EXERCISE TESTING OF CHEST PAIN PATIENTS IN EMERGENCY DEPARTMENT AT PRINCE HASHEM MILITARY HOSPITAL

Jawad F. Maayah, MD, Ghassan I. Kawar, MD**

ABSTRACT

Objective: To describe patients with chest pain and their triage in the emergency department after using treadmill exercise testing when needed.

Methods: This study was conducted during the period between 15th of August 1999 and 15th of July 2000 as indicated by clinical and electrocardiographical criteria in a large heterogeneous group, which excluded patients with proven coronary artery disease.

Results: During the study period, a total of 450 patients with chest pain [(287(63.8%) males, 163 (36.2%) females)] presented to the emergency department underwent treadmill testing. Fifty patients (11.1%) had positive results on exercise electrocardiography, 42 of the latter had further evaluation that revealed evidence of coronary artery disease in 31 (73.8%) patients.
Three hundred sixty nine (82%) patients had negative exercise test results and 31(6.9)% had non-diagnostic tests. No adverse events were recorded.
A 30-day follow-up was achieved in 425 (94.4%) patients and revealed no mortality in any of the patients.

Conclusion: The results in the study population support the safety and utility of exercise testing in low-risk chest pain patients who presented to the emergency department.

Key words: Chest Pain, Angina, Risk for Coronary Artery Disease, Exercise testing.

JRMS Dec 2003; 10(2): 11-14

Introduction

Prince Hashem Military Hospital is a very busy general hospital with a capacity of 100 beds including 6 intensive care unit beds and located in Zarqa, which is 25 Km north-east the capital Amman.

More than 5 million patients present annually to the emergency departments (ED) in the United States of America with chest pain suggestive of myocardial ischaemia [(1)]. Of the 2 million individuals in this group who are hospitalized for suspected myocardial infarction (MI), a coronary event is diagnosed in fewer than 30% [(2)]. More efficient management of the low-risk patients with chest pain could reduce unnecessary hospitalization, lower cost, and improve utilization of monitored beds, all of which are essential to cost-effective care [(2)].

Methods

Patients Selection

A total of 450 patients met the criteria for treadmill testing. An internist selected these patients and attended the procedure.

Patients' descriptions of chest pain varied from typical to atypical for cardiac ischaemia. Low-risk patients were selected from this group on the basis of initial electrocardiogram (ECG) interpretation by ED attending physician, these initial ECGs were categorized as those that were either normal or had only minor nonspecific repolarization abnormalities. Diagnostic ECGs for acute MI or ischaemia were excluded.

Patients with clinically evident left ventricular dysfunction and those unable to perform a Treadmill Test (TMT) were also excluded. Cardiac enzymes including

*From The Department of Internal Medicine, King Hussein Medical Center, (KHMC), Amman-Jordan
Correspondence should be addressed to Dr. J. Maayah, E-mail jmaayah@hotmail.com
Manuscript received September 4, 2001. Accepted September 12, 2002

Troponin and creatinine kinase-MB (CK-MB) were not measured because they were not available at this level. Therefore the criteria for treadmill testing were: Typical chest pain description, normal ECG or non-specific changes, good left ventricular function and no evidence of significant valve disease on echocardiography.

Exercise Stress Test Protocol

Exercise TMT was performed according to Bruce protocol. End points were 1mm or greater horizontal or down sloping ST depression or ST elevation 80 ms after the J point or decrement in systolic blood pressure of 10 mmHg or more.

Criteria for positive (ischemic) test results were the aforementioned ST changes. A non-diagnostic test was defined as one resulting in a peak heart rate less than 85% of age-predicted maximum.

Treadmill testing was available between 8 am and 4 pm daily, during that period, TMT was done immediately at presentation, however, patients who came late in the evening were admitted and tested the next day.

Therefore the study design included consecutive patients seen in the emergency department (ED) during this interval who fullfilled the inclusion criteria.

Exercise testing was performed by internists serving as attending physicians in the hospital rather than by cardiologists who are consulted whenever needed.

The frequency of true or false positive TMT results was based on the subgroup of patients who underwent further evaluation by coronary angiography (positive >50% reduction in coronary artery lumen diameter).

Results

Four hundred and fifty patients met the study criteria for the TMT.

As indicated Table I, more than 85% of patients had no prior evidence of coronary artery disease (CAD). The males (47.3 years) were younger than the females (49.2 years). No significant differences between men and women in mean number of risk factors were detected.

Table I. Number of patients, age and mean number of cardiac risk factors.

	Total	**Male**	**Female**
Number of patients	450	287	163
Age (years) mean ± SD	48±12.9	47.3±13.7	49.2±11.4
Mean number of cardiac risk factors	1	1	1

Exercise Test

The majority of patients 369 (82%) had negative TMT results, 31 (6.9%) non-diagnostic test and 50 (11.1%) had positive test results. The results of TMT were comparable for men and women: Positive 11.2% for men and 11% for women, negative 83.6% for men and 79.2% for women and non-diagnostic 5.2% for men and 9.8% for women.

Only one patient with a positive test result presented to the emergency department a week later, with acute myocardial infarction, which ended in mild congestive heart failure.

Follow-up data at 30 days were available in 425 (94.4%) with no complication including all patients with a positive test result, 344(76.4%) with negative test result, and all patients with non-diagnostic test results.

Patients with Positive (+ve) TMT

Only 11.1% of patients had positive exercise test results of which more than half were true positives.

Of the 50 patients with positive TMT results, 42 underwent further evaluation by coronary angiography and yielded +ve angiographic results in 31 patients. Eight patients lost follow-up and no information was available after their referral, as the study follow-up is limited to 30 days, the revascularization and recatheterization rate were not available to the authors.

The mean age of all patients with true positive test results was significantly higher than that of all other study patients (59 versus 42) p= 0.05.

Patients with Negative (-ve) TMT

All 369 patients with –ve TMT results were dismissed directly after completion of the test. The mean number of cardiac risk factors in patients with -ve TMT results was lower than in those patients with +ve or non-diagnostic test results P=0.008. There were no significant differences in mean age between patients with negative exercise test results and those with positive or nondiagnostic test results (48.6 versus 46.9) p=0.07.

Patients with Non-diagnostic TMT

Thirty one patients in this group were discharged directly after completion of the test. Although the mean percent of age-predictive maximum heart rate during the TMT was 75%±10%, the majority (62%) attained a heart "rate between 75% - 85%". There were no significant difference between this group and the rest of the study group, in age and mean number of cardiac risk factors.

No significant difference in percent of predicted maximum heart rate (HR) achieved in men and women 77%vs. 74%.

Discussion

This study demonstrates the safety of TMT in a large group of low-risk patients presenting to ED with chest pain.

Low-risk patients with chest pain can be identified by clinical evaluation at the time of presentation [3,4]. Since the early studies of Yusuf *et al* [5] and Brush *et al* [6], the initial ECG is the simplest predictor of subsequent life-threatening events and is probably the most widely used. Clinical experience and research results also suggest that

patients with active pain that is typical of myocardial infarction are also at high risk [7-11].

Brush *et al* demonstrated that a normal or near-normal electrocardiogram (ECG) was associated with a 6% occurrence of serious complication during hospitalization compared to 14% incidence in patients with abnormal ECG.

In a recent study, in which more than 10,000 patients presented to ED with acute chest pain, the group with less than 1% probability of major complication could be distinguished by the initial clinical assessment [10].

Furthermore, among patients hospitalized for suspected MI, a subgroup with a coronary event rate less than 5% could be identified on the basis of history, symptoms, and ECG [12]. The ability to recognize low-risk patients presenting with chest pain has led to alternatives to conventional coronary care for this group, including reduced time in coronary care units [4,13], direct admission to a step-down unit [14,15] and management in short-stay observation units [16,17].

We have used exercise Treadmill testing (TMT) in selected patients, to identify those requiring admission and those who can undergo further evaluation as outpatients.

The present study demonstrates that nearly 90% of patients initially identified as low-risk by clinical assessment [18,19] can be safely discharged from the ED based on the results of the exercise.

Low-risk patients presenting to the ED with chest pain identified by clinical indicators, have a very low coronary event rate, and neither require nor benefit from management in coronary care units [19,20]. Recently published guidelines on the management of unstable angina [20] suggest that low-risk patients (who are similar in clinical characteristics to the patients in this study) can, in many cases, be safely discharged from the ED and managed as outpatients. Our results suggest that TMT in selected patients with acute chest pain is safe despite the possibility of testing patients with unrecognized MI or ischaemia.

To maximize the safety of this method, two components are mandatory: Appropriate selection of low-risk patients, and high levels of skill and experience in performing and interpreting treadmill exercise testing.

Exercise testing in the outpatient setting has proven to be very safe, with a reported complication rate 8 per 10.000 tests [21]. Many patients undergoing such testing have had acute symptoms and are subsequently found to have severe CAD. Although we used conventional criteria to define a non-diagnostic exercise (no ischemic ECG alterations at peak heart rate <85% of age-predicted maximum), this definition may not be appropriate when the test is used to exclude ischemia, in contrast to its standard application for detecting CAD in patients in stable condition.

More than 50% of our patients with non-diagnostic exercise test results reached heart rates in excess of 75% of predicted maximum. The lack of ECG evidence of ischemia at these heart rates is consistent with absence of an acute ischemic process in a group with a very low pretest probability of active myocardial ischemia.

Therefore, we believe that patients without ischemic ECG changes at exercise rates in excess of 75% of age-predicted maximum may frequently not require hospitalization.

Because serial ECG and cardiac enzymes testing were not performed, unstable angina or MI may not have been recognized in some individuals. However, it is unlikely that a serious cardiac event was overlooked in these low-risk patients since there were no major morbid events during the follow-up period.

Limitations of this Study

1. It is a hospital-based study where you cannot generalize the results.
2. The study was conducted over a short time period.
3. Patient selection was not randomized; sophisticated investigations can replace the traditional methods regarding safety, efficacy, sensitivity, cost of equipment and manpower.
4. Future studies are needed with different study design where updated diagnostic tools are available.

Conclusion

Treadmill exercise testing in good and experienced hands can provide a safe and reliable method for risk stratification of patients presenting to the ED with chest pain into those requiring admission and those who can be discharged and undergo further management as out-patients, where other recent diagnostic tools are utilized.

This will improve the utilization of monitored beds, and afford vital cost saving.

References

1. **American Heart Association:** AHA Hospital Statistics, 1993-1994. Chicago: American Hospital Association, 1994.
2. **Kerns JR, Shaub TF, Fontanarosa PB.** Emergency cardiac stress testing in the evaluation of emergency department patients with atypical chest pain. *Ann Emerg Med* 1993 22(5): 794-798
3. **Lee TH, Rouan GW, Weisberg MC, *et al*.** Sensitivity of routine clinical criteria for diagnosing myocardial infarction within 24 hours of hospitalization. *Ann Intern Med* 1987; 106: 181-186.
4. **Mulley AG, Thibault GE, Hughes RA, *et al*.** The course of patients with suspected myocardial infarction: The identification of low-risk patients for early transfer from intensive care. *N Engl J Med* 1980; 302: 943-948.
5. **Yusuf S, Pearson M, Sterry H, *et al*.** The entry ECG in the early diagnosis and prognostic stratification of patients with suspected acute myocardial infarction. *Eur Heart J* 1984; 5(9): 690-696.
6. **Brush JE, Brand Da, Acampora D, *et al*.** Use of the initial electrocardiogram to predict in-hospital complication of acute myocardial infarction. *N Engl J Med* 1985; 312(18): 1137-1141.

7. **Braunwald E, Jones RH, Mark DB, et al.** Diagnosing and managing unstable angina. *Agency for Health Care Policy and Research Circulation* 1994; 90(1): 613-622.
8. **Calvin JE, Klein LW, VandenBerg BJ, *et al*.** Risk stratification in unstable angina. Prospective validation of the Braunwald classification. *JAMA* 1995; 273(2): 136-141.
9. **Fesmire FM, Wears RL.** The utility of the presence or absence of chest pain in patients with suspected acute myocardial infarction. *Am J Emerg Med* 1989; 7(4): 372-377.
10. **Goldman L, Cook EF, Johnson PA, *et al*.** Prediction of the need for intensive care in patients who come to emergency department with acute chest pain. *N Engl J Med* 1996; 334: 1498-1504.
11. **Zalenski RJ, Sloan EP, Chen EH, *et al*.** The emergency department ECG and immediately life-threatening complication in initially suspected myocardial ischemia. *Ann Emerg Med* 1988; 17(3): 221-226.
12. **Lee TH, Cook EF, Weisberg M, *et al*.** Acute chest pain in the emergency room: Identification and examination of low-risk patients. *Arch Intern Med* 1985; 145(1): 65-69.
13. **Weingarten S, Ermann B, Bolus R, *et al*.** Early" step-down" transfer of low-risk patients with chest pain. A controlled interventional trial. *Ann Intern Med* 1990; 113(4): 283-289.
14. **Fineberg HV, Scadden D, Goldman L.** Care of the patients with a low propability of acute myocardial infarction: Cost effectiveness of alternatives to Coronary-Care- Unit admission. *N Engl J Med* 1984; 310: 1301-1307.
15. **Feibach NH, Cook EF, Lee TH, *et al*.** Outcomes in patients with myocardial infarction who are initially admitted to a step-down units: Data from the multicenter chest pain study. *Am J Med* 1990; 89(1): 15-20.
16. **Gaspoz JM, Lee TH, Weinstein MC, *et al*.** Cost effectiveness of a new short-stay unit to "rule out" acute myocardial infarction in low-risk patients. *J Am Coll Cardiol* 1994; 24(5): 1249-1259.
17. **Gilber WB, Runyon JP, Levy RC, *et al*.** A rapid diagnostic and treatment center for patients with chest pain in the emergency department. *Ann Emerg Med* 1995; 25: 1-8.
18. **Pozen MW, D'A Agostino RB, Selker HP, *et al*.** A predictive instrument to improve coronary -care- unit admission practices in acute ischemic heart disease: A prospective Multicenter clinical trial. *N Engl J Med* 1984; 310(20): 1273-1278.
19. **Rutledge JC, Amsterdam EA.** Differential diagnosis and clinical approach to the patient with acute chest pain. *Cardiol Clin* 1984; 2: 257-268.
20. **Lewis WR, Amsterdam EA.** Evaluation of the patient with "rule out myocardial infarction". *Arch Intern Med* 1996; 156(1): 41-45.
21. **Gibbons L, Blair SN, Kohl HW, *et al*.** The safety of maximal exercise testing. *Circulation* 1989; 80: 846-852.
22. **Hilton TC, Thompson RC, Williams HJ, *et al*.** Technetiun-99m sestamibi myocardial perfusion imaging in the emergency room evaluation of chest pain. *J Am Coll Cardiol* 1994; 23(5): 1016-1022.
23. **Sabia P, Abbott RD, Afrookteh A, *et al*.** Importance of two-dimensional echocardiographic assessment of left ventricular systolic function in patients presenting to the emergency room with cardiac-related symptoms. Circulation 1991; 84(4): 1615-1624.
24. **Tatum JL, Jesse RL, Kontos MC, *et al*.** Comprehensive strategy for the evaluation and triage of the chest pain patient. *Ann Emerg Med* 1997; 29(1): 116-125.
25. **Varetto T, Cantalupi D, Altieri A, *et al*.** Emergency room Technetium-99m sestamibi imaging to rule out acute myocardial ischemic events in patients with non-diagnostic electrocardiograms. *J Am Coll Cardiol* 1993; 22(7): 1804-1808.