Original Article

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Coronary angiography finding of exercise tread mill test positive patients in a tertiary care center

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Abstract

Background and Aims: The use of coronary angiography in diagnosing coronary artery disease is limited by its invasive property. In the other hand correct interpretation of tread mill test data and its use as a key diagnostic modality also has been a problem. The study was thus aimed to see the diagnostic accuracy of treadmill test to rule out coronary artery disease.

Methods: : We included all the patients who had positive tread mill stress test and underwent coronary angiography and were subsequently analyzed for presence of coronary artery disease.

Results: A total of 303 patients were included with 119 males and 184 females with mean age of 53.6 ±10.5 yrs and 51.7±8.6 yrs respectively. Normal coronaries was seen in 114(54.0%), borderline lesion in 29 (13.7%) and significant lesion in 68 (32.2%) with 48(22.7%) having single vessel disease, 29(13.7%) double vessel disease and 14(6.6%) triple vessel disease. Coronary artery diseases was highest among diabetics (57.7%, OR 1.72 (95 % CI: 0.92 to 3.20), p value-0.08).Similarly the risk of coronary artery disease was significantly highest among patient with ≥2 risk factor (OR: 8.10,95 % CI: 4.96 to 13.24, P < 0.0001). Gender distribution showed that coronary artery disease was significantly higher in males than females (53% vs 35% respectively, OR: 2.08, 95 % CI: 1.30 to 3.32, p value-0.002).

Conclusion: The value of tread mill test to predict coronary artery disease is highest in patients with two or more risk factor especially in those with diabetes with significance increased among males.

Keywords : Coronary angiography; Coronary artery disease ; Tread mill stress test.

Introduction

The diagnostic rate of coronary artery disease (CAD) has been dramatically increasing with the development of interventional technique, which makes coronary angiography (CAG) the "gold standard" tool for CAD diagnosis.[1] However, limited by its invasive property exercise treadmill test is still used as an economic and simple method to screen and assist in diagnosis of patients with known or suspected CAD.[1] The study is thus retrospectively looking at coronary angiographic findings of those with tread mill test positive status .

Another factor is evaluation of ECG changes, specifically ST segment depression during or after exercise. However, with chances of false positive and negative tests, especially in patients with atypical or no angina pectoris is one of the problem of test being not highly specific.[2] Thus, use of the test in specific population to increase the pretest diagnostic accuracy is the main rationale of this study.

In the study we aim to look at the overall prevalence of CAD in exercise tread mill test positive patients and the parameters that affect its diagnostic accuracy.

Methods

Study Design

This was a quantitative cross sectional retrospective study

Place and duration of study

The study was done in the department of cardiology, Manmohan Cardiothoracic Vascular and Transplant Center, Institute of medicine, Maharajgunj, Kathmandu in a study period of approximately 1 and ½ yrs (Oct 2015 to Dec 2016)

Ethical approval and patient consent

The study was started only after ethical clearance for the study was taken from Institutional review board, Institute of medicine. Informed and written consent were taken from all the patients in the study group.

Inclusion and Exclusion Criteria

Inclusion Criteria

- All patients with exercise tread mill test positive (based on ACC/AHA 2002 guidelines)3 undergoing coronary

angiography. The following results will be interpreted as positive

During Excercise

- ST segment depression: ECG portion of the exercise test will be considered abnormal (ie, "positive" for ischemia) when there is ≥1 mm horizontal or downsloping ST segment depression in one or more leads that persists at 80 milliseconds after the J point especially in Leads V4, V5, and V6 or V5 alone.[4]
- ST segment elevation : ≥ 1.0 mm ST segment elevation in leads without pre-existing Q waves
- ST segment elevation in aVR
- Exertional hypotension: Fall in Systolic Blood Pressure from pre-exercise value as exercise intensity increases
- Exercise capacity: Inability to achieve 3 MET workload
- Exercise-induced angina, particularly that which is exercise-limiting or occurs at a low workload
- Heart rate response to exercise or chronotropic incompetence (failure to achieve 85 percent of the age-predicted maximum heart rate in the absence of medications known to slow or blunt the heart rate response to exercise (ie, beta blockers and non-dihydropyridine calcium channel blockers)

During Recovery

- Arrythmias: Frequent ventricular ectopy (defined as ≥7 VPBs per minute, ventricular bigeminy or trigeminy, or more marked ventricular arrhythmia)
- ECG changes :≥ 1mm ST segment depression
- Heart Rate Recovery (HRR): Defined as difference in heart rate at peak exercise and at 1 minute after cessation of exercise. A HRR of 12 beats/min or less during an upright cool down period will be considered as positive test result.

Exclusion Criteria

1. All patients with contraindications to Exercise Testing which includes:
   - o Absolute
     - Acute myocardial infarction (within 2 d)
     - High-risk unstable angina
     - Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
     - Symptomatic severe aortic stenosis
     - Uncontrolled symptomatic heart failure
     - Acute pulmonary embolus or pulmonary infarction
     - Acute myocarditis or pericarditis
     - Acute aortic dissection
   - o Relative
     - Left main coronary stenosis
     - Moderate stenotic valvular heart disease
     - Electrolyte abnormalities
     - Severe arterial hypertension (systolic blood pressure of >200 mm Hg and/or diastolic blood pressure of >110 mm Hg.)
     - Tachyarrhythmias or bradyarrhythmias
     - Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
     - Mental or physical impairment leading to inability to exercise adequately
     - High-degree atrioventricular block
2. All patients unable to perform exercise tread mill test.
3. All patients with known CAD
4. All Patients with the following baseline ECG abnormalities:
   - o Pre-excitation (Wolff-Parkinson-White) syndrome
   - o Electronically paced ventricular rhythm
   - o Greater than 1 mm of resting ST depression
   - o Complete left bundle-branch block

Study Assessments

All of patients with stress test positive went through a detail interview regarding personal details like name, age, gender, profession along with an appropriate medical history of chest pain. History of Coronary artery disease risk factor: Hypertension, Dyslipidemia, Cigarette Smoking, Family history of CAD, diabetes and sedentary life style. Each patient had his/her height and weight measured for calculation of BMI.

Ascertainment of Coronary artery disease

All patients with test positive results underwent coronary angiographic in Manmohan Cardiothoracic Vascular and Transplant Center CATH Lab by cardiology faculty member or cardiology resident. Vascular access for coronary angiography was done either by femoral or radial artery approach. Interpretation of coronary angiogram for CAD and coronary lesion quantification was done in at least two orthogonal views.

The criterion for Significant Coronary artery disease (CAD) was defined as >50% stenosis of the LMS, >70% stenosis in a major coronary vessel {Left Anterior Descending (LAD), Left Circumflex (LCX)or Right Coronary Artery(RCA)} in coronary angiography ; Borderline significant as 50-70% Stenosis and minor or insignificant CAD as <50% stenosis. Patients with significant coronary lesions were further classified depending on the number of major coronary vessel lesion as having single vessel disease (SVD), Double Vessel Disease (DVD) or Triple Vessel Disease (TVD).

Statistical Analysis

We estimated that a sample size of 132 patients would be required to obtain a two-sided 95% confidence interval for an estimated population of approximately 200 patients undergoing coronary angiography after stress test.

The prevalence of CAD and the associated 95% confidence interval were calculated for the entire group of patients and for relevant subgroups. To compare the baseline characteristics between patients with and those without CAD, we used the chi-square test for categorical variables and Student's t-test for continuous variables. Odds ratios with 95% confidence intervals were calculated with the use of logistic regression. The 95% confidence intervals and P values were calculated according to the normal approximation of the binomial distribution. No adjustments were made for multiple testing. All calculations were performed with the use of SPSS software, version 18.0 (SPSS).

Results

Patient Characteristics

A total of 303 patients (mean age 52.8 ±9.7 yrs) were included during a study period of approximately 1 and ½ yrs (Oct 2015 to Dec 2016) among whom male were of average 53.6 ±10.5 yrs and female were of 51.7±8.6 yrs(p value-0.098) . It was observed that more female patients complained of chest pain than males {male 39.27% (n-119) vs 60.72% (n-184)}.

Among all the patients who underwent TMT greatest number of the patient were hypertensive{47.85 % (n-145) and least number of patients were smoker {5.94 % (n-18)} with patients having at least one risk factor being 65.96%(n-188) and those with two or more risk factor being 34.03% (n-97) which was significantly higher in male than female(p -0.196,p-0.036 respectively). Gender based analysis also revealed that most of risk factors were similar except smoking which was higher in female than male (66.66% vs33.33% respectively, p value-0.595) and more female obese than male (66.66% vs33.33% respectively, p value-0.059) as shown in Table 1.

Table 1. Baseline clinical characteristics of the patients

Characteristics	Total Patients (N-303)		P value
	Male (n-119)	Female (n-184)	
Age of patient(yrs)	53.6±10.5 yrs	51.7±8.6 yrs	0.098
Complaint of chest pain	39.27%(n-119)	60.72%(n-184)	0.023
Risk Factor for CAD distribution			
Hypertensive (n-145)	52.9%(n-63)	44.6%(n-82)	0.154
Diabetics (n-32)	59.37%(n-19)	40.62% (n-13)	0.661
Smoker(n-18)	33.33% (n-6)	66.66% (n-12)	0.595
Body Mass Index(BMI)			
Normal BMI(n-192) (18.5 -22.9 kg/m2)	35.41%(n-68)	64.58% (n-124)	0.016
Overweight (n-63) (BMI-23.0-27.5 kg/m2)	66.66%(n-42)	58.33% (n-21)	0.782
Obese(n-27) (BMI-≥27.5kg/m2)	33.33%(n-9)	66.66% (n-18)	0.059
≥2 CAD risk factors(n-95)	65.26%(n-62)	34.73%(n-33)	0.036
At least 1 CAD risk Factor (n-205)	66.82% (n-137)	33.17%(n-68)	0.196

Coronary angiography of all the patients revealed normal coronaries in 54.0% (n- 114), minor CAD in 13.7% (n-29) and significant lesion in 32.2% (n-68) (Fig1.)

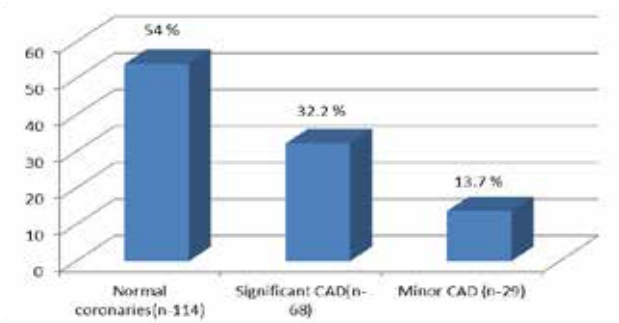

Fig 1. Percentage based on coronary angiographic finding

Among those with diagnosed CAD 22.7 %(n-48) had single vessel disease (SVD), 13.7 %(n-29) had double vessel disease (DVD), 6.6 %(n-14) had triple vessel disease (TVD) (Fig2.).

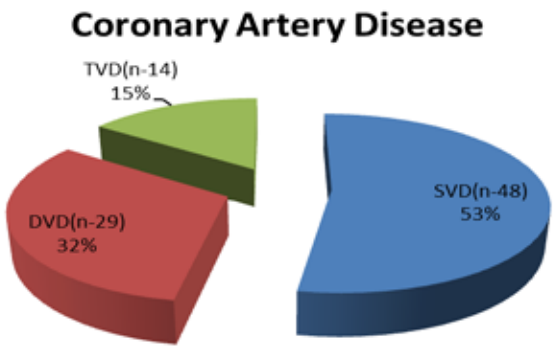

Fig 2. Distribution of coronary artery disease

The sub group analysis based on risk factor and CAD showed CAD was highest among diabetics (57.7%, Odds ratio 1.72 (95 % CI:0.92 to3.20), p value-0.08) followed by smokers (55%,Odds ratio 1.52 (95 % CI:0.59 to3.93), p value -0.38) compared with all the patient groups though not statistically significant.

Table 2. Subgroup analysis between risk factor and Coronary artery disease (CAD)

CAD Risk Factors	CAG finding			Odds Ratio (95% CI)	P Value
	Normal Coronaries (n-173)	Minor CAD (n-41)	Significant CAD (n-89)		
HTN	45.66% (n-79)	51.21 % (n-21)	50.56% (n-45)	1.00 (95% CI:0.68 to 1.48)	0.97
DM	10.98% (n-19)	19.51% (n-8)	20.22% (n-18)	1.72 (95 % CI:0.92 to3.20)	0.08
Smoker	(n-8)	12.19% (n-5)	5.61% (n-5)	1.5259 (95 % CI:0.59 to3.93)	0.38
BMI					
Normal	65.31% (n-113)	73.17% (n-30)	55.05% (n-49)	0.75 (95 % CI:0.52 to 1.08)	0.13
Overweight	26% (n-45)	26.82% (n-11)	31.46% (n-28)	1.05 (95 % CI:0.65 to 1.68)	0.83
Obese	8.6% (n-15)	0	13.48% (n-12)	1.01 (95 % CI:0.46 to 2.21)	0.97

Further analysis of patients comparing the risk of having CAD two or more CAD risk factors to at least one CAD risk factor showed significantly higher chance among patient with ≥2 CAD risk factor (OR: 8.10,95 % CI:4.96 to 13.24, P < 0.0001).

Gender distribution of CAD showed that males with stress test positive had significantly higher chances of having CAD than females (53% vs 35% respectively) with odds ratio(OR) : 2.08, 95 % CI: 1.30 to 3.32 ,p value-0.002).

Discussion:

Graded exercise tread mill test is widely used clinically to assess the ability of an individual to safely tolerate increased physical activity while ECG, hemodynamic, and symptomatic responses are monitored for the development of myocardial ischemia, electrical instability, or other exertion-related abnormalities. Also exercise ECG remains an inexpensive test that has been well validated in the general population, and it can be used as the first diagnostic test for patients with an intermediate risk of having CAD.

Given the differences in presentation of CAD within the diabetic population and particularly the higher incidence of silent myocardial ischemia, exercise ECG testing has been used to assess asymptomatic diabetic patients for CAD. Koistinen et al[5] studied 136 asymptomatic diabetic patients who underwent exercise ECG testing and was abnormal in 14% of these asymptomatic patients, with a positive predictive value of 94%. Similar to the study sub group analysis based on of risk factor and CAD showed that CAD was highest among diabetics (57.7%, Odds ratio 1.72 (95 % CI:0.92 to3.20) ,p value-0.08) though not statistically significant which probably could be due to small sample size of the study group.

Bacci et al[6] evaluated 206 consecutive higher-risk, asymptomatic, T2DM patients with peripheral arterial disease (PAD) and at least 2 cardiovascular risk factors (CRFs); 19% had an abnormal test of those 29% had significant CAD. The positive predictive accuracy of the exercise ECG was 79%. During the study comparing the risk of having CAD two or more CAD risk factors to at least one CAD risk factor showed significantly higher chance among patient with ≥2 CAD risk factor (OR: 8.10,95 % CI:4.96 to 13.24 ,P < 0.0001) which is comparable .

Nayak K C et al [7] performed treadmill exercise test in 50 chronic smokers and 50 non-smokers (93 males and 7 females) who were not having any clinical or electrocardiographic manifestation of ischemic heart disease. The test was positive in 18% chronic smokers and 4% in non-smokers, the chances of positivity of stress test was 4-5 times greater in chronic smokers than in non-smokers. In study too smokers had higher chance of having CAD (55%, Odds ratio 1.52 (95 % CI: 0.59 to 3.93), p value -0.38) compared with other patient groups though not statistically significant.

Miller TD et al[7] directly compared the sensitivity and specificity of treadmill testing in 3,213 women vs. 5,458 men using myocardial perfusion as the reference standard. In the smaller subset of the study patients referred for coronary angiography (205 women, 838 men), the false-positive rate was again higher in women (13% vs. 7%, p = 0.003), but neither specificity (69% vs. 74%, p = NS) nor accuracy (60% vs. 66%, p = NS) was different between the sexes. Gender difference of CAD also seen in this study showed that males with stress test positive had significantly higher chances of having CAD than females (53% vs 35% respectively) with odds ratio(OR) : 2.08, 95 % CI: 1.30 to 3.32 ,p value-0.002).

In this study exercise test has proved to be important to detect early CAD in patient with stable ischemic heart disease but significantly more those of male gender , diabetics & smoker or combination of two or more CAD risk factors compared to those of female in whom chances of having a false positive test positive is much higher. But the study has been limited by small sample size among subgroups of patients which may be the reason not finding a significant relation between the groups.

Conclusion:

The study shows that the pretest probability of detection of stable CAD with treadmill stress-test is highest in males with two or more CAD risk factor especially diabetes and smoking compared to the female counterparts with similar factors.

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