Treadmill Testing Two Weeks After Myocardial Infarction: Comparison With Late Retesting.

By

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Introduction

Recently experimental studies have been published wherein treadmill exercise testing prior to discharge after acute myocardial infarction has been performed in order to obtain guidelines for individual rehabilitation, exericse prescription and identification of high risk patients (2, 3, 5, 7). In Pakistan because of pressing economic problems, most working class patients with acute infarction restart work immediately after discharge or immediately aftr leaving the hospital against medical advice as soon as they are pain free. We therefore undertook the project of symptom limited exercise testing prior to discharge in patients with uncomplicated acute myocardial infarction. The objectives were, firstly to establish the safety and work capacity of these patients, secondly to provide data for comparison with testing later after a longer conventional period, and, lastly to provide data for future identification of prognostic indexes.

Materials and Methods

Subjects: These were consecutive male patients with new acute transmural infarction according to WHO criteria admitted to the NICVD (Pakistan). These patients had been allowed to use the bathroom from day 2 and were fully ambulated from day 5 onwards. Only those patients were selected who on day 5 after infarction were free of any kind of chest pain, arrythmias, evidence of failure in the absence of anti-failure treatment, had a normal chest X-ray and were free of any other serious systemic disease. The first 40 patients of this ongoing project started in mid 1978 who have completed their later re-testing form the basis of this report.

Initial Exercise Testing (*ETT* 1):

The early symptom limited exercise test (ETT1) was performed on day 14 after infarction with the patient in the post absorbtive state. The treadmill exericse was carried out according to the NICVD protocol, a continuous exercise protocol with each 3 minute stage having approximately half the work load of Bruce protocol. All patients had a repeat 12 lead resting ECG, and a set of tissue enzymes 24 hours later. During exercise a CM5 lead was momitored and 12 lead ECG's were done immediately after, after 5 minutes and 10 minutes after exercise.

Late Retesting (*ETT* 2):

After a period of rehabilitation and return to full time work all 40 patients were subjected to a repeat symptom limited exercise test using the same NICVD exercise protocol. None of these subjects had in the period between the initial and later treadmill test been enrolled in any

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exercise programme and were instructed to resume normal activities as prior to their infarction. ETT 2 was performed a mean interval of 7.2±2.3 months after the acute infarction.

Results (Table I):

Clinical Characteristics:

All patients were males. Mean age of patients at time of infarction was 51 years (SD± 7 years). 26 patients (65%) had an anterior myocardial infarction and 14 patients (35%) had an inferior myocardial infarction. At the time of ETT I no patient was on digoxin, diuretics or beta blockers. At the time of ETT 2 only one patient was on digoxin, 4 patients were on diuretics and 5 patients were on beta-blockers. No patient had suffered a recurrent myocardial infarction nor had been hospitalized.

Treadmill Exercise Time:

The mean duration of exercise during ETT 1 was 12.6 minutes (S.D. ± 5.3 minutes). The mean duration of exercise during ETT 2 was 15.5±7.4 minutes. There was thus a significant increase in ETT duration from ETT 1 to ETT 2*.

Heart rate and Blood Pressure Response:

The mean resting heart rate at the time of ETT 1 was 78±15 beats/minutes and 68±15 beats/minute at the time of ETT 2 .The mean maximum heart rate during ETT 1 was 125±24 beats/minute and 126 ± 26 beats/minute during ETT 2. While there was no significant different in the maximum heart rate achieved between that at ETT 1 and that at ETT 2, there was a significant difference* between the resting heart rates. There was therefore a significant increase in heart rate from resting to maximum during ETT 2 compared to ETT 1.

The mean maximum systolic B.P. during ETT 1 was 134±29 mmHg. While that during ETT 2 was 150±28 mmHg. There was thus a significant increase in the maximum systolic B.P. during ETT 2*.

E.C.G. changes: During ETT1, 12 patients showed ST depression equal to or greater than 1 mm, whereas 9 patients showed such ECG changes during ETT2**. ST elevation equal to or greater than 1 mm was not seen in the monitoring CM5 lead during ETT1 but was seen in 1 patient during ETT2**.

Very few arrythmias were encountered during both the exercise tests and consisted of isolated rare PVC's in 2 patients during ETT1 and in 3 patients during ETT2. No other arrythmia or complex or early diastolic PVC's were noted.

The R wave height in the monitoring lead CM5 increased with increasing exercise in 4 patients during ETT1 and 4 patients during ETT2. R wave height remained the same during exercise in 3 patients during ETT1 and 1 patient during ETT2.

Symptoms during exercise:

During ETT1 exercise was terminated due to fatigue and/or dyspnea in 28 patients and due to Angina in 12 patients. During ETT2 exercise was discontinued due to fatigue or dyspnea in 29 patients and due to angina in 11 patients. No patient experienced prolonged chest pain and all anginal episodes subsided spontaneously or immediately after sublingual nitroglycerine. No patient experienced any new symptoms in the first 24 hours after the exercise tests and a set of tissue enzymes done 24 hours after exercise were normal in all patients.

*$p < 0.05$ **$p > 0.05$

Table I

Treadmill Characteristics	*ETT1*	*ETT2*
Mean ETT duration (minutes)	12.6± 5.3	15.5± 7.4*
Mean resting H.R. (beats/minute)	78± 15	68± 15*
Mean maximum H.R. (beats/minute)	125± 24	126± 26
Meam maximum systolic B.P. (mmHg)	134± 29	150± 28*
Drop in B.P. or failure to rise	9 pts	6 pts
ST-depression≥ 1 mm	12 pts	11 pts
ST-elevation≥ 1 mm		1 pt
Arrythmia (Isolated PVC's only)	2 pts	3 pts
R wave height in CM5 increased	4 pts	4 pts
R wave height fail to decrease in CM5	3 pts	1 pts
ETT stopped due to Angina	12 pts	11 pts
Prolonged pain/Infarction post ETT	None	None

Discussion

The utility of graded exercise testing several weeks or months after acute myocardial infarction has been established (8). Attempts are being made to establish the safety and utility of single exercise testing soon after uncomplicated acute myocardial infarction (1). It has been claimed that early exercise testing is safe, provides useful information that can be used for future prognostication, helps in the psychological and physical rehabilitation and provides objective evidence on which to base the post-infarction activity prescription (2, 3, 4, 5, 7). The demonstration of the safety and utility of such an approach in the Pakistani population required that a study such as ours be carried out in our population.

The results of our study provide interesting observations for comparison with studies done in other populations. As expected, there was a degree of deconditioning soon after infarction even in fully ambulated patients. This was reflected in the higher resting heart rate at the time of ETT1 and the lower maximum systolic B.P. and lesser treadmill duration time. It was intriguing that in our group there was no significant difference between maximum heart rate achieved in ETT1 versus ETT2. This is really not surprising as both exercise tests were symptom limited and there is no evidence to suggest a blunting of maximum heart rate response soon after infarction. As the resting heart rates were lower later on at the time of ETT2 therefore, the increase in heart rate from resting to maximum was greater during ETT2. While evaluating the functional capacity of our patients, all of whom happened to be sedentary individuals, it must be kept in mind that the exercise protocol in use at our Institute has about half the work load of Bruce protocol at each 3 minute stage. Our observations regarding exercise capacity are similar to those in the western population (6).

The ECG changes noted were remarkably similar between ETT1 and ETT2 in that while 12 patients had ST depression equal to or greater than 1 mm during ETT1, 11 of them had such changes during ETT2, ST elevation during exercise was not seen in the monitoring lead CM5 during ETT1 and only in 1 patient during ETT2. This contrasts with observation of other investigators (10). It is possible that as only a single lead was monitored during exercise, other leads may have shown such ST elevation which was missed by us. On the other hand we did see in the cases with anteroseptal infarction an increase in the elevated ST segment of the right sided chest lead along with a ST segment depression in the lateral chest leads. This was interpreted as reciprocal ST elevation

and the response was noted as ST depression and not ST elevation. Our patients were remarkably free of arrythmias during both the exercise tests which contrasts with the experience of others (9, 11). We can offer no explanation for this except perhaps stricter patient selection and other unknown factors. The increase in R wave amplitude and the failure of the R wave amplitude to decrease was noted in 7 patients during ETT1 and 5 patients during ETT2 but did not correlate with any other parameter like ocurrence of symptoms or drop in systolic B.P. or ST segment change.

Most patients discontinued exercise because of fatigue or dyspnea. Of the 12 patients who stopped due to anginal pains during ETT1 10 had ST segment changes whereas 10 patients who had Angina during ETT2 showed ST changes with 9 having ST depression and 1 ST elevation.

No complication was encountered in any patient during or after the exercise tests which can be said to be safe at least in these selected group of patients. All 40 patients had returned to full time employment and were leading a normal sedentary life at the time of ETT2 as they were prior to their infarction. In the time interval between ETT1 and ETT2 none in the group had a re-infarction or a re-hospitalization for any cardiac problem and of course all were alive. This good a clinical course may again reflect a strict selection or a better natural history. As the study is ongoing, only a later analysis will reveal the true long term prognosis of these patients and identify parameters recorded during ETT1 and ETT2 wich may serve as useful predictors of prognosis. Since ETT1 can be performed safely in selected patients and because besides many other claimed advantages it provides information similar to ETT2, early treadmill testing may in such patients replace the conventional exercise test done several weeks or months after acute infarction.

Summary

40 patients with uncomplicated transmural acute myocardial infarction were exercised 14 days after infarction (ETT1) and retested a mean interval of 7.2±2.3 months later (ETT2) in order to establish safety and utility of ETT1.

Mean ETT duration was 12.6±5.3 minutes during ETT1 and 15.5±7.4 minutes during ETT2. Mean resting heart rates at the time of ETT1 was 68±15 beats per minute and 78±15 beats per minute at the time of ETT2. Mean maximum heart rate achieved was 125±24 beats per minute during ETT1 and 126±26 beats per minute during ETT2. Mean maximum systolic B.P. was 134±29 mmHg during ETT1 and 150±28 mmHg during ETT2. During ETT1 9 patients (22.5%) and during ETT2 6 patients (15%) had a drop in B.P. or the B.P. failed to rise. 12 patients (30%) had ST depression equal to or greater than 1 mm during ETT1 whereas 9 patients (22.5%) had such changes during ETT2. No patient during ETT1 and 1 patient (2.5%) during ETT2 had ST elevation equal to or greater than 1 mm. Rare isolated PVC's were seen in 2 patients (5%) during ETT1 and in 3 patients (7.5%) during ETT2. The R wave height increased during ETT1 in 4 patients (10%) failed to decrease in 3 patients (7.5%) and during ETT2 this was seen in 4 patients (10%) and 1 patient (2.5%) respectively. Angina occurred in 12 patients (30%) during ETT1 and in 11 patients (27.4%) during ETT2.

No patient developed prolonged chest pain or had any evidence of myocardial necrosis after exercise testing. In conclusion, in selected patients ETT1 is safe and except for a decreased exercise tolerance there is no significant difference in the information obtained during ETT1 from that obtained during ETT2.

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