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Clinical value of exercise testing in elderly patients

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Between 1978 and 1983, 1391 exercise tests were performed by 1083 males and 308 females over 64 years of age. This represents 17% of the total number of 8213 exercise tests. A history of myocardial infarction was present in 53% of the males and 30% of the females, while 12% of patients had previous heart surgery. Exercise was performed on a bicycle ergometer with stepwise workload increments of 10 or 20 W min^{-1}. In 10% of patients the physician stopped the test because of serious arrhythmias or abnormal bloodpressure response. The test was terminated because of fatigue (40%), angina (12%), dyspnea (18%) or tired legs and claudicatio (18%). Peak workload averaged 115 W in males and 85 W in females, which corresponds to 120% of the predicted normal values. Heart rate increased on average to 130 beats min^{-1} and systolic blood pressure increased to 180 mmHg. ECG changes compatible with myocardial ischaemia were observed in 42% of patients.

Although elderly patients constitute a small fraction of the population referred for exercise testing, these findings indicate that the clinical value of the test when performed is similar to that in younger patients. The observation that most patients achieved higher than 'normal' maximum workloads may be due to unreliability of the reference values.

Introduction

Old is not old anymore. The transition between 'middle age' and 'old' is shifting in an upward direction. People are more active in older age than they were in former times. Physical fitness programs are popular in the aged and even marathon running is done by men over 60.

In cardiology similar shifts can be observed. Cardiac catheterization, coronary angiography and cardiac surgery, are nowadays performed frequently in patients over 65 and sometimes even over 70. Rehabilitation programs include elderly patients. It is therefore not surprising that in our exercise laboratory many elderly men and women are tested. However, the interpretation of the results of these tests can be a problem. Research in normal individuals has frequently been limited to people under the age of 60 or 65[1–4].

Reliable reference values of men over 60 are missing. Often these reference values are based on small, selected groups or on extrapolation of data from younger age groups. The significance of ECG changes during exercise are poorly understood. The use of drugs in elderly people is extensive but little is known of the effects of drugs like digitalis and beta-blocking agents on the physical performance of elderly people. We try to interpret the findings on an individual base as well as possible.

The symposium 'Exercise on old age' gave a reason to look retrospectively at our experience gained in the past six years. Aim of this study was to assess the clinical value of exercise testing in elderly patients.

Methods

All patients were exercised on a bicycle ergometer with a stepwise increasing workload of 10 or 20 W min^{-1}. Blood pressure was measured every one or two min. The three orthogonal Frank ECG leads X, Y and Z were continuously monitored; the probability of myocardial ischaemia, based on ST depression and heart rate, was calculated by a computer system[6].

The exercise tests were always supervised by a physician who encouraged the patients to continue until fatigue, moderately severe angina or dyspnoea. The test was terminated only if

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the patients had serious findings such as ventricular tachycardia, an abnormal blood pressure response or physical signs of dysregulation of the circulation.

Results

In 6 years a total of 8213 exercise tests were performed, including 1391 tests in people over 60 years of age (17%), 1083 males and 308 females. Only 97 patients (12%) were 70 years or older (Table 1).

Table 1 Number of patients tested

Age	Male	Female	Total
60–64	739	184	923
65–69	272	99	371
70–79	72	25	97

A history of myocardial infarction was present in 53% of the males and in 30% of the females. The percentage was independent of age. Most patients were tested for evaluation of cardiac symptoms, and some following cardiac surgery (12%), as a part of a rehabilitation program.

Angina pectoris in males and atypical chest pain in females were the most frequent symptoms before the exercise test. Many men (36%) and some women (19%) had no symptoms at all. Most of these were tested after recovery of a myocardial infarction[5].

The main reasons for termination of the exercise test in men were general fatigue (40%), tired legs (18%) and dyspnoea (18%). Only a few (12%) stopped because of angina pectoris. The test was terminated by the supervising physician in a small part of the patients, because of arrhythmias, abnormal blood pressure response or an inadequate circulation. In the older age group we observed more frequently dyspnoea and signs of inadequate circulation, and less angina and general fatigue.

In comparison with men, women stopped more frequently because of fatigue and dyspnoea (23%) less frequently because of tired legs (12%) and angina pectoris (8%). The supervising physician terminated the exercise test in only 5% of the women.

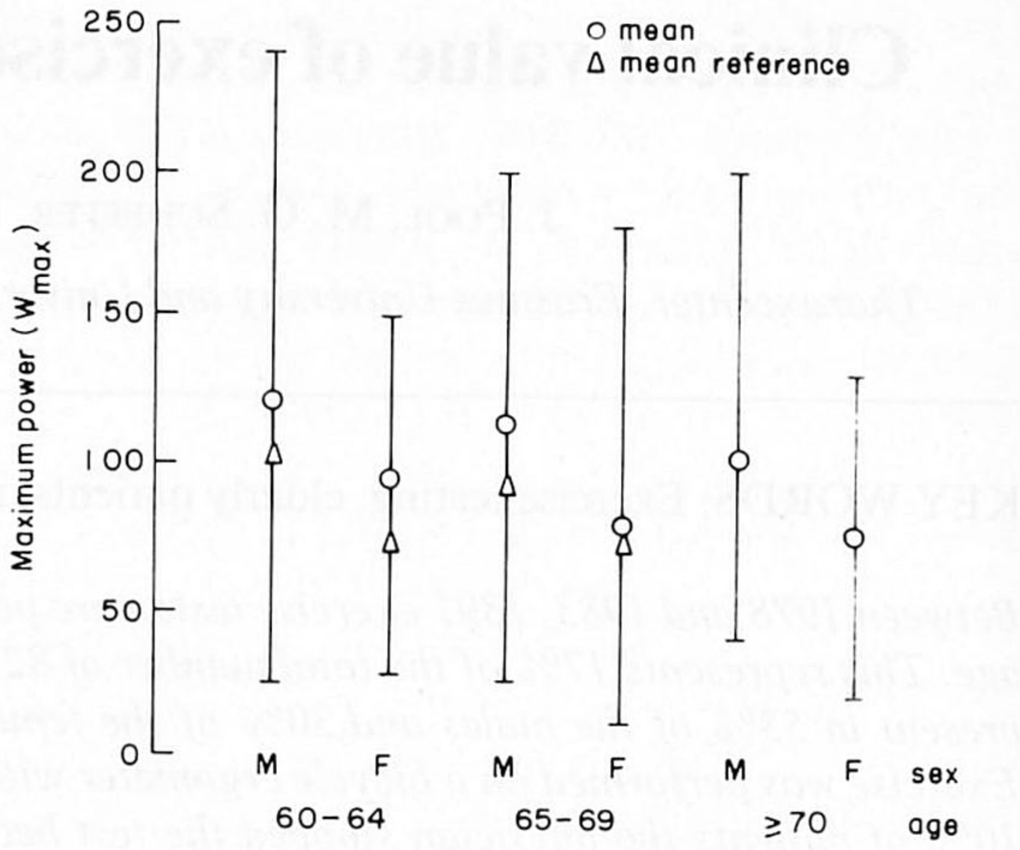

Figure 1. Average (○) and range of maximum workload (M = male; F = female). △ calculated mean reference values.

The maximum workload reached by patients in the three age groups is shown in Fig. 1. A wide scatter is obvious, varying from 10 W up to 240 W. Even in the oldest age group some patients were able to perform 200 W. A reference value was calculated for each patient based on sex, age and height[3,4]. In patients over 70, no reference values were available. The mean values of the observed maximum workload were higher than the calculated reference values as shown in Fig. 1.

In Fig. 2 the maximum heart rates are presented. The mean heart rates are lower than the reference values calculated as (220-age). Some patients reached heart rates up to 200 beats min^{-1}.

Blood pressures at maximal work are shown in Fig. 3. On average the systolic pressure was 180. Again the scatter was large. Some patients had blood pressures up to 270 mmHg while in others the systolic blood pressure remained below 100 mmHg. Some of these patients were only able to cycle at 10 or 20 W. The incidence of abnormal ST segment changes during exercise is presented in Table 2. In 35% of the male patients the ST segment remained within normal limits, while most patients showed ST segment changes compatible with myocardial ischaemia[6]. Many patients used digitalis, so in these cases it is not sure whether ST segment depression is due to ischaemia or to the use of digitalis. Only about 1/3 had no ischaemic changes.

Discussion

Many patients were exercised as a routine procedure soon after myocardial infarction. These

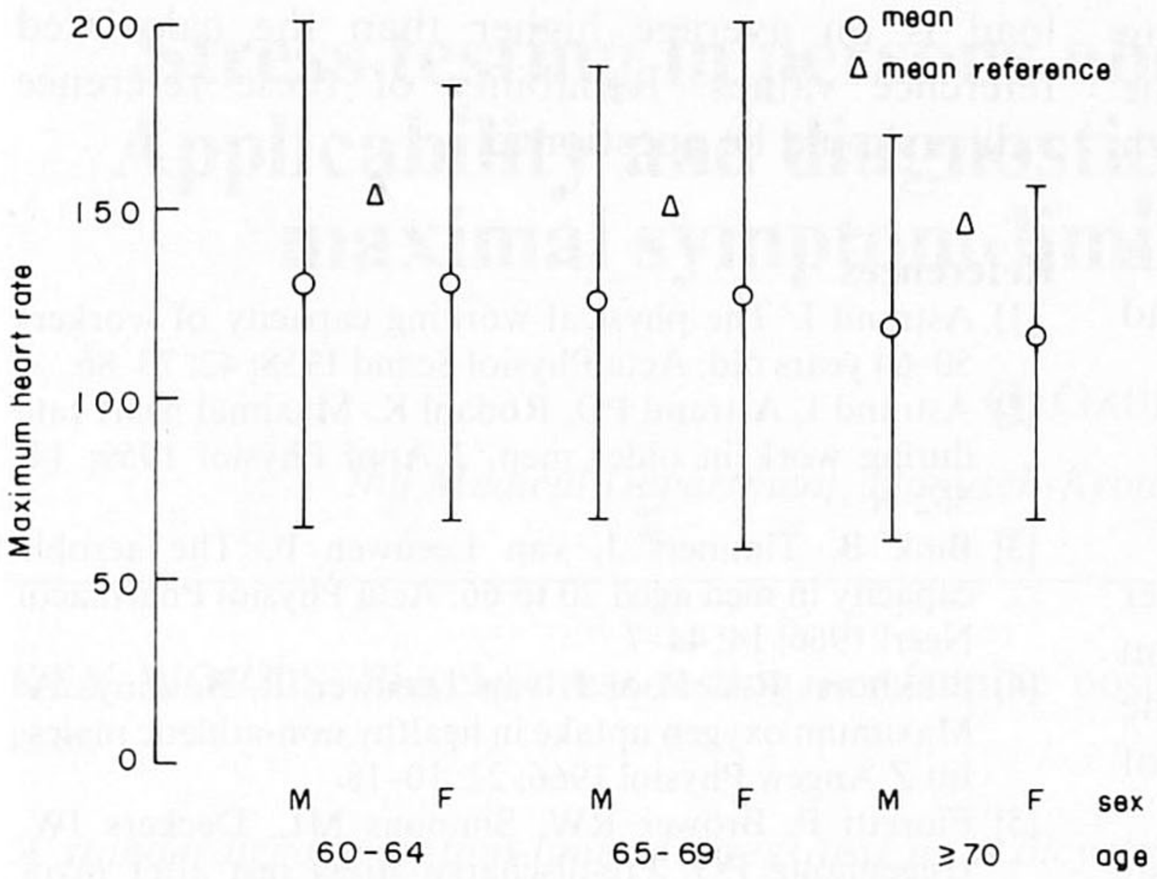

Figure 2. Average (○) and range of maximum heart rate (M = male; F = female). △ calculated mean reference value.

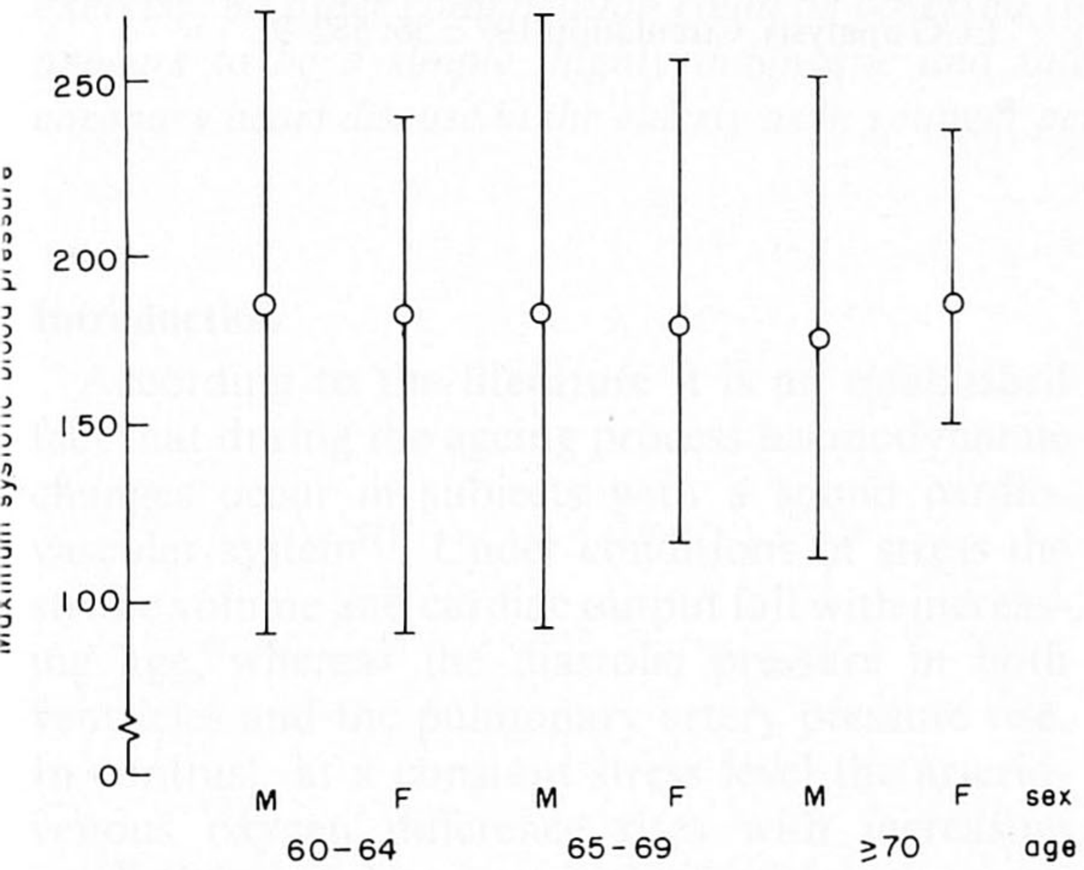

Figure 3 Average (○) and range of maximum systolic blood pressure. M = male; F = female.

Table 2 ST segment depression (%) in males compatible with ischaemia

	Age group		
	60–64	65–69	⩾70
No ischaemia	35	33	35
ST segment depression compatible with ischaemia	42	39	46
ST segment depression compatible with ischaemia and/or use of ditigalis	23	28	19

patients are described extensively by Fioretti *et al.*[5] The remaining patients were tested mainly for evaluation of chest pain or estimation of their exercise capacity. Only a minority of the male patients had angina pectoris, while many developed ST segment depression during the test. In the analysis of the results two findings are remarkable: firstly, many male patients developed ST segment depression, while only a minority had angina pectoris during the exercise test; and, secondly, relatively high maximum workloads were found.

Myocardial ischaemia is the most probable explanation of the ST changes since many patients had suffered myocardial infarction and coronary atherosclerosis is frequently found in elderly males. Surprisingly the maximum workload of the patients was higher than the calculated reference values. These reference values were derived from studies in healthy Dutch males[3–4]. Probably these reference data are unreliable for people over 60. The number of subjects over 60 in these studies was small and the reference data were mainly calculated from the data found in the younger subjects. Moreover these studies were done approximately 20 years ago. Although exercise tests were done by selected patients, at least able to cycle, the relatively high values of maximum workload cannot be explained by this selection. Many patients were tested within 2 weeks after myocardial infarction, many had symptoms and about 25% used a beta-blocker. Also maximum heart rates were lower than the reference values[4]. This can be well explained by the limitation due to

symptoms and by medication with beta-blocking agents in 25% of the patients. Nevertheless some patients had maximum heart rates up to 200, much greater than the so called target heart rate. Termination of exercise tests when the target heart rate is reached means that the maximum workload of these patients is underestimated.

Conclusions

Symptom limited exercise tests in patients over 60 are feasible, even in post myocardial infarction patients. Only in a small part of elderly patients the exercise test has to be terminated because of serious complications.

In a large percentage of males ST segment abnormalities are present, partly due to digitalis, but probably mainly caused by myocardial ischaemia. Maximum heart rates are lower than reference values. Nevertheless, maximum workload is on average higher than the calculated reference values. Reliability of these reference values should be questioned.

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