



DIAGNOSTIC USEFULNESS OF EXERCISE TREADMILL TEST IN PATIENTS OF CHEST PAIN WITH NORMAL ECG.

General Medicine

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ABSTRACT

Background: The incidence and prevalence of CAD has increased tremendously in India during the last two decades and this change is largely attributable to lifestyle changes. India has reportedly shown the highest burden of acute coronary syndromes in the world.

Objective: To determine diagnostic usefulness of Exercise Treadmill Test in Patients of chest pain with normal ECG.

Method: Based on inclusion and exclusion criteria, a cross-sectional study was carried out on symptomatic chest pain patients having normal ECG and attending Medicine department of SRG hospital during study period. They were subjected to laboratory evaluation for chest pain by routine and special investigation like ECG and treadmill exercise test.

Result: Among the 114 enrolled participants, age varies from 21 years to 79 years. Mean age of study participants was 49.95 ± 12.38 year. Chest pain was commonly found in male (80, 70.18%) as compare to female (34, 29.82%). Out of 114 cases of chest pain with normal ECG who were subjected for treadmill exercise test, 36 (31.58%) were found positive. Statistical significant association of positive treadmill exercise test was found with age ($p=0.02$), gender ($p=0.03$), and BMI ($p=0.01$).

Conclusion: Approx one third patients of chest pain with normal ECG were found positive for treadmill exercise test. Significant difference in mean value of various parameters such as BMI, SBP, triglyceride and LDL was observed among treadmill exercise test positive and negative participants.

KEYWORDS

Chest pain, ECG, Exercise Treadmill Test.

INTRODUCTION:

Coronary artery disease (CAD), also known as coronary heart disease (CHD) or ischemic heart disease (IHD), involves the reduction of blood flow to the heart muscle due to build-up of plaque in the arteries of the heart.¹⁻³ It is the most common type of cardiovascular diseases.⁴ Out of 17.9 million deaths from CVDs in 2016, over 75% of CVD deaths take place in low and middle-income countries where raised blood pressure happens to be amongst the most important risk factors for CVDs.⁵ It may affect individuals at any age but becomes dramatically more common at progressively older ages, with approximately a tripling with each decade of life. Males are affected more often than females.⁶

It is estimated that 60% of the world's cardiovascular disease burden will occur in the South Asian subcontinent despite only accounting for 20% of the world's population. This may be secondary to a combination of genetic predisposition and environmental factors. In 2016 India reported 63% of total deaths due to NCDs, of which 27% were attributed to CAD. Coronary artery disease also account for 45% of deaths in the 40-69 year age group.^{5,7}

The incidence and prevalence of CAD has increased tremendously in India during the last two decades and this change is largely attributable to lifestyle changes.⁸ India has reportedly shown the highest burden of acute coronary syndromes in the world.⁹

Often, there are no symptoms of the underlying disease of the blood vessels. For many people, the first clue that they have CAD is a heart attack and represented by chest pain radiating to shoulder and left arm.¹⁰

Diagnosis of acute CAD is based on history of acute chest pain in conjunction with ECG criteria and laboratory findings.

ECG is still the most readily available and remains a crucial tool in the identification and management of acute CAD. A detailed analysis of patterns of ST segment elevation may influence decisions regarding the use of reperfusion therapy.^{11,12}

Exercise stress testing, which is now widely available at a relatively low cost, is currently used most frequently to estimate prognosis and determine functional capacity, to assess the probability and extent of coronary disease, and to assess the effects of therapy.¹³

Although ECG changes are not remarkable or found normal in many CAD patients. In such cases, diagnosis will be delay and that will be reason for inappropriate treatment in such patients. Considering the severity of disease, early diagnosis and treatment is crucial for survival and quality of life. Against these backgrounds, the present study will be carried out to determine diagnostic utility of Exercise Treadmill Test in patients of chest pain with normal ECG.

OBJECTIVES:

1. To determine proportion of abnormal Exercise Treadmill Test among patients of chest pain having normal ECG.
2. To determine diagnostic usefulness of Exercise Treadmill Test in these patients.

MATERIAL & METHODOLOGY:

Based on inclusion and exclusion criteria, a cross-sectional study was carried out on symptomatic chest pain patients having normal ECG and attending Medicine department of SRG hospital during 1 January to 31 December 2020. Individual patient information was collected in pre-designed proforma.

Inclusion Criteria:-

1. Symptomatic patients of chest pain having normal ECG.
2. Age >18 years.
3. Patients willing to participate in study without compulsion.

Exclusion Criteria:-

1. Diagnosed case of CAD or undergone coronary intervention.
2. Patients having abnormal ECG.
3. Seriously ill patients (Severe systemic disease or condition, bed ridden or comatose patients, psychiatric illness etc)
4. Physically challenged patients (Not able to walk on treadmill).
5. Patients not willing to participate in study.

Data Collection:

First, all the study participants were explained in detail about the purpose and methodology of the study, potential risk and benefit. Thereafter, the participant information sheet was explained to each participants and written consent was obtained. Each interview began with a general discussion to build rapport with the participants and gain their confidence. Thereafter selected patients were undergone through detail history (socio-demographic profile, personal and past history, disease history like symptoms, duration, family history, addiction and

dietary history etc) and thorough clinical examination (general and systemic examination, anthropometry, vitals etc.) under the supervision of experience faculties.

They were subjected to laboratory evaluation for chest pain by routine and special investigation like ECG and treadmill exercise test. Patients with chest pain and normal ECG were enrolled in study. All the information was reported in individual case proforma.

Electrocardiogram:¹⁴

The electrocardiogram (ECG or EKG) is a graphic recording of electric potentials generated by the heart. The signals are detected by means of metal electrodes attached to the extremities and chest wall and are then amplified and recorded by the electrocardiograph. ECG leads actually display the instantaneous differences in potential between these electrodes. The 12 conventional ECG leads record the difference in potential between electrodes placed on the surface of the body. These leads are divided into two groups: six limb (extremity) leads and six chest (precordial) leads. The limb leads record potentials transmitted onto the frontal plane and the chest leads record potentials transmitted onto the horizontal plane. The six limb leads are further subdivided into three standard "bipolar" leads (I, II, and III) and three augmented "unipolar" leads (aVR, aVL, and aVF). Each standard lead measures the difference in potential between electrodes at two extremities: lead I = left arm – right arm voltages, lead II = left leg – right arm, and lead III = left leg – left arm. The unipolar leads measure the voltage at one locus relative to an electrode (called the central terminal or indifferent electrode) that has approximately zero potential. Thus, aVR = right arm, aVL = left arm, and aVF = left leg (foot). The right leg electrode functions as a ground. The spatial orientation and polarity of the six frontal plane leads is represented on the hexaxial diagram. Together, the frontal and horizontal plane electrodes provide a three-dimensional representation of cardiac electrical activity. Each lead can be likened to a different camera angle "looking" at the same events—atrial and ventricular depolarization and repolarization—from different spatial orientations. The conventional 12-lead ECG can be supplemented with additional leads under special circumstances such as right precordial leads V3R, V4R, etc., are useful in detecting evidence of acute right ventricular ischemia. Bedside monitors and ambulatory ECG (Holter) recordings usually employ only one or two modified leads.

Technique Of Treadmill Test:¹⁴

The patient was instructed not to eat or drink caffeinated beverages three hours prior to testing and to wear comfortable shoes and loose fitting clothes. A brief physical examination was performed prior to the test and a written informed consent was taken. A standard 12 lead electrocardiogram was taken following which a torso ECG was obtained in the supine position and in the sitting or standing position. Blood pressure was recorded in both positions and the patient was instructed on how to perform the test. Standard multistage maximal exercise test was done on a motorised treadmill according to Bruce protocol. The heart rate, blood pressure and electrocardiograms were recorded at the end of each stage of exercise, immediately before and after stopping the exercise and for each minute for at least 5 to 10 minutes in the recovery phase.

Exercise test was terminated in all patients following the achievement of target heart rate or an abnormal ischemic response. This was defined as development of 0.10 mV (1 mm) of J point depression measured from the PQ junction, with a relatively flat ST segment slope (<1mV/sec), depressed ≥ 0.10 mV 60 to 80msec after the J point in three consecutive beats with a stable baseline. Exercise test was also terminated if patient developed dyspnoea, fatigue or chest pain.

Statistical Analysis:

All the Data was entered and complied in Microsoft Excel and analyzed in SPSS 23 (trial version) software and coded appropriately. The data were analyzed using appropriate statistical tests such as Chi-square test and t-test. Data are presented in the form of tables, pie chart and bar diagrams. P value <0.05 is considered statistically significant.

Ethical Consideration:

The study was started after obtaining ethical approval from the Institutional Ethics Committee, Jhalawar Medical College, Jhalawar, Rajasthan.

RESULTS:

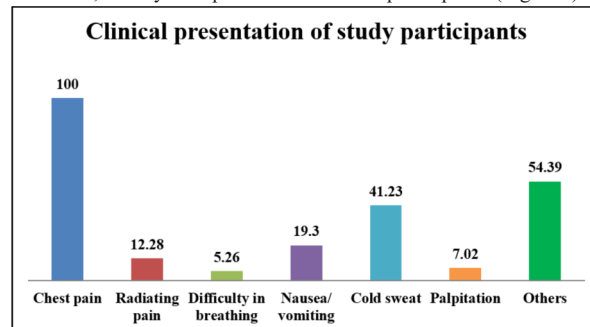
Among the 114 enrolled participants, age varies from 21 years to 79

years. Mean age of study participants was 49.95 ± 12.38 year (Male- 48.56 ± 12.18 , Female- 53.26 ± 15.24). Most of the study participants were belong to age group of 31 to 60 years (77, 67.54%) followed by more than 60 years (29, 25.44%) and 18 to 30 years (08, 7.02%). Chest pain was commonly found in male (80, 70.18%) as compare to female (34, 29.82%) with a ratio of M:F::2.35:1. According to modify B.G. Prasad classification of socio-economic stats, 11 (9.65%) were belong to upper class (class I & class II), 28 (24.56%) were belong to middle class (class III) and 75 (65.79%) were belong to lower class (class IV & class V). Out of 114 participants, 51 (44.74%) had family history of CAD. Among these 51 participants, 18 had family history only in parents, 08 had family history only in grandparents, 11 had family history in both (parents and grandparents) and 14 had family history in brothers and sisters. (Table 1)

Table 1: Distribution Of Study Participants According To Socio-demographic Variables.

Socio-demographic Variables	Number (n=114)	Percentage (%)
Age (in years)		
18 -30	08	7.02
31 -60	77	67.54
>60	29	25.44
Gender		
Male	80	70.18
Female	34	29.82
SES		
Class I	04	3.51
Class II	07	6.14
Class III	28	24.56
Class IV	44	38.60
Class V	31	27.19
Family history of CAD		
Yes	51	44.74
No	63	55.26

As per inclusion criteria, all cases had chest pain when appear for medical care. Chest pain was radiating to left arm, left shoulder, elbow, jaw or back in 12.28% participants. Along with chest pain, difficulty in breathing, nausea/ vomiting, cold sweat and palpitation were chief complaints among 5.26%, 19.30%, 41.23% and 7.02% of participants respectively. Other complaints such as dizziness, weakness, fatigue, heartburn, anxiety were present in 54.39% of participants. (Figure 1)



* Multiple responses

Figure 1: Clinical Presentation Of Study Participants.

Out of 114 cases of chest pain with normal ECG who were subjected for treadmill exercise test, 36 (31.58%) were found positive. (Table 2)

Table 2: Treadmill Exercise Test Among Study Participants.

Treadmill Exercise Test	Numbers (n=114)	Percentages (%)
Positive	36	31.58
Negative	78	68.42

Statistical significant association of positive treadmill exercise test was found with age ($p=0.02$) and gender ($p=0.03$). Treadmill exercise test found positive more commonly with increasing age and among males. Association of positive treadmill exercise test was not found significant with socio-economic status ($p=0.77$). (Table 3)

Table 4 shows mean value of clinical and laboratory parameters among treadmill exercise test positive and negative participants. Significant

difference in mean value of various parameters such as BMI ($p=0.0001$), SBP ($p=0.001$), triglyceride ($p=0.008$) and LDL ($p=0.0003$) was observed among treadmill exercise test positive and negative participants.

Table 3: Association Of Positive Treadmill Exercise Test With Socio-demographic Variables.

Socio-demographic variables	TMT positive (n=36)	TMT negative (n=78)	Total (n=114)	P value
Age				
18 -30	00 (00%)	08 (100)	08	0.02
31 -60	21 (27.27)	56 (72.73)	77	
>60	15 (51.72%)	14 (48.28%)	29	
Gender				
Male	30 (37.5%)	50 (62.5%)	80	0.03
Female	06 (17.64%)	28 (82.35%)	34	
SES				
Upper class	04 (36.36%)	07 (36.64%)	11	0.77
Middle class	10 (35.71%)	18 (64.29%)	28	
Lower class	22 (29.33%)	53 (70.67%)	75	

Chi square test was used as test of significance and p value <0.05 was considered as significant.

Table 4: Clinical And Laboratory Parameters Among TMT Positive And TMT Negative Participants.

Parameters	TMT positive (n=36)	TMT negative (n=78)	P value
	Mean± SD	Mean± SD	
BMI	30.42±5.1	26.50±3.68	0.0001
SBP (mmHg)	138.4±6.2	128.6±4.4	0.001
DBP (mmHg)	82.2±5.4	80.4±4.8	0.07
Total cholesterol (mg%)	184.82±26.26	175.56±24.82	0.07
Triglyceride (mg%)	164.29±22.80	151.72±23.22	0.008
LDL (mg%)	118.34±20.74	109.45±18.56	0.0003
HDL (mg%)	37.89±2.80	38.51±2.84	0.27
FBS (mg%)	164.42±21.09	159.84±23.63	0.32

Student T Test Was Used As Test Of Significance And P Value <0.05 Was Considered As Significant.

Difference in mean value of various parameters such as DBP ($p=0.07$), total cholesterol ($p=0.07$), HDL ($p=0.27$) and FBS ($p=0.32$) was found insignificant among treadmill exercise test positive and negative participants. (Table 4)

DISCUSSION:

Treadmill exercise testing is helpful as part of the diagnostic evaluation of patients with known or suspected coronary disease and it provides significant prognostic information for patients with known disease. Exercise stress testing without an imaging modality has a sensitivity and specificity of about 70% and 75%, respectively. The ACC/AHA guidelines suggest that exercise radionuclide myocardial perfusion imaging or exercise echocardiography has potential use as a follow-up test in patients with intermediate or high risk.¹⁵⁻¹⁷

In present study, mean age of study participants was 49.95±12.38 year. Most of the study participants belong to age group of 31 to 60 years (67.54%) followed by more than 60 years (25.44%) and 18 to 30 years (7.02%). In accordance to our study Renee Y Hsia et al¹⁸ analyzed 10907 patient records, representing patient visits to the ED with a primary symptom of chest pain and found that most patients (75.6%) were aged 18 to 64 years. In present study, Chest pain was commonly found in male (70.18%) as compare to female (29.82%). Statistical significant association of positive treadmill exercise test was found with gender ($p<0.05$) of the participants. In contrast to this, Renee Y Hsia et al¹⁸ reported that most patients were females (52.7%). Men (50.6%) and women were nearly equally represented in the patient population in study by G. M. Egeland et al.¹⁹ Angina prevalence showed a small female excess with a pooled random-effects sex ratio

of 1.20 (95% CI 1.14 to 1.28, $P<0.0001$) in study by Harry Hemingway et al.²⁰

In present study, Out of 114 participants, 44.74% had family history of CAD. In contrast to present study, Héctor González-Pacheco et al²¹ reported that only 10.3% patients had family history of CAD in their study.

In present study, Chest pain was radiating to left arm, left shoulder, elbow, jaw or back in 12.28% participants. Along with chest pain, difficulty in breathing, nausea/ vomiting, cold sweat and palpitation were chief complaints among 5.26%, 19.30%, 41.23% and 7.02% of participants respectively. Muhammad Ajmal Malik et al²² reported that radiation of the pain to shoulder, neck and jaw was seen in 22.7% patients. In 12.7% patient pain radiated to both sides of chest and 16.6% patients had pain radiation to chest, shoulder, upper arm and forearm. In our study 55(16.6%) patients had pain radiation to left shoulder, left upper arm and ulnar side of left forearm. Solt et al²³ claimed a high prevalence of chest pain radiation to the jaw especially in females.

In present study, Out of 114 cases of chest pain with normal ECG who were subjected for treadmill exercise test, 36 (31.58%) were found positive. In contrast to our study, positive tests results were obtained in 20% of the study participants in the study by Juan Sanchis et al.²⁴ A total of 10% out of 220 treadmill tests, were considered positive by ECG criteria in study by Ron Blankstein et al²⁵ among patients presenting to the emergency room with chest pain. The sensitivity of TMT for detecting coronary artery disease in study participants was 61% in study by Stanley George et al.²⁶

Association of positive treadmill exercise test was found statistically significant with dyslipidemia ($p<0.05$) in present study. Dyslipidemia is an independent major risk factor for CAD. A combination of low HDL-C and high TG referred to as atherogenic dyslipidemia, have been implicated as important predictors of CAD.²⁷ Association of BMI category was found statistically significant ($p<0.05$) with positive treadmill exercise test in present study. 54.1% and 20.1% participants were pre-obese and obese respectively in study by Héctor González-Pacheco et al²⁷ among 3447 patients with ACS. According to longitudinal studies, at least two decades of obesity is likely to be an independent risk factor of coronary artery disease. A 10 kg rise in body weight increases the risk of coronary artery disease by 12%.²⁸

In present study, Mean values of total cholesterol, triglyceride, LDL and HDL were 184.82±26.26 mg%, 164.29±22.80 mg%, 118.34±20.74 mg% and 37.89±2.80 mg% respectively among patients with positive treadmill exercise test. As compare to our study, the mean total cholesterol, triglycerides, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol were 183.43±35.9 mg/dl, 140.59±46.83 mg/dl, 109.9±26.38 mg/dl and 41.17±4.78 mg/dl respectively in Patients with Acute Coronary Syndrome Admitted at Tertiary Care Hospital in Nepal in the study by Sahadeb Prasad Dhungana et al.²⁹

CONCLUSION:

Approx one third patients of chest pain with normal ECG were found positive for treadmill exercise test. Statistical significant association of positive treadmill exercise test was found with increasing age and among males. Significant difference in mean value of various parameters such as BMI, SBP, triglyceride and LDL was observed among treadmill exercise test positive and negative participants although difference in mean value of DBP, total cholesterol, HDL and FBS was found insignificant. Routine screening with Exercise Treadmill Test should be considered among patients with chest pain having normal ECG for early diagnosis of cardio-vascular diseases.

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Conflict Of Interest: Nil.

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