

Predischarge stress test after myocardial infarction in the old age: Results and prognostic value

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The aim of this study was to evaluate the results of predischarge stress testing in the elderly, and to assess the prognostic value of the test during one-year follow-up. The database consisted of 48 patients older than 64 years of age and 109 patients 55–64 years of age, who survived acute myocardial infarction, out of 532 consecutive patients admitted for myocardial infarction. Stress-test results were not different in the two groups. During one-year follow-up mortality was 6% in the younger patients and 4% in the older group, and the incidence of non-fatal reinfarctions was 8% in both groups. Mortality was best predicted by the extent of blood pressure rise (43 ± 26 mmHg in survivors vs 19 ± 15 mmHg in non-survivors, $P < 0.001$). Stress-test results were no more predictive when non-fatal reinfarction was added to mortality as an end-point. We conclude that for patients in whom the stress test is not contraindicated, (1) age does not affect stress test results, (2) the extent of blood pressure rise during a stress test is the best single predictor of mortality, (3) stress tests are not predictive of reinfarctions.

Introduction

Stress testing early after myocardial infarction is an examination which has been shown, in properly selected patients, to be safe, useful in the recommendations for an individual's activities, to provide psychological support and prognostic information^[1]. However, little attention has been given in the majority of studies to the results in older patients. The aim of this study is to compare the results of stress tests performed at discharge in patients older than 64 years of age with the results of patients 55–64 years of age, who survived in acute myocardial infarction, and, secondly, to assess the prognostic value of the stress test during one year follow up.

Patients and methods

From March 1981 to December 1982, 532 patients suffering from myocardial infarction were admitted to the coronary care unit of the Thoraxcenter. A definite myocardial infarction was

diagnosed when at least two of the following three criteria were present: typical chest pain, typical electrocardiographic changes and elevated serum creatine kinase levels. Of these patients, 72 died in hospital, 16 underwent elective transluminal coronary angioplasty before discharge and 25 underwent coronary artery bypass grafting (4 with additional cardiac surgery). Of the remaining patients, 298 underwent a stress test at discharge. The test was contraindicated in 105 patients. Forty-eight (43%) patients older than 65 years and 109 (81%) patients 55–64 years of age were eligible for the test. The baseline clinical profile of the two age groups, including sex, history of previous myocardial infarction, peak creatine kinase, site of infarction and Killip class were similar. Left ventricular ejection fraction, measured by radionuclide ventriculography at discharge was $47 \pm 14\%$ in the younger group and $49 \pm 15\%$ in the elderly (NS). The description of patients contraindicated for the test is given by Deckers *et al.* in this supplement (see pp. 97–100)^[2]. The stress test was performed in the manner as previously published^[3] at a median interval of 12 days after the infarction. All patients were followed-up for one-year after discharge.

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Table 1 Stress test results

	Patients 55–64 years of age	Patients > 64 years of age
No. of patients	109	48
Max workload (W)	107 ± 29	101 ± 27
Resting heart rate (beats min ⁻¹)	83 ± 16	82 ± 19
Max heart rate (beats min ⁻¹)	128 ± 21	125 ± 21
Resting blood pressure (mmHg)	122 ± 16	128 ± 17
Max blood pressure (mmHg)	165 ± 31	168 ± 30
Angina (%)	23	14
ST depression (%)	50	44
ST elevation (%)	46	31
Ventricular ectopy (%)	20	21

ST depression or elevation ≥ 1 mm; ventricular ectopy = any ventricular arrhythmia.

STATISTICAL ANALYSIS

Univariate analysis with unpaired Student's t-test for continuous variables and chi-square or Fisher's exact test was applied, when appropriate, for the discrete variables. To compare the predictive value of the continuous variables of the stress test, we utilized the receiver-operator characteristic curves (ROC curves)^[4]. End-point of this study were cardiac mortality or non-fatal reinfarction.

Table 2 Prediction of cardiac mortality and cardiac mortality or non-fatal infarction from stress test

	Non-survivors (N = 9)	Survivors (N = 148)	P value
Max workload (W)	89 ± 12	106 ± 29	0.05
Max heart rate (beats min ⁻¹)	134 ± 23	127 ± 21	NS
Blood pressure rise (mmHg)	19 ± 15	43 ± 26	0.01
Ventricular ectopy (%)	44	19	NS
Angina (%)	22	21	NS
ST depression (%)	50	49	NS
ST elevation (%)	50	41	NS
	Non-survivors or non-fatal reinfarction (N = 20)	Survivors and no non-fatal reinfarction (N = 137)	
Max workload (W)	100 ± 21	116 ± 30	NS
Max heart rate (beats min ⁻¹)	125 ± 22	127 ± 21	NS
Blood pressure rise (mmHg)	35 ± 21	43 ± 27	NS
Ventricular ectopy (%)	35	18	NS
Angina (%)	20	21	NS
ST depression (%)	50	49	NS

Results

The stress-test results in the two age groups are summarized in Table 1. We did not find any significant difference between the two groups.

The incidence of mortality and non-fatal reinfarction in the two age groups was the same. Mortality was 6% (N = 7) and 4% (N = 2) and recurrent infarction 8% (N = 9) and 8% (N = 4), respectively, in the younger and in the older group. In Table 2 the results of the stress tests are summarized in 'event' and 'non-event' patient groups. It appears that mortality was most significantly associated with a low blood-pressure rise during exercise, while the stress test was not predictive in reinfarction. In Fig. 1 the predictive accuracy for late mortality of some stress-test results is presented as ROC curves which shows that the most accurate predictor is the extent of blood-pressure rise.

Discussion

The results of stress tests performed before discharge in survivors of an acute myocardial infarction were independent of age. This is consistent with the data recently reported by Hakki *et al.*^[5] in patients with coronary artery disease younger or older than 60 years. However, our results as well as

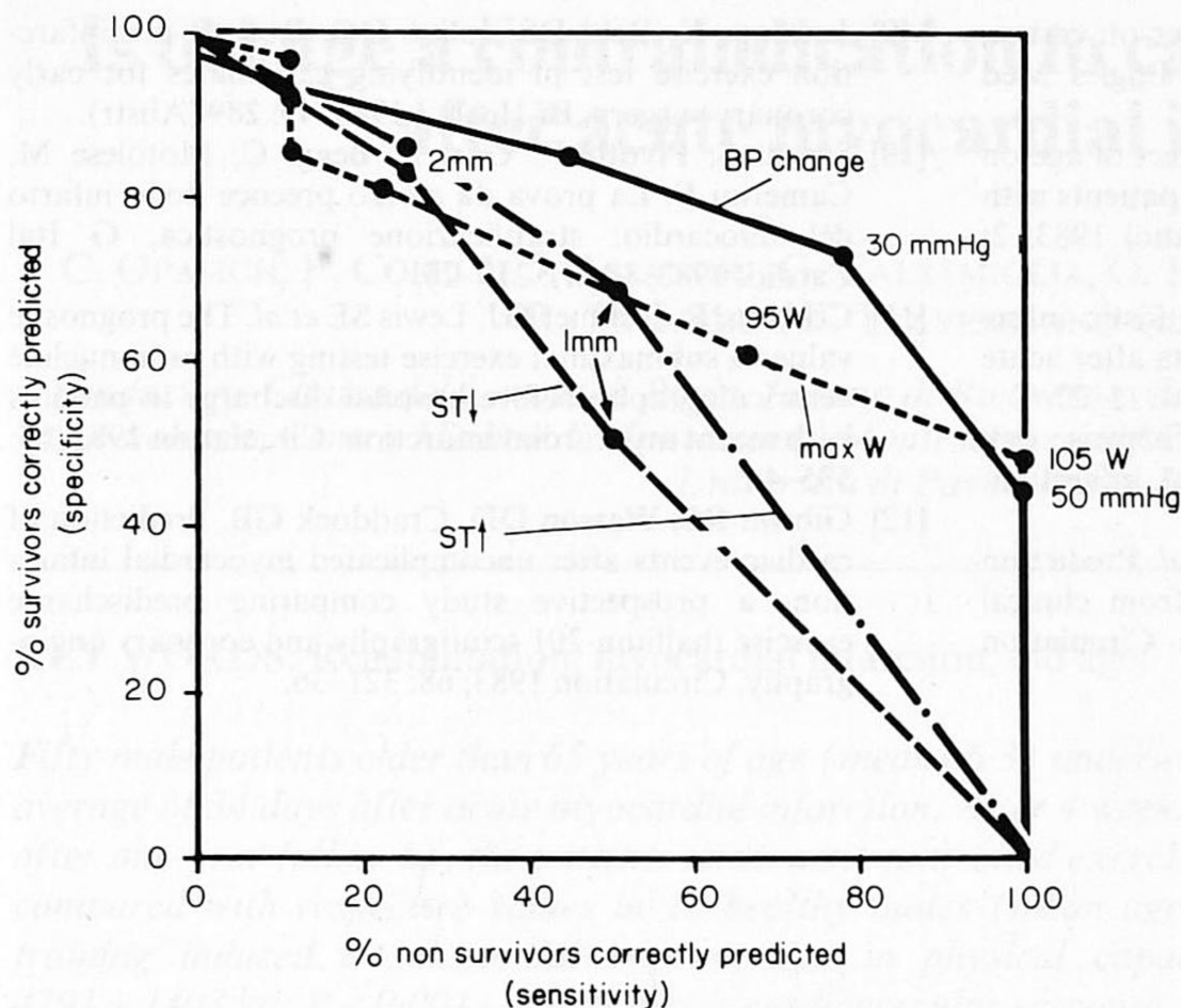


Figure 1 Specificity vs sensitivity (ROC curve) for prediction of late mortality from stress-test derived data — $N=157$ [BP change = blood pressure rise; max W = maximal workload (W); $ST\uparrow$ = ST elevation (mm); and $ST\downarrow$ = ST depression (mm)].

those of Hakki could have been biased by the selection criteria that were applied. In fact in our series a larger percentage of patients were excluded from the test in the older age group (57% vs 19% in the younger group)^[2]. Patients eligible for the test had a comparable baseline clinical profile and ejection fraction (on average 49% and 47%), which is consistent with their similar test results. This also explains the similar follow-up data in the two groups. Mortality during the first year was low (6% and 4%), confirming that, also in the elderly, patients eligible for stress testing represent a low-risk group compared with patients who cannot perform the test^[2,3,5,6,8]. Despite this, different risk groups could be delineated based on the extent of blood pressure rise. Only 2 out of 110 patients with a blood pressure greater than 30 mmHg died (1.8%), vs 7 out of 47 (15%) with a blood pressure rise of less than 30 mmHg. This confirms the data of our previous study in a larger group of patients^[8]. Others reported similarly that prognosis after myocardial infarction is related to direct or indirect measurement of left ventricular function, and not to the appearance of exercise-induced myocardial ischaemia^[6,10,11]. Stress-test results were not predictive when non-fatal reinfarction

was considered an end-point in addition to mortality. The predictive value of the stress test for reinfarction is controversial^[6,7,10]. It is possible that the utilisation of more elaborate techniques such as exercise thallium scintigraphy may provide more accurate prediction of recurrent infarction^[12].

In conclusion, for patients in whom a stress test can be performed, (1) age does not influence the results of stress test and prognosis, (2) a stress test is predictive of mortality but not of reinfarction and (3) the extent of blood pressure rise during stress test is the single best predictor of mortality.

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