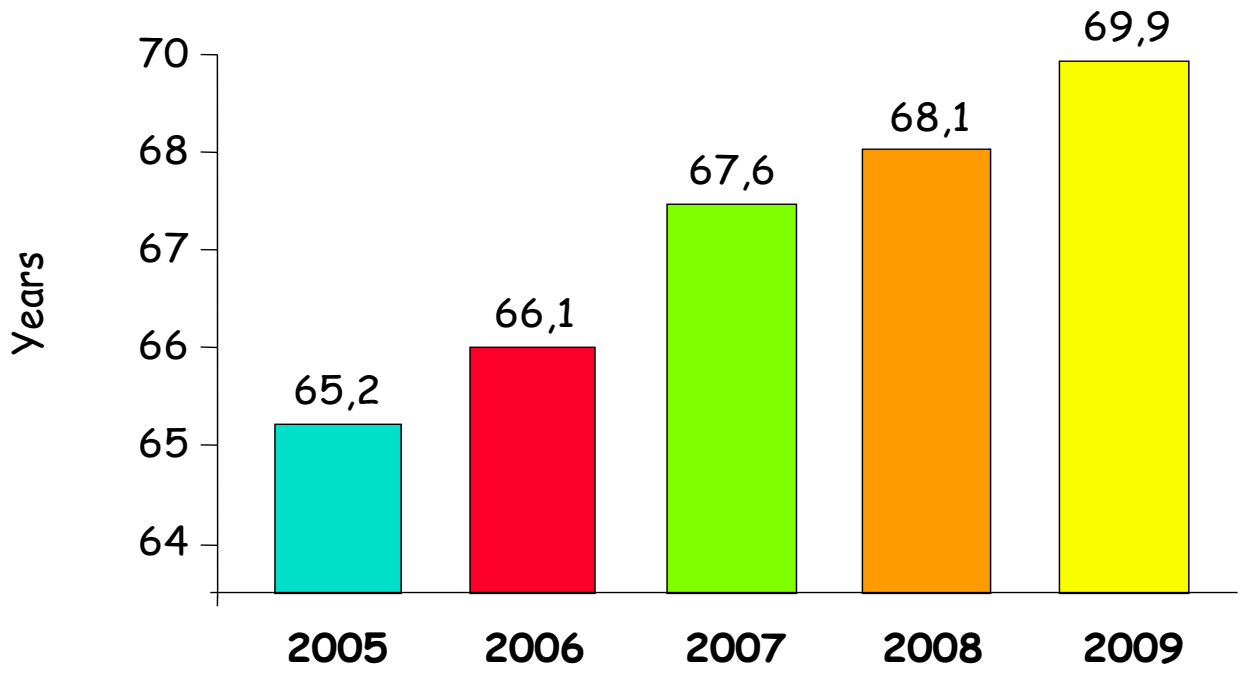
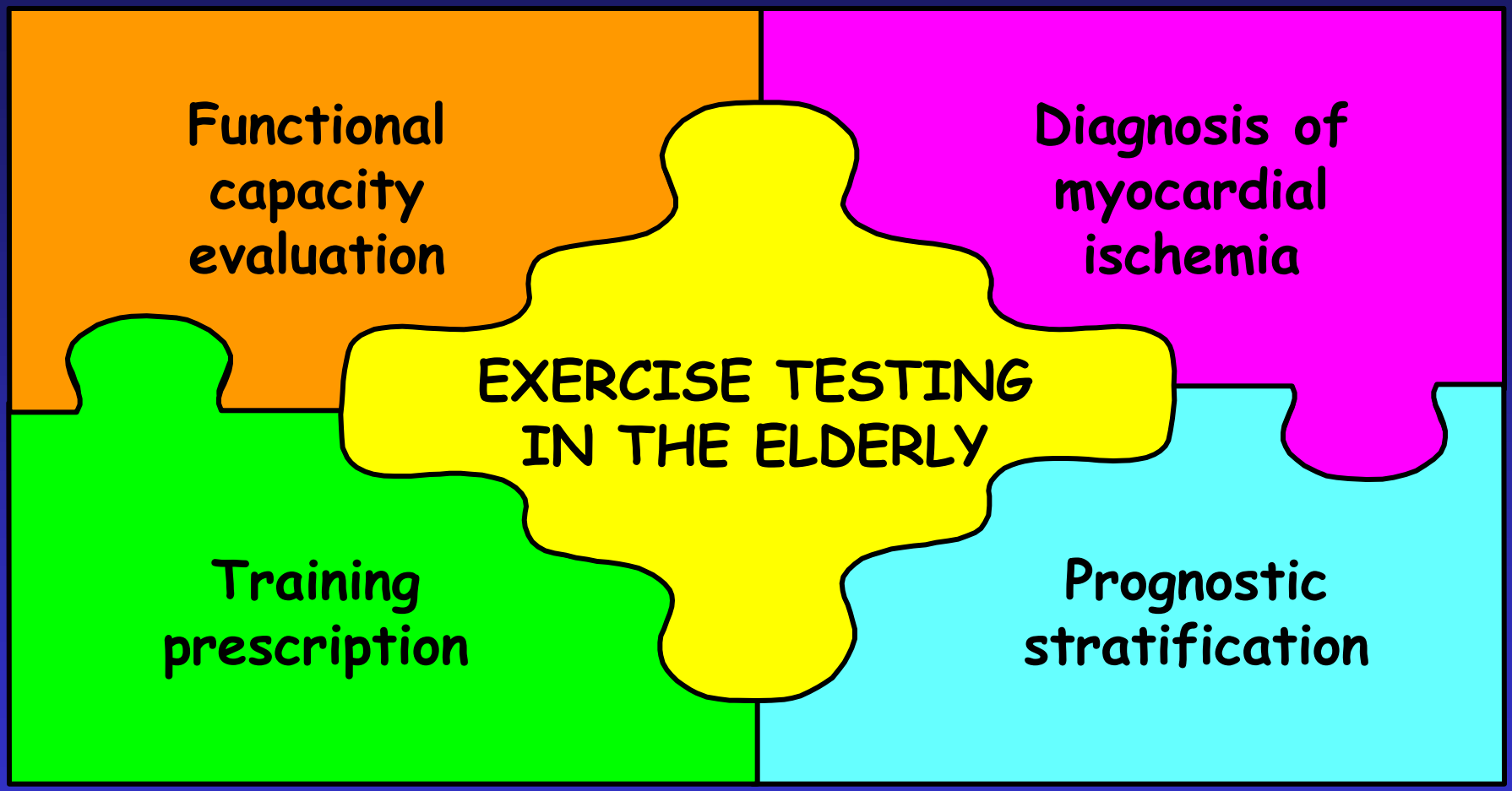
Patients' mean age

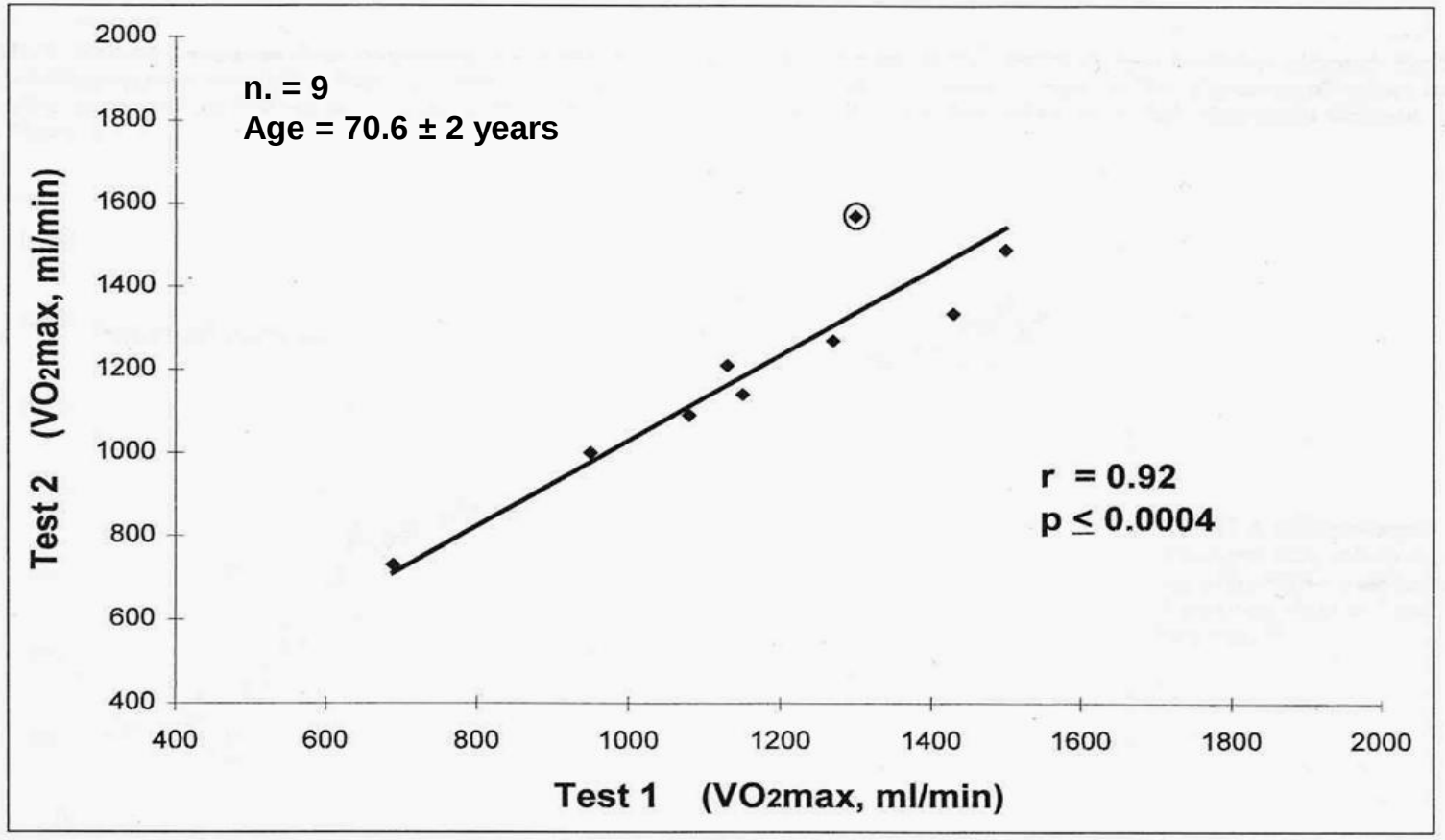



Functional capacity evaluation
Diagnosis of myocardial ischemia
EXERCISE TESTING IN THE ELDERLY
Training prescription
Prognostic stratification

Cardiopulmonary ET in CHF patients
Veruno 2000 - 2009

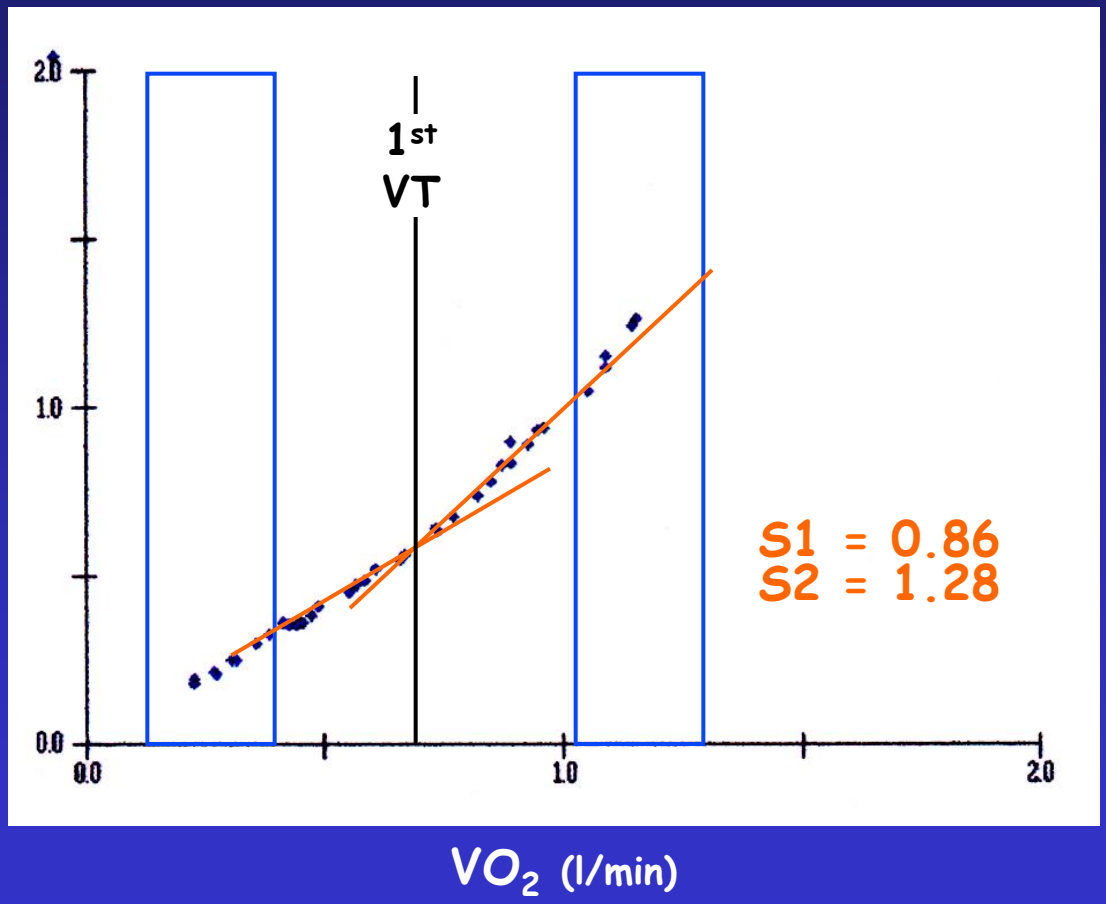
	≥65<75 years	≥75 years
n.	793	154
Age (yrs)	69±3	77±2
BMI (kg/m^2)	25.44±4	24.65±3
Peak VO_2 (ml/kg/min)	14.3±4	13.5±3
Peak W	84±24	77±19
VE/VCO_2 slope	33±7	34±6
NYHA	1.9±0.7	1.9±0.6
EF (%)	28±8	30±8
EDV (ml/m^2)	112±45	98±29
β-B (%)	50	54

Cardiopulmonary ET in CHF patients
Repeatability in elderly patients



Marburger CT, Am J Cardiol 1998

First ventilatory threshold identification in elderly CHF patients



n. = 395
Mean age = 76 yrs

1st VT identified = 80%

Scardovi AB, J Cardiovasc Med 2007

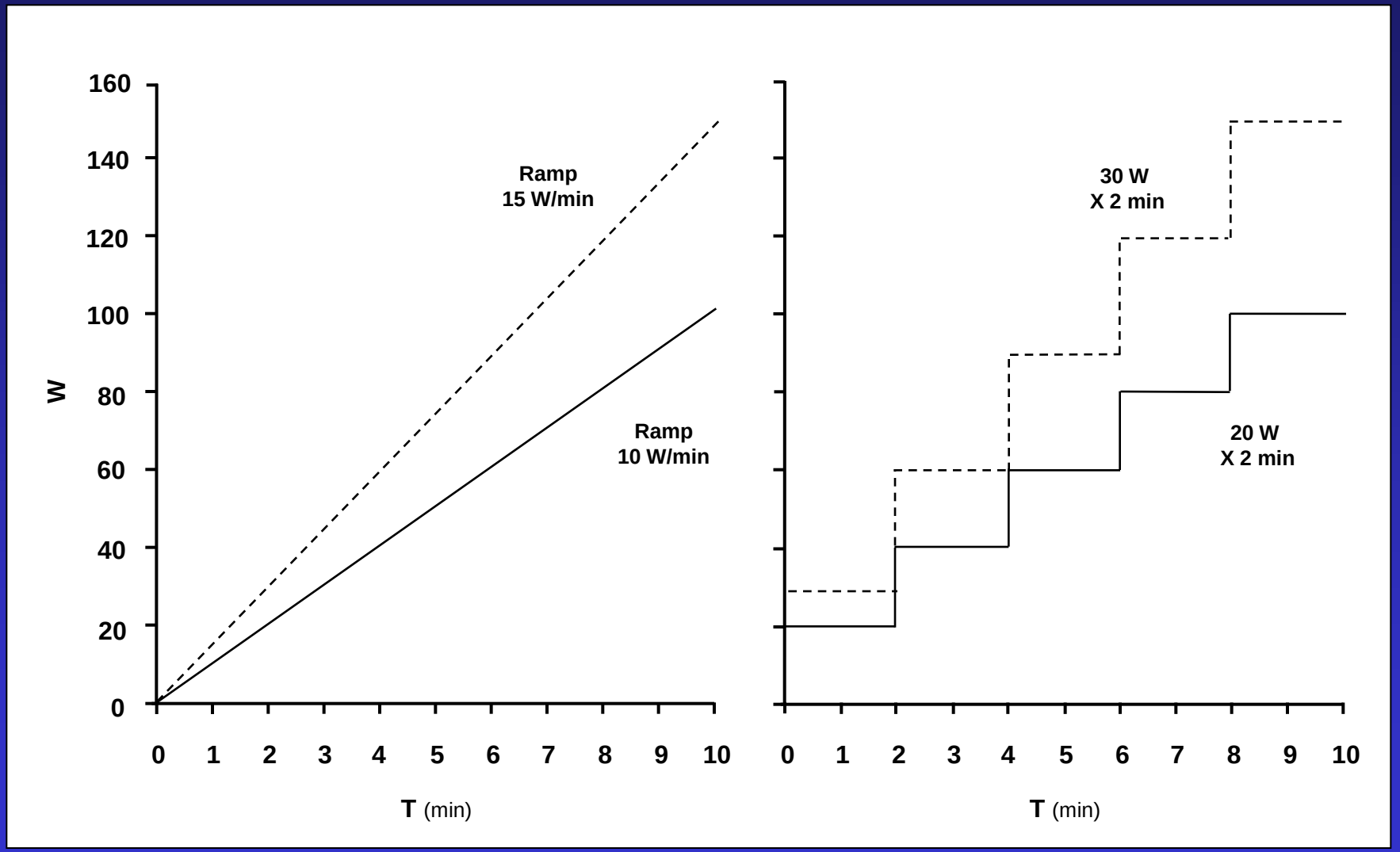
Table III. Predictors of mortality in 188 patients with CHF >70 years old (Cox proportional hazard multivariate analyses)

Variable	*P* value	RR (95% CI)
NYHA class	.1131	1.49 (0.91-2.44)
LVEF (%)	.0827	0.98 (0.96-1.00)
Peak VO_2 (mL/min/kg)	.0106	0.86 (0.76-0.96)
Sex (female vs male)	.023	0.46 (0.23-0.69)
Systolic dysfunction (LVEF <45%)	.036	0.56 (0.33-0.79)
NYHA class	<0001	2.31 (1.72-2.90)
Age (y)	.126	1.04 (0.99-1.09)

RR, Relative risk; *CI*, confidence interval. *NYHA*, New York Heart Association; *LVEF*, left ventricular ejection fraction; *RVEF*, right ventricular ejection fraction; *LVEDD*, left ventricular end-diastolic diameter; *LVESD*, left ventricular end-systolic diameter; *LAD*, left atrial diameter; VO_2, oxygen consumption; VE/VCO_2, slope of the relationship of minute ventilation to carbon dioxide production; *BP*, blood pressure.

Cicoira M, Int J Cardiol 2008

Incremental exercise testing
Cycle ergometer protocols



Main noncardiac causes of ineligibility for exercise testing in the elderly

1) COPD
2) Peripheral arterial disease
3) Degenerative arthritis
4) Unfamiliarity with vigorous exercise and/or exercise testing equipment
5) Clinician's unwillingness to allow patients to exercise

	Patients in 55–64 year age group		Patients in > 64 year age group	
	XT	no XT	XT	no XT
No. of patients	109	24	48	63
Age	60 ± 3	61 ± 3	68 ± 3	73 ± 5*
Previous MI (%)	23	37	33	39
Location MI (%)				
anterior	35	50	18	30
inferior	43	29	54	37
Non transmural	22	21	27	33
MIRU				
I or II (%)	98	62*	98	86*
III or IV (%)	2	38	2	14
Max CPK (IU l^{-1})	574 ± 456	863 ± 576*	383 ± 276	376 ± 273
Late heart failure (%)	13	37*	10	28*
Angina (%)	17	25	10	25*
Ejection fraction (%)	47 ± 15	38 ± 19*	49 ± 15	42 ± 16*

*$P < 0.05$ *vs* stress test (XT) performed.
MI = myocardial infarction.

Deckers JW, Eur Heart J 1984

TABLE 4. Ranked Independent Predictors and Factors Not Predictive of 6-Month Mortality Among 10 219 Hospital Survivors by the Cox Model

Variable	Relative risk	95% Confidence interval
Independent predictors		
Ineligibility for exercise test		
Cardiac reason	3.30	2.36-4.62
Noncardiac reason	3.28	2.23-4.72
Early LV failure	2.41	1.87-3.09
Recovery-phase LV dysfunction	2.30	1.78-2.98
Age >70 y	1.81	1.43-2.30
Electrical instability	1.70	1.32-2.19
Late LV failure	1.54	1.17-2.03
Previous myocardial infarction	1.47	1.14-1.89
History of treated hypertension	1.32	1.05-1.65
Nonpredictive factors		
Female sex	0.92	0.70-1.21
History of angina	1.03	0.80-1.30
History of insulin-dependent diabetes	1.17	0.69-1.99
Postinfarction angina	1.09	0.81-1.46
Anterior (Q wave) site	1.14	0.91-1.42
QRS score >10	0.95	0.73-1.24
Positive exercise test	1.50	0.94-2.38

LV indicates left ventricular.

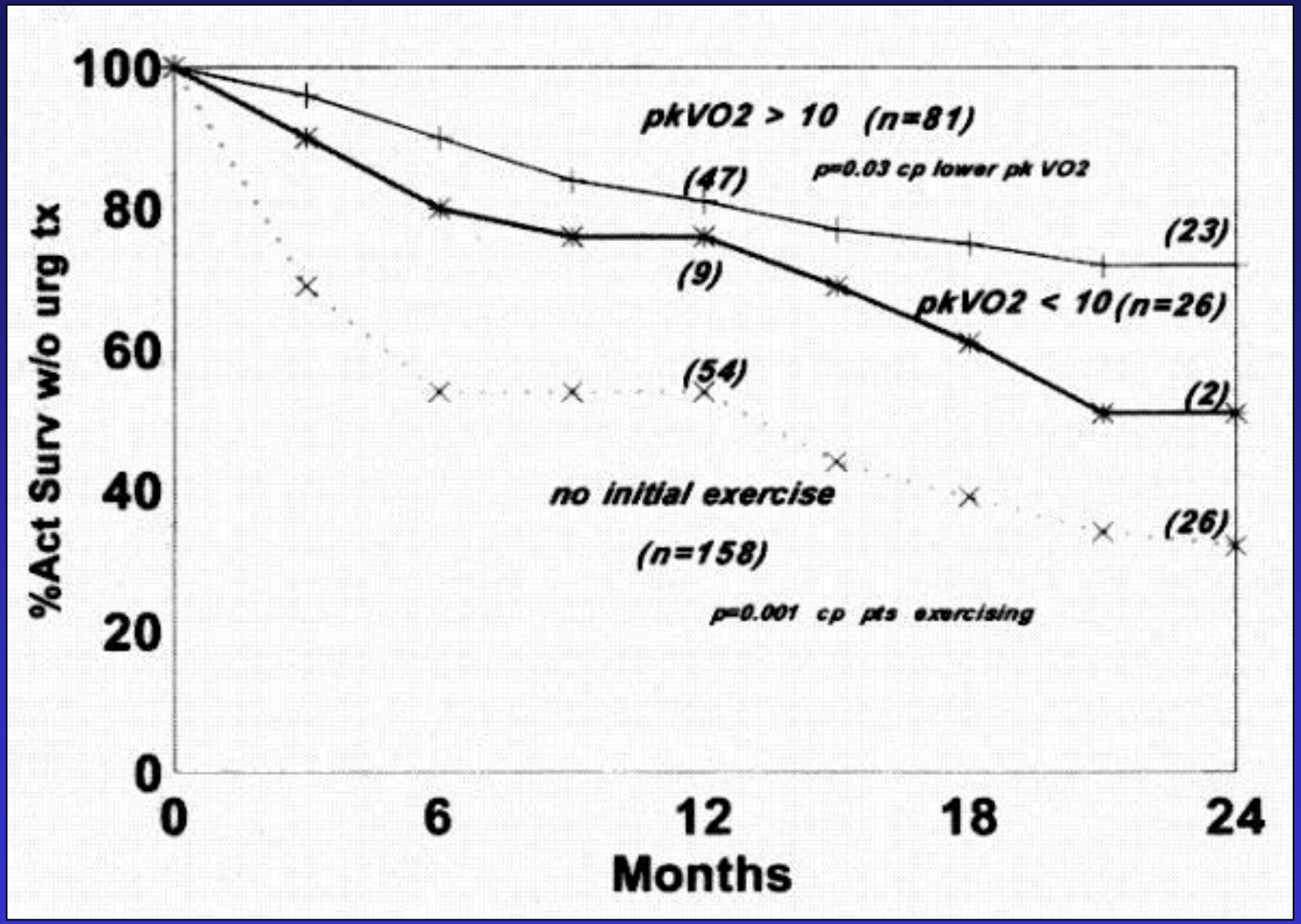
Volpi A, Circulation 1993

TABLE 5. Comparison of Historical and Clinical Data for Non–Exercise-Tested and Exercise-Tested Patients

Variable	Without exercise test (n=2833)		With exercise test (n=5482)		*P*
	No.	%	No.	%	
Age >70 y	1067	37.7	479	8.7	<.01
Female sex	828	29.2	642	11.7	<.01
History					
Myocardial infarction	509	18.0	616	11.2	<.01
Angina	670	23.6	999	18.2	
Hypertension (treated)	967	34.1	1356	24.7	<.01
Insulin-dependent diabetes	89	3.1	83	1.5	
Hospital course					
Early LV failure	652	23.0	445	8.1	<.01
Late LV failure	513	18.1	205	3.7	<.01
Postinfarction angina	429	15.1	434	7.9	<.01
ECG					
Anterior (Q wave) site	1109	39.1	1726	31.5	<.01
Special tests					
Recovery-phase LV dysfunction (Echo)	629	22.2	645	11.8	<.01
Electrical instability (Holter)	898	31.7	1582	28.9	
Medications at discharge					
β-Blockers	443	15.6	1662	30.3	<.01
Antiarrhythmics	410	14.5	481	8.8	<.01
Digitalis	538	19.0	222	4.0	<.01
Diuretics	871	30.7	697	12.7	<.01

LV indicates left ventricular.

Volpi A, Circulation 1993

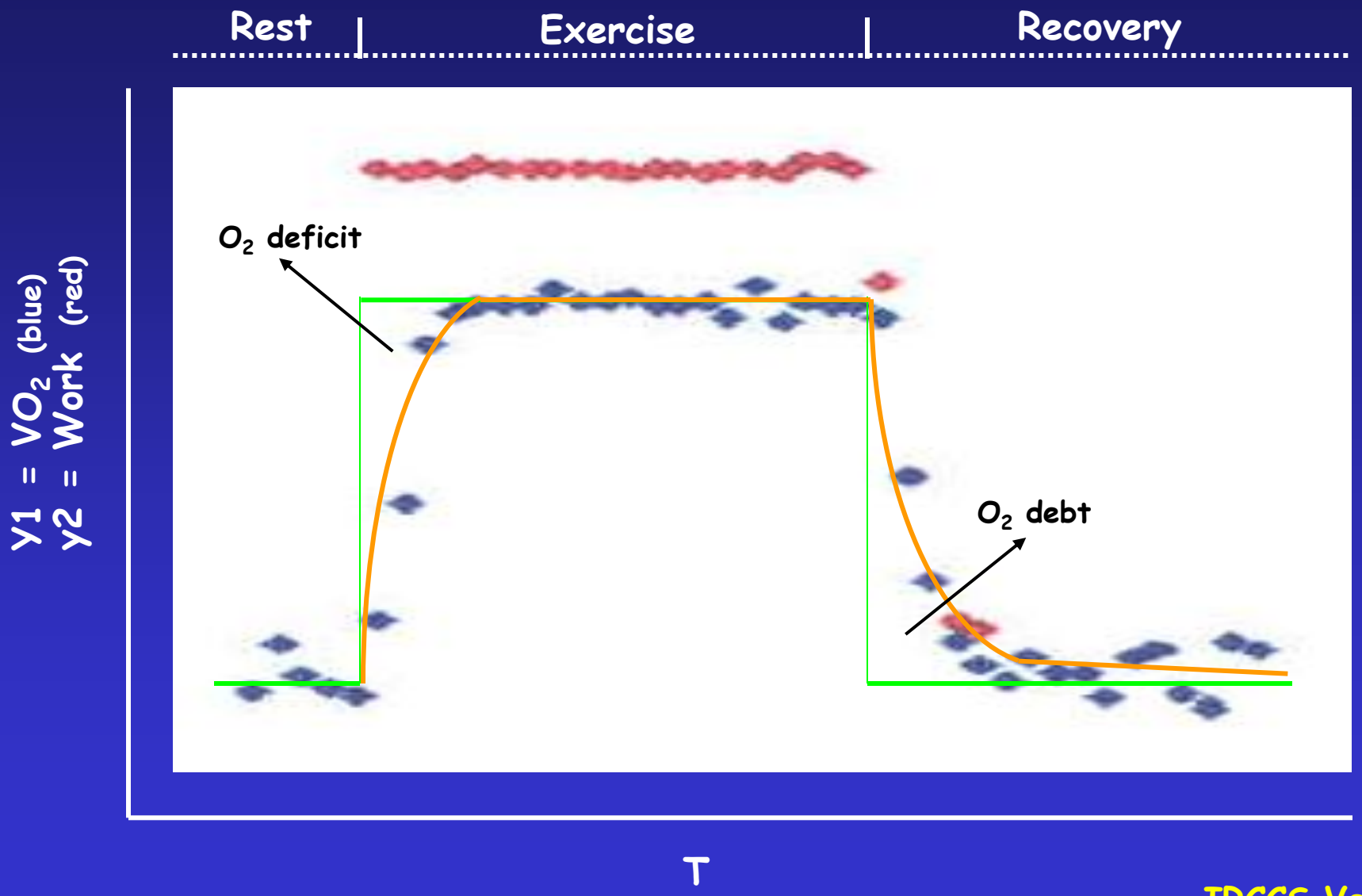


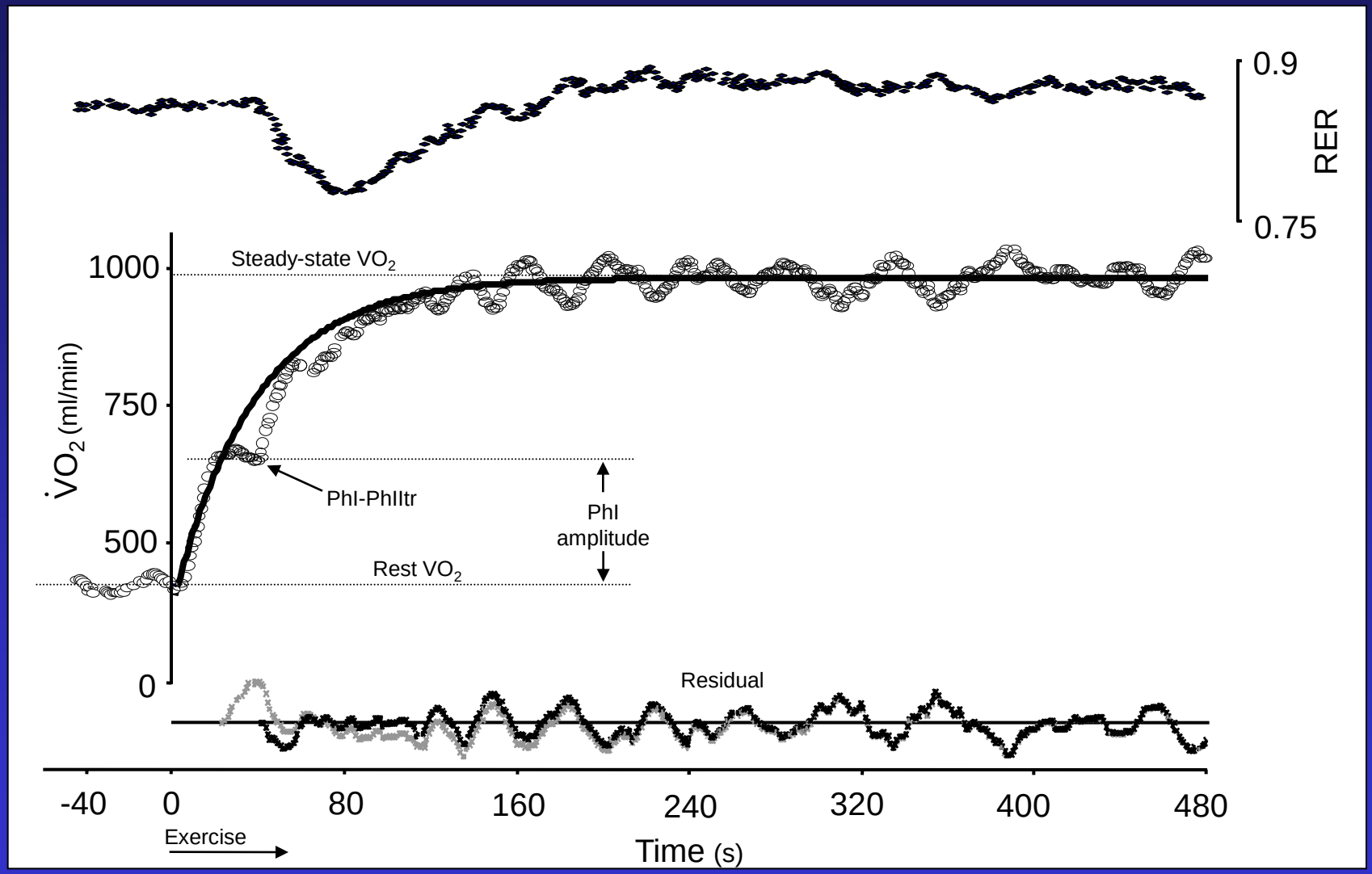
Stevenson LW, Circulation 1995

'Thus, exclusion from the exercise test appears to be an empiric index that incorporates the cumulative risk resulting from overlapping of known adverse prognostic factors and their detrimental interactions.'

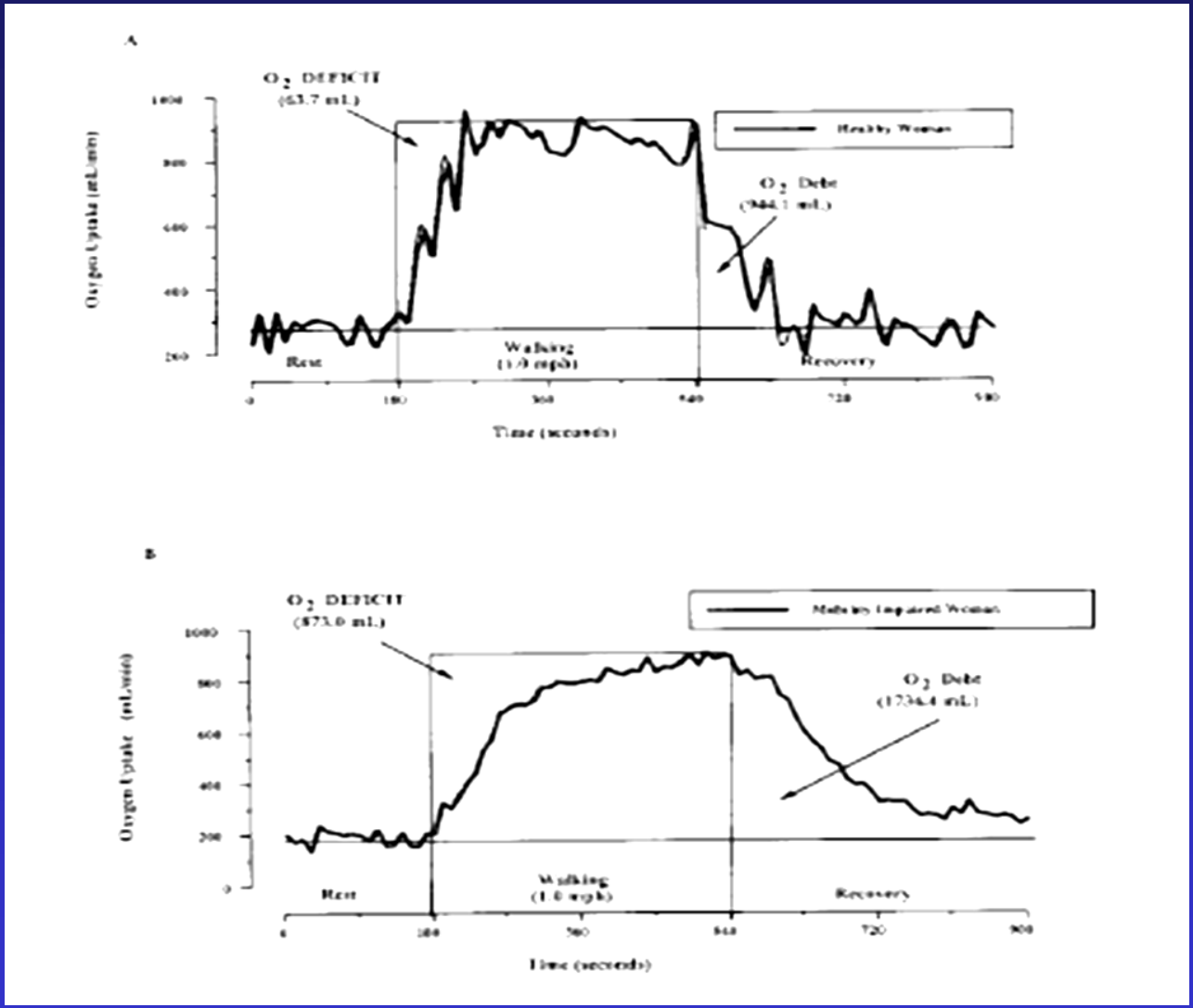
Volpi A, Circulation 1993

Constant-power exercise testing





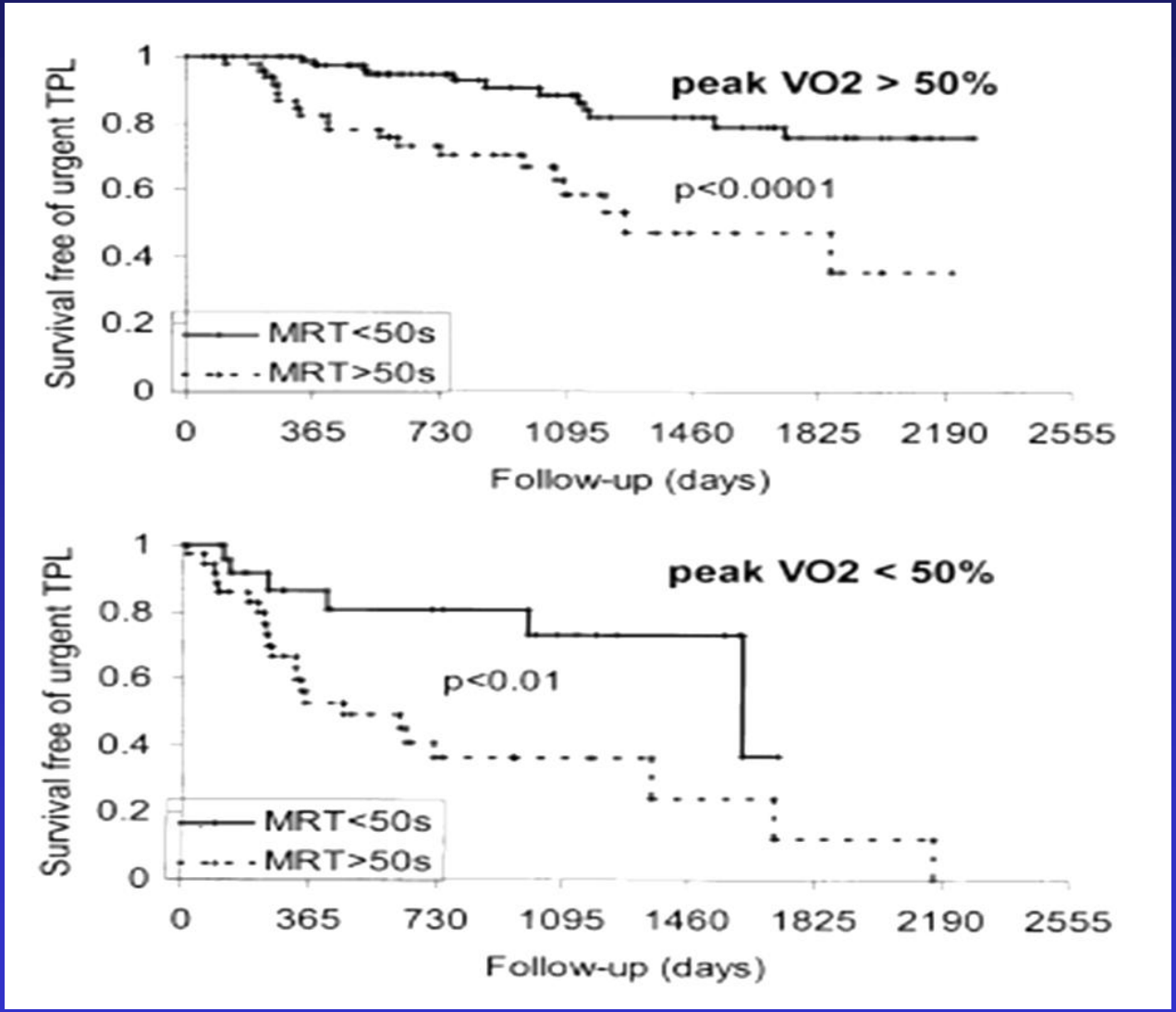
1 mph – 0% grade – 6 minutes



Alexander NB, J Gerontol 2003

IRCCS Veruno

1 mph – 6% grade – 6 minutes



Rickli H, J Am Coll Cardiol 2003

IRCCS Veruno

6-min walking test

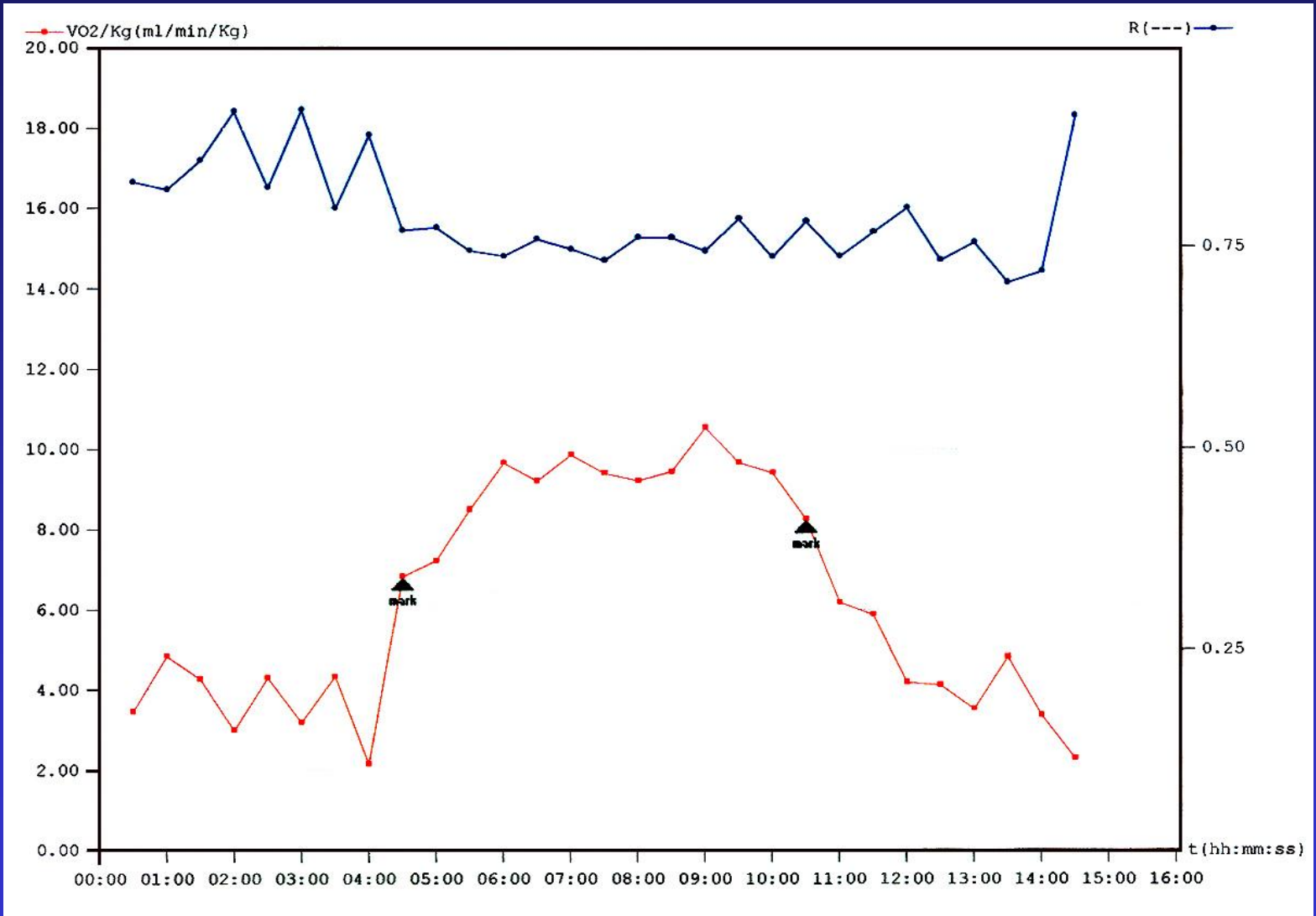


Table II. Peak oxygen consumption during maximal exercise (Max-Ex) and 6-MWT and distance (D) walked in the 6-minute period according to New York Heart Association functional class

	NYHA class		
	II	III	IV
n	10	10	6
Max-Ex (ml/kg/min)	18.2 ± 3.8	14.1 ± 2.5*	11.5 ± 1.75*†
6-MWT (ml/kg/min)	16.5 ± 4.2	11.1 ± 2.9*	10 ± 2.7*
D (m)	503 ± 73	385 ± 89*	334 ± 155*

*$p < 0.05$ vs NYHA II.
†$p < 0.05$ vs NYHA III.

90% 79% 87%

Faggiano P, Am Heart J 1997

6-min walking test in CHF patients
Repeatability in elderly patients

n. = 24
Age (median) = 81 years

ICC = 0.91

O'Keeffe ST, Heart 1998

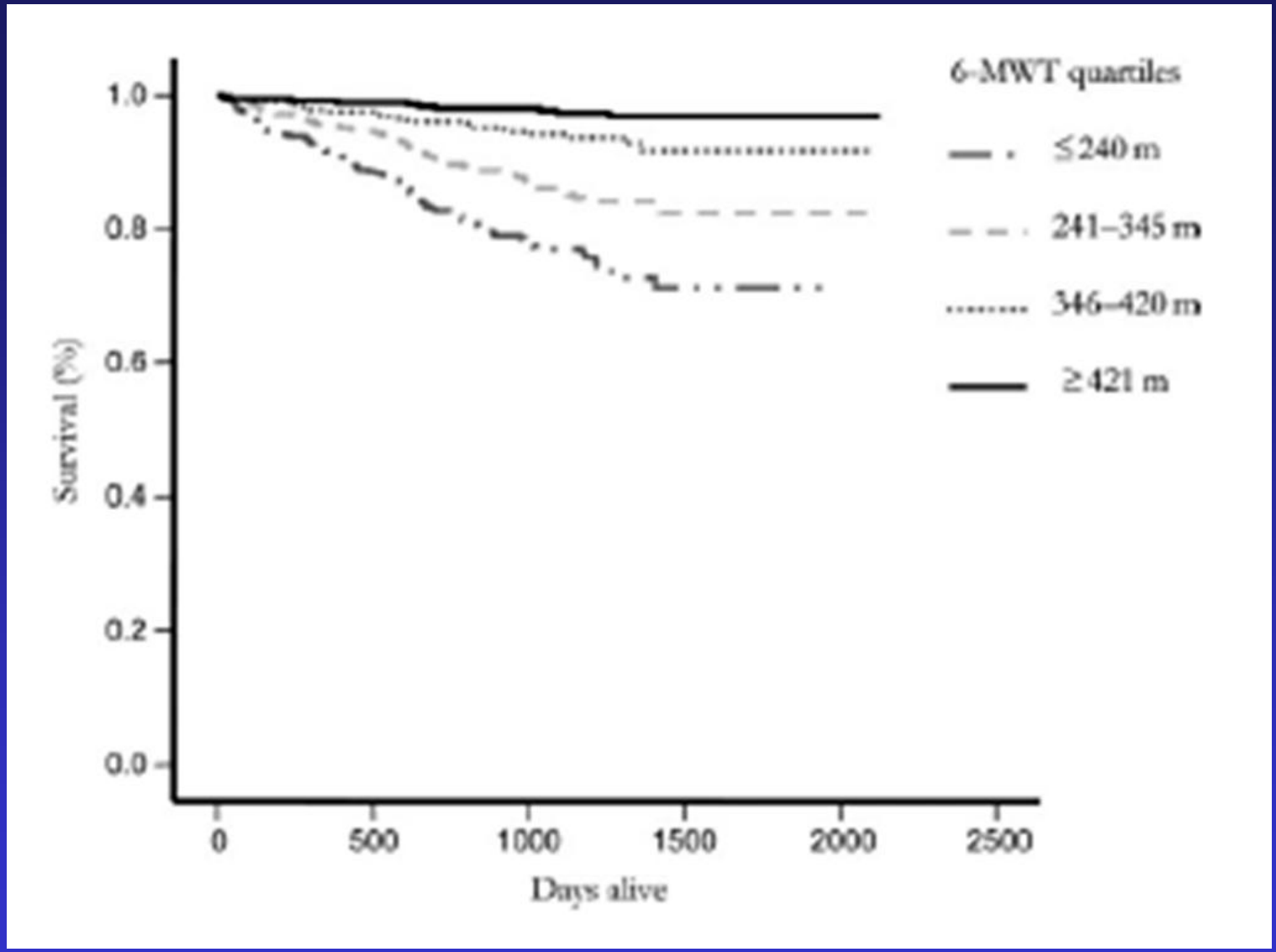
Distance walked at 6-min WT soon after cardiac surgery

Table 2 Reference values for the distance walked stratified by age, LVEF, and comorbidity in men

	Age ≤ 60 years		Age 61–70 years		Age ≥ 71 years	
	LVEF ≥ 50%	LVEF <50%	LVEF ≥ 50%	LVEF < 50%	LVEF ≥ 50%	LVEF <50%
Absence of comorbidities	*n* = 205	*n* = 119	*n* = 191	*n* = 108	*n* = 113	*n* = 79
Mean ± SD	369 ± 92	360 ± 90	330 ± 98	302 ± 101	310 ± 113	369 ± 102
Median	370	360	340	309	300	270
Lower quartile	310	310	260	241	220	180
Upper quartile	427	420	400	377	390	340
Presence of comorbidities	*n* = 109	*n* = 63	*n* = 156	*n* = 105	*n* = 124	*n* = 85
Mean ± SD	346 ± 102	341 ± 89	326 ± 109	282 ± 100	287 ± 122	254 ± 119
Median	350	344	334	286	284	2460
Lower quartile	292	282	250	220	200	175
Upper quartile	416	400	400	360	371	325

Modified from Opasich et al. [28]. LVEF, left ventricular ejection fraction.

De Feo S, Eur J Cardiovasc Prev Rehabil 2009



Ingle L, Eur Heart J 2007

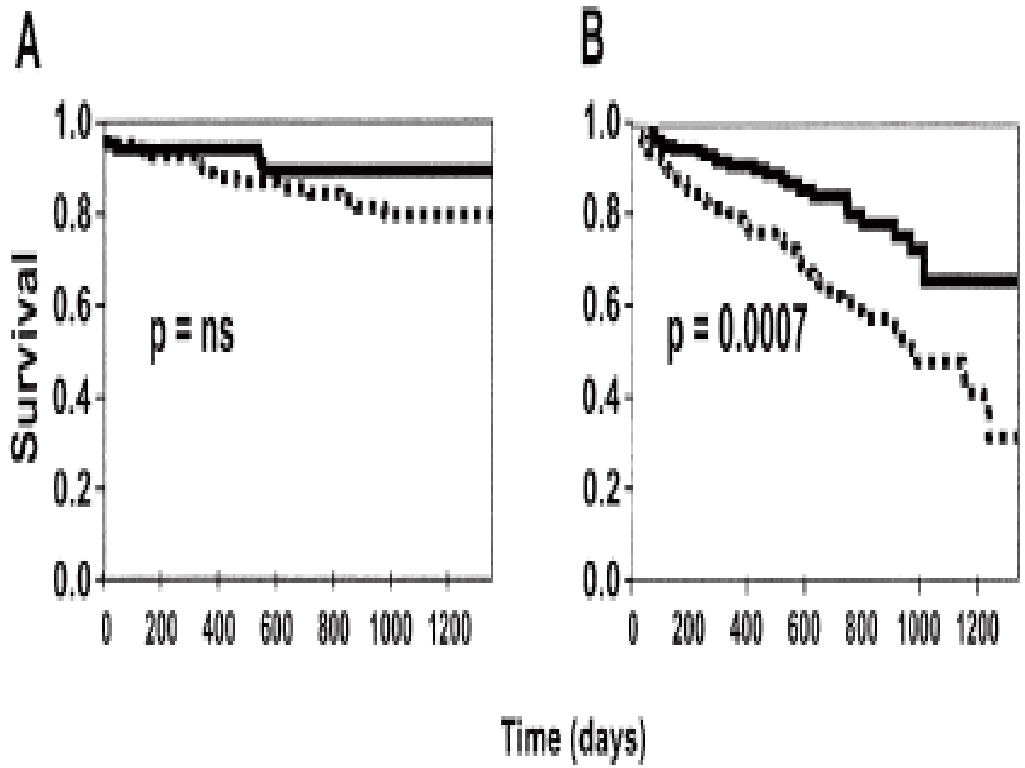


Figure 2. Survival according to the median value (70 m) of the increase in distance walked following drug intervention in the two subgroups of patients who walked >340 m (A) or <340 m (B) at baseline. Solid line = >70 m; dotted line = <70 m.

Passantino A, J Am Coll Cardiol 2006

Conclusions - 1

1) The indications and safety of exercise testing in the elderly are similar to those in younger patients.

2) The frequent presence of both cardiovascular and noncardiovascular comorbid conditions requires concerted efforts to match the older patient with an appropriate exercise testing protocol.

Conclusions - 2

3) Ineligibility for symptom-limited incremental exercise testing due to clinical reasons bears per se a negative prognostic value, irrespective of the cause of functional limitation.

4) Patients unable to undergo incremental, maximal effort can be offered alternative methods of ergometric evaluation, that provide an adequate functional and prognostic stratification.


Thank you!