Research Article

Interpretation of computerised exercise stress test in symptomatic subjects referred for cardiac evaluation

Pravin N Soni[1*], Kulkarni D A[2]

[1]Associate Professor, Department of Medicine, IIMS and R Warudi, Jalna, Maharashtra, INDIA.
[2]Medical Office, Vaijpur, Aurangabad, Maharashtra, INDIA.
Email: dilipk.63@gmail.com, drpravinsoni18@gmail.com

Abstract

Introduction: Coronary artery disease (CAD) is one of the common causes of morbidity and mortality all over the world. Its first clinical manifestation is acute myocardial infarction or sudden death .which has evolved slowly over many years without notable clinical manifestations. Detection of its presence at an early stage is essential in order to slow the evolution of disease. The value of electrocardiographic stress test as a non-invasive screening procedure for early detection of asymptomatic coronary heart disease or ischemia. **Aims and Objectives:** The present study was carried out in the department of medicine Government medical college and Hospital, Aurangabad to analyze the computerized stress test for – ischemia. **Material and Methods:** Patient referred for any reason included in study . A detailed history with clinical examination was carried out according to proforma. Computerized Treadmill Schiller's Cardiovit CS-200 system was used for exercise test. **Summary and Conclusions:** Out of 100; 17 subjects grouped as positive test group having ST depression. 83 subjects who had no ST depression grouped together as negative test group. Amongst the ECG parameters, as duration of ST segment depression, time of onset of ST segment depression, leads showing ST segment depression, 'R' wave amplitude, QTc interval were significantly associated with a positive stress test, said to have coronary artery disease. Non-ECG parameters were significantly associated with positive stress test and parameters as delta heart rate, heart rate had no relation with the positivity of stress test.
Keyword: Computerized Stress Test.

[*]**Address for Correspondence:**
Dr. Pravin N. Soni, Associate Professor, 16, New Shrinathnagar, Opposite SFS, Jalna Road Aurangabad, Maharashtra, INDIA.
Email: drpravinsoni18@gmail.com
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INTRODUCTION

Coronary artery disease (CAD) is one of the common causes of morbidity and mortality all over the world. Frequently its first clinical manifestation is acute myocardial infarction or sudden death the result of advanced coronary arteriosclerosis, which has evolved slowly over many years without notable clinical manifestations. Detection of its presence at an early stage is essential in order to slow the evolution of disease by such preventive measures as diet, exercise, drug therapy (Bellet S, 1967) In the light of these considerations, a simple, objective means of detecting latent coronary artery disease is of utmost importance. With the advent of graded exercise testing and selective coronary arteriography , identification of the patient with the severe coronary artery disease who is at risk for a major cardiovascular event has become a prime diagnostic goal By delineating advanced degrees of coronary disease, coronary arteriography has proved to be one means by which future coronary events might be predicted, the inconvenience, expense and potential danger of this invasive procedure, however, militate its use, as a selective procedure (Goldschlager N *et al*, 1976) Prognostication of coronary events from response to exercise (stress) testing therefore seems a reasonable alternative. The electrocardiographic exercise test is the most easily applicable and frequently used method available today in the diagnosis of latent coronary heart disease Modern stress testing is based upon the empirical discovery that exercise in patients with coronary artery disease (CAD) produces ST segment depression. The

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discovery might be credited to Bousfield in 1918 Master and oppenheimer (1929) published first paper on exercise test in 1929. Rober Bruce of seatle made the greatest contribution to the technique of stress testing whose protocol is the standard in most laboratories in the United States. Many other workers made major contributions to the understanding of stress testing (Ellestad M 2003) The value of electrocardiographic stress test as a non-invasive screening procedure for early detection of asymptomatic coronary heart disease is well established with a variable sensitivity and specificity depending upon criterion taken. The exercise electrocardiographic test undergone extensive modifications with the increase in knowledge of the disease and progress in medical instrumentation, which includes the application of computer technology towards evaluation of the electrocardiographic signals (Ellestad M 2003) The interpretation of stress testing has been largely quantitative the principle aim of the procedure being the production of myocardial ischemia, and by implication, the diagnosis of coronary artery disease. Despite criticism, the exercise test remains widely used in the evaluation of chest pain syndromes. The present study designed to analyse the various ECG and non-ECG parameters and their usefulness in interpretation of exercise test

AIMS AND OBJECTIVES

The present study was carried out in the department of medicine Government medical college and Hospital, Aurangabad to analyse the computerized stress test for –

a) The incidence of inducible and reversible ischaemia
b) The significance of various other parameters in the diagnosis of ischemia in interpretation of exercise test-

ECG Parameters

1. Time of onset of ST segment depression
2. Duration of ST segment depression
3. Leads showing ST segment depression
4. R wave amplitude
5. QRS Score (Athen's Score)
6. QX/QT Ratio
7. QT c interval

Non -ECG Parameters

1. Duration of exercise
2. Double product
3. Delta heart rate
4. Heart rate recovery at end of one minute of exercise
5. Anginal score

MATERIAL AND METHODS

This study was conducted in the Department of Medicine at Government Medical College and Hospital, Aurangabad during the period from September, 2001 to August 2004.

Selection of Subjects

The subjects referred for computerized stress test during the period for various reasons comprised the material for the present study. From these, the subjects were selected according to the criterion given below:

Criterion for exclusion

1. Those having ST-T changes in electrocardiogram recorded at rest.
2. History and/or ECG changes suggestive of myocardial infarction.
3. Receiving medications known to affect heart rate rhythm such as beta-blockers, vasopressor, digitals, thyroid harmones, antiarrhythmic drugs as amiodarone, quinidine, lidocaine, mexilletine, phenytoin, flecainide etc.
4. History suggestive of acute illness as infection, severe anaemia, hyperthyroidism.
5. Subjects with locomotion problems.
6. Having left bundle branch block, left ventricular hypertrophy.
7. Having valvular or congenital heart disease.
8. Having diastolic BP more than 100 mmHg at rest.
9. Not attained at least 85% of target heart rate during exercise.
10. Having significant respiratory disease of any etiology.
11. Having acute myocarditis or pericarditis.
12. Those diagnosed to have cardiomyopathy.
13. Subjects with cardiac failure.
14. Subjects with ventricular of atrial arrhythmias at the time of test.

STATISTICAL ANALYSIS

The parameters were compared between positive and negative test groups. Statistical analysis was performed using Chi-square test. Chi square analysis with Yate's correction was also used to evaluate 2 by 2 contingency tables. Differences were considered significant at a 'p' value of ≤ 0.05.

OBSERVATIONS AND RESULTS

The present study comprised of 100 subjects who underwent computerized stress test (CST) of Government Medical College and Hospital, Aurangabad during the period from September 2001 to August 2004. Those who fulfilled the criteria for inclusion and achieved at least 85% of target heart rate (THR) were only included for the analysis. Of these 100 subjects, 17 subjects who had ST

segment depression of 2.00 mm or more were taken positive for CST and comprised test "positive group" and the rest 83 subjects who had no ST segment depression or ST segment depression of less than 2.00 mm comprised the "negative group". Various parameters were then analysed and compared between these two groups.

Table 1: Age distribution of 100 studied subjects

Age in yrs.	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
21 – 30	01 (5.88)	09 (10.84)	10
31 – 40	04 (23.52)	20 (24.09)	24
41 – 50	05 (29.41)	32 (38.55)	37
51 – 60	03 (17.64)	16(19.27)	19
>60	04 (23.52)	06 (7.22)	10

(Figures in bracket indicate percentage)

Table 2: Sex distribution of 100 studied subjects

Sex	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
Male	13 (76.47)	65 (76.31)	78
Female	04 (23.52)	18 (21.68)	22

(Figures in bracket indicate percentage)

Table 3: Distribution of risk factors for coronary artery disease in studied subjects

Risk factors	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
No risk factors	02 (11.76)	56 (67.46)	58
Hypertension	12 (70.58)	20 (24.09)	32
Smoking	07 (41.17)	06 (7.22)	13
Diabetes	00	03 (3.61)	03

(Figures in bracket indicate percentage)

Table 4: Distribution of subjects according to number of risk factors for coronary artery disease

Number of risk factors	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
0	02 (11.76)	56 (67.46)	58
1	11 (64.70)	25 (30.12)	36
2	04 (23.52)	02 (2.4)	06

(Figures in bracket indicate percentage)

Table 5: Distribution of subjects according to duration of exercise

Duration of exercise	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
< 3 minutes	02 (11.76)	00	02
3 – 5.59 minutes	09 (52.94)	27 (32.53)	36
6 – 8.59 minutes	03 (17.64)	47 (56.62)	50
≥9 minutes	03 (17.64)	09 (10.84)	12

(Figures in bracket indicate percentage)

Table 6: ST segment depression magnitude in studied subjects

ST depression in mm	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
No ST depression	00	49	49
0.05 to 1.00	00	22	22
1.00 to < 2.00	00	12	12
≥2.00	17	00	17

Table 7: Distribution of subjects according to time required to produce st depression

Time required to produce ST epression	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
No ST depression	00	49 (59.03)	49
≤3 minute	10 (58.83)	20 (24.09)	30
>minutes	07 (41.17)	14 (16.86)	21

(Figures in bracket indicate percentage)

Table 8: Distribution of subjects according to leads showing st depression

Leads showing ST depression	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
No ST depression	00	49 (59.03)	49
Inferior	00	17 (20.48)	17
Infero-lateral	12 (70.50)	17 (20.48)	29
Antero-lateral inferior	5 (29.41)	00	5

(Figures in bracket indicate percentage)

Table 9: Distribution of subjects according to change in r-wave amplitude

R-wave amplitude	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
Increased	12 (70.58)	28 (33.73)	40
Decreased	05 (29.41)	47 (56.62)	52
No change	00	08 (9.63)	08

(Figures in bracket indicate percentage)

Table 10: Distribution of subjects according to heart rate recovery at the end of one minute of exercise

Heart rate recovery at the end of one minute of exercise	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
$\leq$ 18	02 (11.76)	08 (9.63)	10
>18	18 (88.23)	75 (90.35)	90

(Figures in bracket indicate percentage)

Table 11: Distribution of subjects according to anginal score

Angina score	Positive Test Group (n=17)	Negative Test Group (n=83)	Total (n=100)
< - 11	08 (47.05)	00	08
-11 to + 5	09 (52.94)	45 54.21)	54
> +5	00	38 (45.78)	38

(Figures in bracket indicate percentage)

SUMMARY AND CONCLUSIONS

The present study comprised of 100 subjects (78 male and 22 female) who were referred for exercise test, were subjected to computerized treadmill exercise test, with criteria of ST segment depression of more than or equal to 2.00 mm at 80 msec from J junction, said to have positive test, so as to have CAD, which comprised 17 subjects grouped as positive test group. The remaining 83 subject who had no ST depression or ST segment depression of less than 2.00mm were considered as negative for exercise test and grouped together as negative test group. Amongst the ECG parameters, as duration of ST segment depression, time of onset of ST segment depression, leads showing ST segment depression, 'R' wave amplitude, QTc interval were significantly associated with a positive stress test, said to have coronary artery disease and the parameters as QRS score, QX/QT ratio had no relation with positivity of stress test. Other (non-ECG) parameters as exercise duration, anginal score were significantly associated with positive stress test and parameters as double product, delta heart rate, heart rate recovery at the end of one minute of exercise, had no relation with the positivity of stress test. The studied parameters are summersied in the following table.

Table 12

Sr. No.	Parameters	Positive Test Group(n=17)	Negative Test Group (n=83)	Significance
1	Mean age in years	50 $\pm$ 12	45 $\pm$ 11	NS
2	Sex (M:F ratio)	3.25 : 1	3.61 : 1	NS
3	Mean exercise duration in minutes	5 $\pm$ 2	6.21 $\pm$ 2.20	S
4	Mean duration of ST segment depression (min)	7 $\pm$ 2	5 $\pm$ 3	S
5	Mean time of onset of ST segment depression (min)	4 $\pm$ 2	4 $\pm$ 1.4	S
6	Increase in R-wave amplitude	70.58%	33.73%	S
7	QRS score of $\leq$ 5 mm	88.23%	91.56%	NS
8	Decrease in QTc interval	17.64%	2.4%	S
9	Double product $\leq$ 25000	52.94%	40.96%	NS
10	Mean delta heart rate	50 $\pm$ 14	68 $\pm$ 18	NS
11	Heart rate recovery at the end one minute of exercise < 18 beats/min	11.76%	9.63%	NS
12	Anginal score of $\leq$ + 5	100.0%	54.21%	S

S = Significant; NS = Not significant

Thus, from the present study we recommend that while interpreting stress test, apart from ST segment changes, still considered as gold standards, analysis of additional parameters may be useful for the diagnosis and probably prognosticating coronary events in future.

DISCUSSION

Coronary artery disease (CAD) Is one of the common causes of morbidity and mortality all over the world .The detection of disease when it becomes symptomatic is easy but in most of the individuals it remains asymptomatic before manifesting as a catastrophy. The value of electrocardiographic stress test as a non-invasive procedure for early detection of asymptomatic coronary artery disease is well established with a variable sensitivity and specificity depending upon criteria taken (Ellestad M,2003) Exercise stress testing has received much attention in recent years with the principal focus of interest being its predictive power. Among asymptomatic individuals, those with an abnormal ECG response during exercise have a substantial higher risk of developing manifest coronary heart disease then those with a normal ECG response In the present study 100 subjects underwent routine exercise. Only those subjects, who had no ST changes at resting ECG, no history of myocardial infarction, ischemic heart disease arrhythmia, no any cardiovascular, pulmonary disease and who attained target heart rate of at least 85% of predicted maximal heart rate, were selected under study, which included 100 subjects

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