

Coronary artery profile on coronary angiography in TMT positive female patients presenting in BPKIHS, Nepal

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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% accuracy¹. 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

Abstract

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. Women tend to have a greater release of catecholamines during exercise, which could potentiate coronary vasospasm and augment the incidence of abnormal exercise results. TMT in women have a relatively low diagnostic yield for CAD compared to men, especially when symptoms are atypical or non-specific.

Aim and Objective: To analyze the coronary artery profile on Coronary Angiography (CAG) in TMT positive female patients.

Methods: This was a cross sectional observational study carried out over a period from 15th July 2024 to 15th October 2024 in Department of Cardiology. A total of 64 female patients with positive Treadmill test and underwent CAG after pre-test probability

Results: A total of 64 patients were enrolled in the study. The mean age of the patient was 53.38±16.7 years. Hypertension was present in (43.8%) study female as most common risk factors. DM female patient was 35.9% study patients. Dyslipidemia was seen in 34.4% patients. CAD was seen in 29.7% of cases with significant CAD in 18.97% study patients. The most common coronary artery involved having significant disease during coronary angiogram was LAD in 38.89% of cases with CAD. Two third of patient who had CAD was at high pre-test probability categories.

Conclusions: TMT has a low predictive value of CAD in female patients except those female TMT positive patients with a high pre-test probability score.

digoxin with less than 1mm depression, but the standard exercise test is still a reasonable option in such patients².

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 hypertension³. Though in a high-risk patient

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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. TMT in women have a relatively low diagnostic yield for CAD compared with men, especially when symptoms are atypical or non-specific^{4,5,6}.

TMT has been reported to have sensitivity of 70% and specificity of 61% for detection of CAD in women^{6,7,8}. The relative lack of evidence regarding the diagnostic accuracy of TMT in females is challenging^{6,7,8}. TMT in women has questionable reputation both with cardiologist and the primary care physician. Women tend to have a greater release of catecholamines during exercise, which could potentiate coronary vasospasm and augment the incidence of abnormal exercise results. False positive results have been reported to be more common during menses and preovulation. Data from a meta-analysis depicting a specificity of 70% suggests false positivity of around 30% in TMT positive patients⁵. Coronary angiography is used to establish the presence or absence of coronary artery stenosis due to CAD. This provides the most reliable anatomical information for definite therapeutic options

Methods

This is a prospective observational hospital-based study carried out in the department of cardiology at BPKIHS, Dharan from 15th July 2024 to 25th October 2024 After approval from institutional ethical committee. Informed consent was taken from each participated patients with positive treadmill test. Patients were categorized into low, intermediate and high pre-test probable groups on the basis of pre-test probability score system (Table 1) and coronary angiography was done at this center.

Table 1: Pre-test score method

RISK FACTOR	SCORE
Age	
<50	03
50-60	06
>65	09
Symptoms	
Typical angina	05
Atypical angina	03
Non-specific chest pain	01
Co-morbid Illness	
Diabetes mellitus	
Hypertension	02
Obesity	01
Dyslipidemia	01
Smoking	01
Estrogen Status	
Positive	03
Negative	-03
Total Probability Score	
Low	06 to 08
Intermediate	09 to 15
High	16 to 24

Inclusion criteria:

1. TMT positive female patients.
2. Female 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

Exclusion Criteria

1. Patients presenting with classical angina or non-cardiac chest pain.
2. Known case of CAD, prior PCI or CABG.
3. Not willing to give consent

Study assessment

All female patient with Positive Tread mill test were subjected to detailed history of risk factors associated with CAD (Diabetes, Hypertension, Dyslipidemia, Smoking), height and weight were taken for calculation of BMI. Patients were categorized into low, intermediate and high pre-test probable groups on the basis of pre-test probability score system and all were subjected to coronary angiographic evaluation at Department of Cardiology, BPKIHS, Dharan CATH LAB by cardiology faculty. Interpretation of coronary angiogram for coronary artery disease was performed. Coronary artery quantification was done in at least two orthogonal views. The criteria for significant CAD were defined as > 50% stenosis of Left Main, > 70% stenosis in a major coronary vessel (LAD, RCA & LCx) in coronary angiogram and insignificant coronary artery disease as < 50% stenosis in coronary angiogram. Patients with significant coronary artery lesions was further classified based on number of major coronary artery involved as SVD, DVD and TVD.

Results:

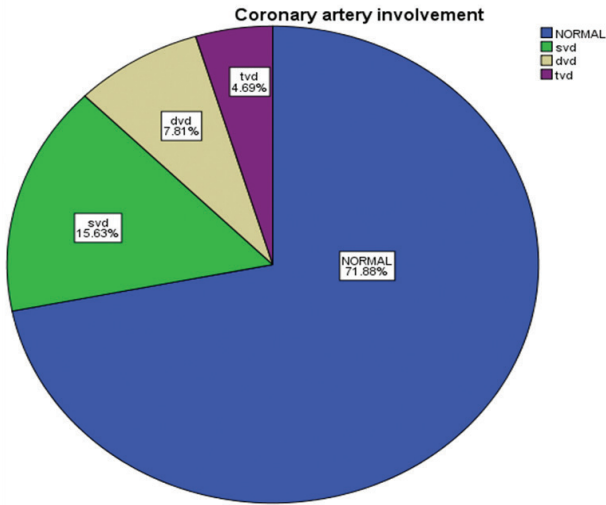
A total of 64 female patients were enrolled in the study. The mean age of the patient was 53.38±16.7 years. Hypertension (43.8%) was number one risk factors in female group. DM, Dyslipidemia as important risk factors (Table 2).

Table 2. Baseline clinical characteristics of the patients Characteristics

Characteristics	Total Patients (N=64)		P Value
	YES	NO	
Diabetes	23(35.9%)	41(64.1%)	0.184
Hypertension	28(43.8%)	36(56.2%)	0.874
Smoking	5(7.8%)	59(92.2%)	0.000
Dyslipidemia	22(34.4%)	42(65.6%)	0.267
Body Mass Index			
Normal	49(%)		
Overweight	10(%)		
Obese	3(%)		

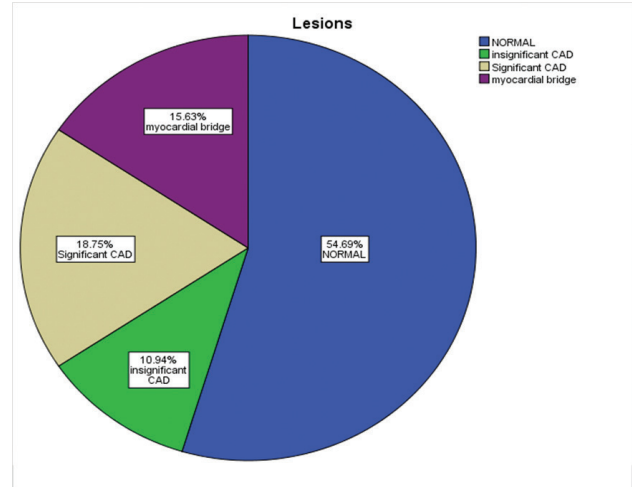
Out of 64 patients the coronary angiogram showed normal coronaries in 71.88% of patients. SVD was present in 15.63% of cases, DVD and TVD was present in 7.81% and 4.69% of cases respectively. (Fig 1)

Fig 1: Distribution of coronary artery disease



Out of 64 female patients with positive Treadmill test, Significant CAD was seen in 18.75% of cases and insignificant disease was present in 10.94% of cases, myocardial bridge was present in 15.63% of cases. (Fig 2)

Fig 2: CAG findings in patient with positive TMT



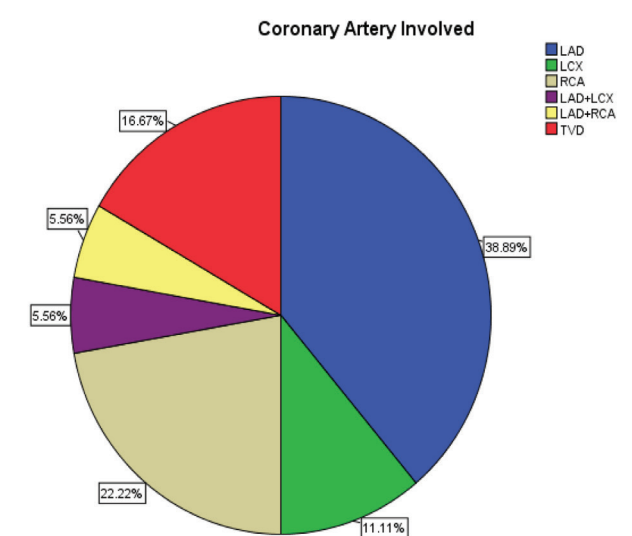
Out of 64 patient, 22,27 and 15 of study population falls under low, intermediate and high probability of CAD respectively. 2 patients in low probability, 5 patients in intermediate probability and 11 patients in high probability had coronary lesion in angiography. (Table 3)

Table 3: Prevalence of CAD by Pre-test score

	Low proba-bility	Intermediate probability	High proba-bility
No of patients	22	27	15
CAD	2(9.1%)	5(18.5%)	11 (73%)
SVD	1(50%)	3 (60%)	6 (54.5%)
DVD	1 (50%)	1 (20%)	3 (27.2%)
TVD	0	1 (20%)	2 (18.2%)

Out of 64 female patients, those with CAD, the most common coronary artery involved having significant disease during coronary angiogram was LAD in 38.89% of cases followed by RCA in 22% of cases and LCx in 11.11% of cases. Among significant disease TVD was seen in 16.67% 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 ischemia⁹. 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 diagnosis¹⁰. 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 CAD¹¹. 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 specific².

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%)¹².

Exercise stress test has been reported to have a sensitivity of 70% and specificity of 61% for the detection of CAD in women^{4,5}. In a review of nine studies correlating exercise induced ST segment changes with angiographic findings in female patients, the prevalence of CAD ranged from 18% to 40%. In our study, the prevalence of angiography documented CAD was 28.2% with significant CAD in 18.75% in TMT positive women.

In a study by Tartangoglu et al¹³. one hundred and twenty postmenopausal females with typical angina or atypical chest pain underwent TMT of which 110 had undergone angiography. A positive predictive value of 78% and a negative predictive of 80% were determined. Single Vessel Disease (SVD) was found to be the most common form of CAD. In our study, single vessel disease was seen in 71.1% consistent with the above study. Among single vessel LAD artery disease was seen in 38.87% followed by RCA 22.22%, and LCX 11.11%.

TMT in women to detect CAD has low sensitivity and specificity^{4,5,6}. The diagnostic yield of TMT in females results from lower prevalence of CAD in females^{6,7}. Women tend to have a greater release of catecholamines during exercise, which could potentiate coronary vasospasm and augment the incidence of abnormal ECG results, moreover false positive results have been reported to be more common during menstruation and preovulation⁸.

Glaser and Clark correlated the ST fluctuation with estrogen and progesterone levels concluding that only estrogen fluctuation has a correlation with ST segment changes⁸.

In a study by Martin and Conalay et al¹⁴. and Bruce Hossack et al.¹⁵ maximum (75% to 80%) diagnostic value of ST segment depression is contained in leads V4-V6 and at times in V5R. In our study patients having severe CAD, i.e. triple vessel disease, ST depression was seen in leads V4 –V6, thereby indicating ST segment depression in leads V4-V6 of severe degree of CAD.

In a study by Morise and Beckner¹⁶ sixty percent of patients had CAD on angiography belonging to high probability group compared with 40% with intermediate group and 16% in low pre-test probability

group. In our study, the incidence of CAD was 80% in high pre-test probability group compared to 4% in low pre-test probability group

In this study exercise test has proved to be important to detect early CAD in TMT positive patients but had significantly lower predictive value for those of female gender, whom chances of having a false positive test positive is much higher compared to male. 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 non-invasive tests that help in diagnosis of CAD. There is variable correlation between TMT results and CAG findings. TMT has a low predictive value for detecting CAD in female patients with low and intermediate pre-test probability.

Conflict of Interest: None.

Acknowledgement: None

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