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Effects of Exercise Treadmill Test to Evaluate Coronary Heart Disease in Non-Symtomatic Subjects

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Abstract: The exercise treadmill test is also called a stress test. The cardiac stress test is done with heart stimulation by exercise on a treadmill in which the patient connected to an electrocardiogram to evaluate the cardiac condition related to irregular heart rhythms, decreased supply of blood and oxygen to the heart, amount of work that the heart can perform before the symptoms showed, amount of time it takes the heart to recover after exercise, overall level of cardiovascular conditioning and Exercise target heart rate. A stress may be accompanied by echocardiography. Objective is to evaluate the value of Exercise treadmill test (ETT) in the diagnosis of myocardial ischemia. **S**eventeen patients were undergone to graded exercise for evaluating of myocardial ischemia. Male subjects (Age: 40+/-0.4) who came for the health check up to Columbia Asia Hospital were reviewed, Ghaziabad, India and all the patient underwent for Exercise Treadmill Test. Statistical analysis data are expressed as mean value ± S.D. Students t-test was used to compare significant differences in the blood pressure and heart rate before and after the exercise treadmill test. $P<0.05$ was considered statistically significant. Results revealed that analyzing the data of patients by calculating the duration of exercise, their systolic blood pressure and diastolic blood pressure, Maximum Peak Heart Rate (MPHR), peak Heart Rate,%Target Heart Rate and MET. The average mean of duration of time of patients was nine minutes and eighteen seconds, mean SBP was 117.14 mmHg and mean DBP: 78.5 mmHg, MPHR: 183.7. BPM, mean peak heart rate was 309.2 BPM, their mean percent target heart rate was 90.28% and the average mean of MET was 11.0 METS. There was no significant change in ST- depression in all the patients and there were no symptoms of chest pain, breathlessness and immature fatigueness. It was concluded that all seventeen patients who underwent the exercise treadmill test did not showing any signs and symptoms of coronary heart diseases with no chest pain, no immature fatigueness, no myocardial infarction, no arrhythmia and no ST- depression. The value of exercise testing is well established for determining coronary heart diseases even in asymptomatic patients. In our study, all the patients who underwent the Exercise treadmill test showed normal response on TMT and had no signs and symptoms of coronary heart disease.

Key words: ETT- Exercise Treadmill Testing · MET · % Target Heart Rate · Peak Heart Rate · Blood Pressure

INTRODUCTION

The cardiac stress test is done with heart stimulation by exercise on a treadmill in which the patient connected to an electrocardiogram [1]. A stress may be accompanied by echocardiography [2]. Exercise testing provides information on exercise capacity and facilitates assessment of path0physiologic characteristics, effectiveness of medication and risk of potential disease [3]. The initiation of dynamic exercise results in increase in ventricular heart rate, stroke volume and cardiac output. In the initial phase of exercise which held in upright position, cardiac output which is increased by an augmentation in stroke volume that can mediated through the use of the Frank Starling Mechanism. As exercise progresses, skeletal muscle blood flow increases, oxygen exertion increases, peripheral resistance decreases and systolic blood pressure, mean arterial pressure and pulse pressure increases. Diastolic blood pressure remains unchanged or may increase or decrease by approximately

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10 mmHg. In the post exercise phase, hemodynamic return to baseline within few minutes after the exercise is discontinued. The return of vagal stimulation is an important deceleration mechanism after exercise [4]. A suitable electrocardiographic (ECG) recording system is essential for the regular monitoring of heart rhythm and also the evaluation of ischemic ECG changes during the exercise and recovery [5].

When the authors performed stress test such as the treadmill test, they asked two questions: does the patient suffering from coronary artery disease (What is the patient's diagnosis) and is he or she likely to suffer a coronary event soon (What is the patient's prognosis) [6, 7]. A stress test is used to diagnose is considered to have a positive result if the patient shows signs and symptoms of ischemia during exercise stress which means ST- segment depression and angina [1]. This diagnostic accuracy of exercise test is commonly assessed separately from its prognostic accuracy. Unfortunately, diagnostic accuracy can be measured only in the minimum population of patients which subsequently undergoes coronary angiography. The main difference is that the prognostic accuracy of a stress test can be measured in much larger group of patients, which can be measured by using clinical outcomes as the comparison standard: only those patients who undergo early revascularization and those who are lost to follow up are excluded from this group. Although the stress induced markers of ischemia which is used in diagnosis i.e., ST- segment depression and angina also have prognostic value and the other variables are more powerful predictors of outcome. So, in this, authors discussed those other prognostic variables and how to interpret them Michaels [8].

Oxygen uptake is a major determinant of a physical work capacity. So, the measurement of the maximum oxygen consumption not only determining an individual's capacity to perform work, but also of comparing work capacity between the subjects. The present report describes the application of the Bruce treadmill protocol which is a modified technique; it is used to measurement of maximum oxygen uptake in a group of seven subjects [9]. The aims and objectives of this study were to find out the effect of Exercise Treadmill Test to evaluate coronary heart disease in an individual and to evaluate the value of Exercise treadmill test (ETT) in the diagnosis of myocardial ischemia.

METHODS AND MATERIALS

Seventeen subjects were undergone to graded exercise for evaluating of myocardial ischemia. We reviewed the male subjects (Age: 40+/-0.4) who came for the health check up to Columbia Asia Hospital, Ghaziabad and all the patient underwent for Exercise Treadmill Test.B

- Sample size(n)= 17
- Gender= male
- Age= 25-52 years
- Source of the Sample= Columbia Asia Hospital.
- Sample Design= Non- probability sampling.
- Research Design= Experimental.
- Variable:
- DV= B.P, H.R, E.C.G, M.E.T,MPHR, Peak HR,%THR
- IV= ETT, duration of exercise.

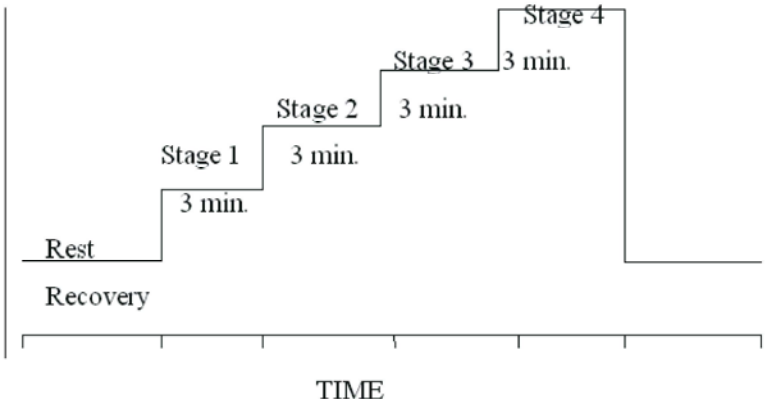
Exercise tolerance testing is one of the methods which are widely used to determine the presence of significant coronary heart disease. Bruce's first report on treadmill exercise tests which is published in 1949, it is analyzed minute by minute changes in respiratory and circulatory function of normal adults and patients with lungs or heart ailments [10, 11]. So, while performing the ETT in selected patient, the following criteria should be followed:

- Ability to exercise.
- Normal baseline 12- lead ECG.
- No previous cardiac problems [12].

Patients who are the candidates for exercise testing may be have stable symptoms of chest pain may be stabilized by medications or may be post- myocardial infarction [13].

Treadmill Exercise Testing: TMT was performed according to the Bruce Protocol [14], using the graded treadmill. Exercise was continues for 3 minutes at each stage. A 12- lead ECG standard was performed before the exercises and at 1- minute intervals for at least 10 minutes after the treadmill exercise. During the exercise 6 precordial leads were measured continuously and recorded at every minute. Cuff blood pressure measurement was measured at the same interval of times. Patients were encourages to exercise with his maximum physical capacity unless any chest pain, significant ST- depression, arrhythmia showed up during the exercise. The TMT was only considered negative when the patient at least 85% of the maximal Heart Rate (HR) without any signs and symptoms of ST-depression or if the patient failed to achieved such HR or in the presence of delaying of intraventricular conduction [15].

Bruce Protocol: The format of the Bruce Protocol is shown here. This Protocol allows for the continuous step increase in work load up to a treadmill speed of 8 km.hr^{-1} and 20% incline. There are 5 stages in which first stage is the pre- exercise stage and the fifth stage is the recovery stage. Additionally, in 7 subjects an electrocardiogram (E.C.G) was recorded continuously from electrode located over the body of the sternum [16].



Preparation of the Subject Before Exercise Treadmill Test: Subjects at the age group ranged from 32 to 52 years. All the tests were carried out for 2 hours after the last meal had been taken and the environmental conditions were always similar. Subjects were not allowed to support themselves using the treadmills hand – rails during the 3 minutes period of the data collection, but they were allowed to do during the starting of the first stage of the exercise to the next stage [17].

Exercise Tolerance Involves:

- ETT consists of exercising on a treadmill on a well defined BRUCE PROTOCOL for approximately 20 minutes. The test begins gently and gradually the level of intensity is increased with the increase in treadmill speed and become slightly incline.
- MET is the unit of intensity of exercise where 1 MET is the amount of energy expenditure at rest.
- This test is divided into seven stages of every 3 minutes.
- ECG is recorded throughout the exercise and blood pressure is measured.
- ETT can be stopped early during the exercise due to development of chest pain, presence of ST elevation or ST depression, arrhythmia and if the patient becomes tired and is unable to continue his exercise.

Statistical Analysis: All the data are expressed as mean value ± S.D. Students t-test was used to compare significant differences in the blood pressure and heart rate during before and after the exercise treadmill test. $P<0.05$ was considered statistically significant.

RESULTS

Table 1 showed the demographics of the subjects. It showed the data presented in Mean ± S.D. for all subjects.

The results showed that the heart rate was increased after treadmill exercise. Table 2 showed Pre- exercise HR was 77.2 ±20.41 and post exercise H.R was 166.4±7.72. The difference was statistically significant ($p<0.05$). Subjects showed statistically significant rise in systolic B.P i.e., Pre- exercise SBP was 117.14 ±9.51 and post exercise B.P was 157.14±14.96. There were no significant changes in DBP and Peak HR.

Before the exercise begins heart rate increased in the subjects due to anticipation. This is known as the anticipatory response. It is mediated through the release of neurotransmitters called epinephrine and nor epinephrine [18]. The heart rate increases rapidly with the onset of activity, providing exercise intensity remains constant, heart rate will level off. This is known as steady-rate heart. During prolonged steady state exercise, particularly in a hot climate, a steady state heart rate will gradually increase. This phenomenon is known as cardiac drift and is thought to occur due to increasing body temperature [19].

The mean blood pressure of all the subjects i.e., systolic blood pressure was 115.7 and diastolic blood pressure was 78.5 during pre-exercise and the mean blood pressure after post exercise i.e., systolic was 157.1 and diastolic 78.5. The results showed that both systolic and diastolic blood pressure had increased after the exercises and diastolic B.P remained unchanged after exercise. This may be because of blood pressure can decrease (Both systolic and diastolic pressure) at rest and

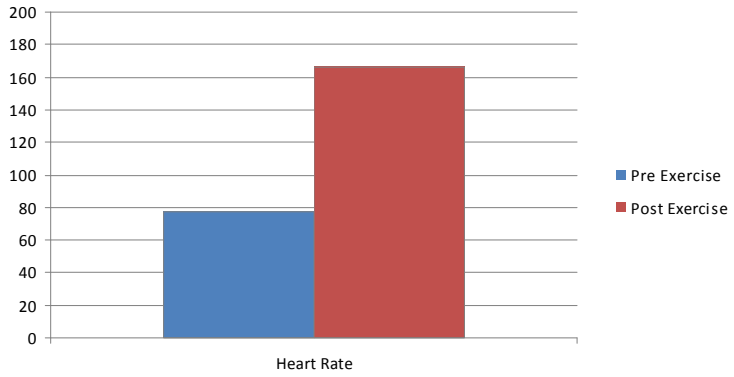


Fig. 1: Comparison of post exercise H.R and pre- exercise H.R.

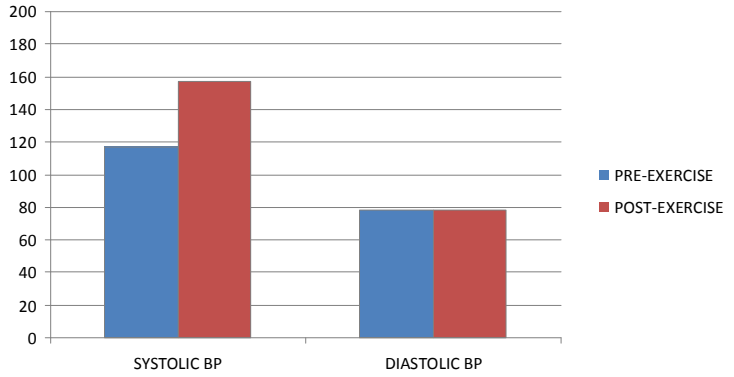


Fig. 2: Comparison of systolic B.P and diastolic B.P before exercise and after exercise.

Table 1: Demographic data of the subjects.

S.no.	Variable	Mean± S.D.
1.	Age(Years)	36±11.70
2.	Weight(Kg)	72.55±11.01
3.	Height(cm)	169.48 ±5.064
4.	Systolic B.P(mmHg)	117.14 ±9.51
5.	Diastolic B.P(mmHg)	78.57 ±8.99
6.	HR(BPM)	77.28 ±20.41
7.	MPHR(BPM)	183.7 ± 11.44

Table 2: Comparison of Variables of Pre- Exercise And Post- Exercise During The Exercise Treadmill Test Performance

S.No	Variables	Pre- exercise	Post- exercise	t-value	P-value	Level of significance
1.	H.R.	77.2±20.41	166.4±7.72	1.53	P>0.05	**
2.	SBP	117.14 ±9.51	157.14±14.96	6.51	P<0.05	**
3.	DBP	78.57 ±8.99	78.57±6.9	1	P>0.05	*
4.	Peak HR(BPM)	183.7 ± 11.44	309.28±380	0.39	P>0.05	*

** Significant, * Non-significant

during the sub maximal exercise. Although the resistance exercises can raise systolic and diastolic blood pressure significantly during the activity, it can lead to a long term reduction in blood pressure [20].

DISCUSSION

Exercise treadmill testing is an important tool for assessing patients with suspected or known ischemic heart disease. In the Bruce protocol which is used in exercise treadmill testing, the test starts with treadmill set to a low speed and a 10% incline and every 3 minutes the speed and angle of incline is increased. The test continues for a maximum of 27 minutes until the patients quits or develops signs and symptoms of ischemia. Average time for the middle aged adult is 8 to 10 minutes [8]. The usual criteria used in exercise treadmill test are known to lead to false result [19]. All the seven patients

who were observed, showed negative result to coronary heart disease. But, two patients out of the seven patients had hypotension and asthma for last 3 years.

The significant ST- depression and arrhythmia were not found in the recent studies. However, if there is asymptomatic patient (i.e., those with hypertension), more cardiac risk was seen with an abnormal ST heart rate index than with an abnormal result on standard exercise stress testing [20]. The mean heart rate for all the seventeen subjects of pre- exercise is 77.2 and the mean heart rate of post exercise is 166.4. It means that the pre- exercise value is less as compared to the post exercise value which shows that the heart rate increases after the treadmill exercise.

Exercise testing has an established role in the evaluation of patients with valvular heart disease and can aid clinical decision making. Because symptoms may develop slowly and indolently in chronic valve diseases and are often not recognized by patients and their physicians, the symptomatic, blood pressure and electrocardiographic responses to exercise can help identify patients who would benefit from early valve repair or replacement. In addition, stress echocardiography has emerged as an important component of stress testing in patients with valvular heart disease, with relevant established and potential applications [21].

CONCLUSION

We concluded that all the seven patients who underwent the exercise treadmill test did not showing any signs and symptoms of coronary heart diseases with no chest pain, no immature fatigueness, no myocardial infarction, no *arrhythmia* and no ST- depression. The value of exercise testing is well established for determining coronary heart diseases even in asymptomatic patients. In our study, all the patients who underwent the Exercise treadmill test showed normal response on TMT and had no signs and symptoms of coronary heart disease.

REFERENCES

1. "Exercise stress test". MedlinePlus: U.S National Library of Medicine. Retrieved, 31 May 2013.
2. Rimmerman and Curtis, 2011. The Cleveland Clinic Guide to Heart Attacks. Kalpn Publishing. Retrieved, 25: 113.
3. Monique, H.M. Vn der Cammen-van Ziip, Hanneke IJsselstijn, Tim Takken, Sten P. Willemsen, Dick Tibboell, Henk J. Stam and Rita J.G. Van den Berg-Emons, 2009. Exercise testing of pre- school children using the bruce treadmill protocol: new references value, doi: 10.1007/s00421-009-1236-x.
4. David Akinpelu, Javier M. Gonzalez, Eric H. Yang, Ronald J. Oudiz and Justin D. Pearlman, 2014. Francisco Talavera: "Treadmill Stress Testing".
5. Ileana, L. Pina, Gary J. Balady, Peter Hanson, Arthur J. Labovitz and Deborah W. Madonna, 1995. Jonathan Myers. Guidelines for Clinical Exercise Testing Laboratories: A Statement for Health care Professionals From the Committee on Exercise and Cardiac Rehabilitation, American Heart Association.Circulation. 91:912-921, doi:10.1161/01.CIR.91.3.912.
6. Myers, J., R. Arena, B. Franklin, I. Pina, W.E. Kaurs, K. Mclnnis and G.J. Balady, 2007. American Heart Association Committee on Exercise, Rehabilitation and Prevention of the Council on Clinical Cardiology and the Council on Cardiovascular Nursing. Circulation, 116: 329-343.
7. Gibbons, R.J., G.J. Balady and J.T. Bricker, 2002. American College of Cardiology/ American Heart Association Task Force on Practice Guidelines.ACC/AHA 2002 guideline update for exercise testing: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committees to Update the 1997 Exercise Testing Guidelines). Circulation, 106:1883-1892.
8. Michaels Lauer, 2008. The Exercise Treadmill Test: Estimating cardiovascular Prognosis. Cleveland Clinic Journal of Medicine, 75(6): 424-430.
9. Victor, F., Froelicher and Malcolm C. Lancaster, 1974. American heart Journal. The prediction of maximal oxygen consumption from a continuous exercise treadmill protocol, 87(4): 445-450.
10. Robert A. Bruce, Frank W. Lovejoy, Jr., Raymond Pearson, Paul N.G. Yu, George B. Brothers and Tulio Velasquez, 2010. Normal respiratory and circulatory pathways of adaptation in exercise, Invest 28: 1423-1430. Doi: 10.1172/JCI102207. PMC 439698. PMID, 15407661.
11. Robert A. Bruce, Raymond Pearson, Frank W. Lovejoy, Jr., Paul N.G. Yu and George B. Brothers, 2010. Variability of respiratory and circulatory performance during standardized exercise. J. Clin Invest 28 (6):1431-1438. Doi: 10.1172/JCI102208. PMC439699. PMID,15395945.

12. Raymond J. Gibbons, Gary J. Balady, John W. Beasley, Faafp, J. Timothy Bricker, Wolf F.C. Duvernoy, Victor F. Froelicher, Daniel B. Mark, Thomas H. Marwick, Ben D. McCallister, Paul Davis Thompson, FACSM, William L. Winters Jr. and Frank G. Yanowitz, 1997. "ACC/AHA Guidelines for Exercise Testing: Executive Summary". Circulation 96: 345-354. Doi: 10.1161/01.CIR.96.1.345.
13. Bruce, R.A. and T.R. Hornsten, 1969. Exercise Testing in Evaluation of patients with Ischemic Heart disease. Prog Cardiovasc Dis., 11: 371-390.
14. Bakr I. Salem, Masahisa Terasawa, Virendra S. Mathur, Efrain Garcia and Robert J. Hall, 1978. Exercise Testing and Left Coronary Artery Disease: Experience with 57 patients." Cardiovasc Dis., 5(4): 384-390. PMCID: PMC287752.
15. Astrand, I., 1960. Aerobic work capacity in men and women with special reference to age. Acta Physiol. Scand, 49: 169.
16. Jonathan, H. and Adam Timmis, 2002. BMJ: 324, doi: http//dx.doi.org/10.1136/bmj.324.7345.1048.
17. Fotuin, N.J. and J.L. Weiss, 1977. Exercise stress testing. Circulation, 56: 699-712.
18. Okin, P.M., K.M. Anderson, D. Levy and P. Kligfield, 1991. Heart rate adjustment of exercise – induced ST segment depression. Improved risk stratification in the Framingham Offspring Study. Circulation, 83: 866-874.
19. McArdle, W.D., F.I. Katch and V.L. Katch, 2000. Essentials of Exercise physiology: 2nd edition Philadelphia, PA: Lippincott Williams and Wilkins.
20. Hagberg, J.M., A.A. Ehsani, D. Goldring, A. Hernandez, D.R. Sinacore and J.O. Holloszy, 1984. Effect of weight training on blood pressure and hemodynamics in hypertensive adolescents. J. Pediatr, 104(1): 147-151.
21. Eugenio Picano, Philippe Pibarot, Patrizio Lancellotti, Jean Luc Monin and Robert O. Bonow, 2009. The Emerging Role of Exercise Testing and Stress Echocardiography in Valvular Heart Disease. Journal of the American College of Cardiology, 54(24): 2251-2260.