

Comparative study of treadmill test positive patients with coronary artery profile on coronary angiography in patient presenting with chest pain in BPKIHS, Dharan, Nepal

Achyut Gyawali¹, Prahlad Karki¹, Naveen Kumar Pandey¹, Brijesh Pandey¹, Sanjay Shrestha¹, Rajan Thapa¹, Binam Shrestha¹, Payal Gupta¹, Rajesh Kumar Mandal², Nilisha Neupane³

¹Department of Cardiology, BPKIHS, Dharan, Nepal

²Department of Gastroenterology and Hepatology, BPKIHS, Dharan, Nepal

³Beyond Borders, Program manager, Nepal

ABSTRACT



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BACKGROUND

Diagnosis of Coronary artery disease by Coronary artery angiography is limited by its availability, cost and as an invasive procedure. Treadmill test is a noninvasive and easily available test for diagnosing as well as prognosis of coronary artery disease and is most commonly performed stress test for diagnosis of coronary artery disease. Treadmill test is often used as an initial assessment of patient with suspected coronary artery disease serving as a poor man's angiogram

METHODS

This was a cross sectional observational study carried out over a period from 25th August 2023 to 25th November 2023 in Department of Cardiology. A total of 100 patients with positive Treadmill test underwent CAG and subsequently analyzed for the presence of CAD were enrolled in the study. TMT test was done using Bruce Protocol and results were classified as positive and negative upon ECG changes. Data about Socio demographic profiles, clinical data, major comorbidity, the presumed risk factor for CAD were entered in MS Excel and analyzed through SPSS 25.

RESULTS

A total of 100 patients were enrolled in the study. Males were 45(45%) and females were 55(55%). The mean age of the patient was 53.38 ± 16.7 years and 44.27 ± 13.8 years in male and female group respectively. Smoking (82%) was the number one risk factor in male group and Hypertension (52%) in female group.. Significant CAD was seen in 33% of cases and normal coronaries in 45%. The most common coronary artery involved having significant disease during coronary angiogram was LAD in 25% of cases

CONCLUSIONS

There was a significant correlation between positive TMT Results and coronary artery disease in coronary angiography.

KEY WORDS

Coronary angiography; coronary artery disease; Tread mill stress test.

*Corresponding Author |
Dr. Achyut Gyawali
Department of Cardiology, BPKIHS, Dharan, Nepal
Email: achyutgyawali838@gmail.com

INTRODUCTION

American college of cardiology (ACC) has developed a consensus as to which patients are at increased risk for cardiac events, and which patients should be screened. Stress testing is warranted if the patients have typical or atypical cardiac symptoms. Silent ischemia is a frequent occurrence in patient with diabetes which is a major risk factor of CAD. A resting ECG showing evidence of an infarction warrants stress testing. The accuracy of TMT in predicting coronary heart disease depends on Bayes theorem. In asymptomatic patient with predisposing factors for CADs can be diagnosed with an abnormal TMT by > 90% accuracy.¹ CAG is used as a gold standard for the diagnosis of CAD. Even though the TMT is a cost effective, easily available, and widely applicable approach for early diagnosis of CAD, it has a relatively low sensitivity and specificity. Specificity of TMT is lowered by somewhat by resting ST depression of less than 1mm, although it is the first option in evaluation of possible CAD in such patients with an intermediate pretest probability. Specificity is also lowered by LVH with less than 1mm of ST depression and use of digoxin with less than 1mm depression, but the standard exercise test is still a reasonable option in such patients.²

In contrast, other baseline ECG abnormalities such as pre-excitation, ventricular pacing, greater than 1mm of ST depression at rest, and complete LBBB affect the diagnostic performance of the exercise test. Imaging modalities are preferred in these subsets of patients. In the elderly, due to the higher prevalence of coronary artery disease, it has got a slightly higher sensitivity than in younger patients with a slightly lower specificity, which may reflect the coexistence of LVH due to valvular disease and hypertension.³ Though in a high-risk patient abnormal TMT is highly predictive of a coronary heart disease with more than 90% accuracy but a relatively normal or inconclusive TMT may not reflect the absence of significant disease in a person with the same risk factors. Similarly, in a low-risk patient a normal TMT is a very predictive of the absence of significant coronary heart disease with more than 90% accuracy but a abnormal test may reflect a "false positive TMT". For low pretest probability of disease, TMT is a good non-invasive test to assess the functional capacity and functional testing of patients. To avoid the risk of invasive procedures of angiography in low to intermediate risk patients there are many noninvasive methods for evaluation including the TMT, stress echocardiography, stress myocardial perfusion scintigraphy, pharmacologic nuclear stress testing, electron beam Computed Tomography (EBCT), multidetector CT(MDCT), and stress MRI. Exercise TMT being noninvasive, relatively inexpensive and widely used in clinical settings. Exercise tolerance testing is widely used as a diagnostic test in the initial evaluation of patients with symptoms suggestive of myocardial ischemia and in persons with previously recognized coronary heart disease.

METHODS

This is a prospective observational hospital-based study carried out in the department of cardiology at BPKIHS, Dharan from 25th August 2023 to 25th November 2023 After approval from institutional ethical committee. Informed consent was taken from each participated patients with positive treadmill test and were admitted for coronary angiography at this center.

INCLUSION CRITERIA

1. Patient presenting with chest pain possibly ischemic in origin (atypical chest pain)
2. Patient's symptoms not suggestive of acute coronary syndrome.
3. Not a known case of CAD
4. No prior acute coronary syndrome, prior PCI or CABG
5. TMT positive patient with atypical chest pain

EXCLUSION CRITERIA

1. Patients presenting with classical angina or non-cardiac chest pain.
2. Baseline ECG abnormalities such as LVH with ST segment depression > 1mm, LBBB, pre-excitation, ventricular pacing, >1mm ST depression.
3. Patients not able to perform TMT or are having contraindication for TMT.

STUDY ASSESSMENT

American college of cardiology (ACC) has developed a consensus as to which patients are at increased risk for cardiac events, and which patients should be screened. Stress testing is warranted if the patients have typical or atypical cardiac symptoms. Silent ischemia is a frequent occurrence in patient with diabetes which is a major risk factor of CAD. A resting ECG showing evidence of an infarction warrants stress testing. The accuracy of TMT in predicting coronary heart disease depends on Bayes theorem. In asymptomatic patient with predisposing factors for CADs can be diagnosed with an abnormal TMT by > 90% accuracy.¹ CAG which is used as a gold standard for the diagnosis of CAD. Even though the TMT is a cost effective, easily available, and widely applicable approach for early diagnosis of CAD, it has a relatively low sensitivity and specificity. Specificity of TMT is lowered by somewhat by resting ST depression of less than 1mm, although it is the first option in evaluation of possible CAD in such patients with an intermediate pretest probability. Specificity is also lowered by LVH with less than 1mm of ST depression and use of digoxin with less than 1mm depression, but the standard exercise test is still a reasonable option in such patients.²

RESULTS

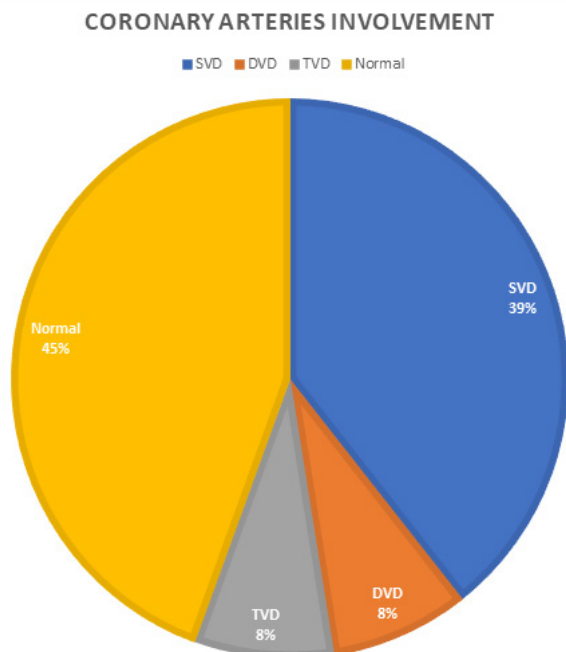
A total of 100 patients were enrolled in the study. Males were 45(45%) and females were 55(55%). The mean age of the patient was 53.38±16.7 years and 44.27±13.8 years in male and female group respectively. Smoking (82%) was the number one risk factor in male group followed by hypertension, dyslipidemia, diabetes and overweight whereas Hypertension (52%) was number one risk factors in in female group. (Table 1)

Table 1. Baseline clinical characteristics of the patients Characteristics

| Characteristics | Total Patients (N=100) | | P Value |
|------------------------|------------------------|---------------|---------|
| | Male (n=45) | Female (n=55) | |
| Age of patients (yrs.) | 53.38±16.7 | 44.27±13.8 | 0.004 |
| Diabetes | 13(28.8%) | 23(41.8%) | 0.184 |
| Hypertension | 23(51.1%) | 29(52.7%) | 0.874 |
| Smoking | 37(82.2%) | 8(14.5%) | 0.000 |
| Dyslipidemia | 17(37.7%) | 15(27.2%) | 0.267 |
| Body Mass Index | | | |
| Normal | 29(64.4%) | 47(85.4%) | 0.026 |
| Overweight | 12(26.6%) | 7(12.7%) | 0.079 |
| Obese | 3(6.6%) | 2(3.6%) | 0.494 |

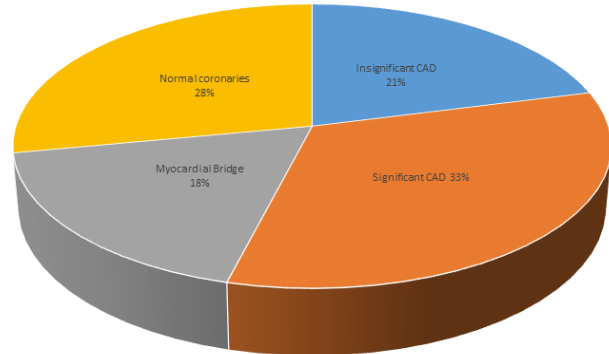
Out of 100 patients the coronary angiogram showed normal coronaries in 45% of patients. SVD was present in 39% of cases, DVD and TVD was present in 8% of cases. (Fig 1)

Fig 1: Distribution of coronary artery disease



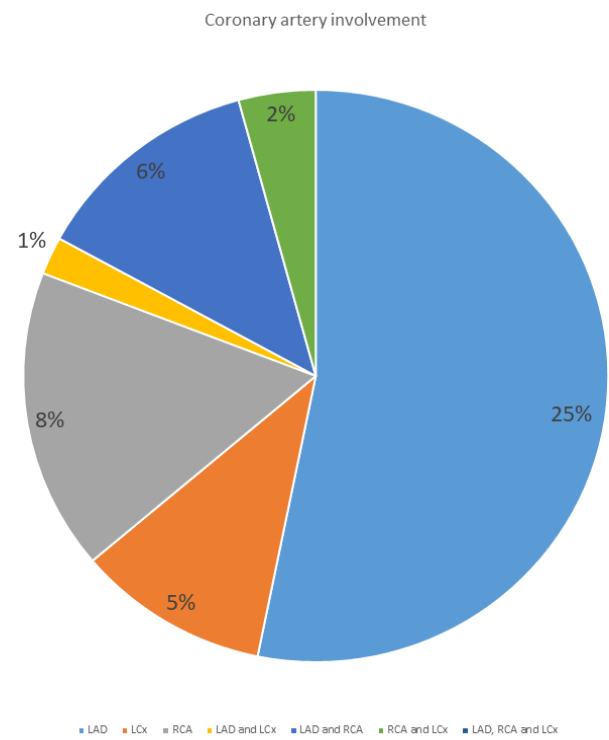
Out of 100 patients with positive Treadmill test Significant CAD was seen in 33% of cases and insignificant disease was present in 21% of cases, myocardial bridge was present in 18% of cases. (Fig 2)

Fig 2: CAG findings in patient with positive TMT



Out of 100 patients, the most common coronary artery involved having significant disease during coronary angiogram was LAD in 25% of cases followed by RCA in 8% of cases and LCx in 5% of cases. Among significant disease SVD was seen in 39% of cases followed by DVD in 8% and TVD in 8% of cases. (Fig 3)

Fig 3: Distribution of Coronary artery involvement



DISCUSSION

Coronary artery disease is a rising scourge in developing and underdeveloped countries. It remains the most common single cause of mortality and morbidity. For early diagnosis of CAD, before the occurrence of major mishap like myocardial infarction, treadmill stress test remains a chief, cost effective and widely available and applicable approach. The advent of selective coronary arteriography has enabled the clinician to correlate in vivo coronary artery anatomy with such non-invasive tests as exercise electrocardiography. People who are at high risk for coronary artery disease and positive TMT is highly suggestive of the presence of coronary artery disease. Even though the TMT remains a cost effective, easily available and widely applicable approach for early diagnosis of CAD, it has relatively low sensitivity and specificity.

Stress testing has been used since the late 1920s as a convenient, noninvasive way to assess for exercise induced myocardial ischemia.⁴ The diagnostic rate of CAD has been dramatically increasing with the development of interventional technique which makes coronary angiography the gold standard tool for CAD diagnosis.⁵ However limited by its invasive property TMT is usually used as an economic and simple method to screen and assist in diagnosis of patients with known or suspected CAD.⁶ However, with chances of false positive and negative tests, especially in patients with atypical or no angina pectoris is one the problem of test being not highly specific.⁷

Gianrossi et al. investigated the diagnostic accuracy of ETT through a meta-analysis including 147 published reports involving 24,074 patients who underwent both coronary angiography and ETT. There was a wide variability in sensitivity and specificity of ETT [sensitivity $68 \pm 16\%$ (range 23–100%); specificity $77 \pm 17\%$ (range: 17–100%)]. Another Meta analysis showed sensitivity of $81 \pm 12\%$ (range: 40–100%) and specificity of $66 \pm 16\%$ (range: 17–100%).⁸

In chronological order Alen G. Bartel established the angiographic severity of coronary artery disease correlates strongly with the frequency of positive exercise stress test.⁹ Left main coronary stenosis of 70% or greater was associated with more severe ST segment changes, inability to achieve target heart rate during stress, and lower maximum heart rate during stress. He demonstrated the angiographic occurrence of collateral vessel was related to the extent of coronary artery disease and was associated with high percentage of positive exercise tests.

Later, Jaishankar et al reported that incidence of extensive Triplet vessel disease with probable diffuse disease is more in patients with diabetes.¹⁰ They also suggested the extent of left ventricular dysfunction associated with single vessel disease is more in diabetics and coronary artery disease with multiple vessels involvement is more common in patients

with diabetes and they also have a greater incidence of diffuse disease.

In this study exercise test has proved to be important to detect early CAD in patient with ischemic chest pain 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 and low absolute number of study end points. The preferential selection of patients based on an abnormal exercise test response for referral to CAG to verify CAD (Work up bias) may be seen as an apparent increase in sensitivity and decreased specificity in this study.

CONCLUSION

Despite of wide variability of sensitivity and specificity of treadmill test, this test still is useful for the evaluation of chest pain because of its simplicity and its cost effectiveness. It is one of the non-invasive tests that help in diagnosis of CAD especially patients with chest pain and normal ECG. There is significant correlation between TMT results and CAG findings.

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