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Correlates of treadmill test results among hypertensive patients with ischemic heart disease

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Abstract

Introduction: Coronary artery disease (CAD), also called heart disease or ischemic heart disease, results from a complex process known as atherosclerosis, fatty deposits (plaques) of cholesterol and other cellular waste products build up in the inner linings of heart's arteries.

Methodology: Detailed history was taken and thorough clinical examination was done as per the proforma with particular reference to coronary risk factors. Relevant biochemical investigations and risk factor stratification was carried out in every case of IHD.

Results: All the patients with hypotensive and flat or non-raising blood pressure response were positive for IHD while 39.28% and 21.42% of patients with normal and hypertensive response were positive for IHD.

Conclusion: To improve the prognostic outlook in hypertensives one should aim to improve all the risk factor interventions considering the total cardiovascular risk profile.

Keywords: Hypertension, TMT, Risk factor

1. Introduction

Coronary artery disease is one of the main reasons for deaths in the developed as well as developing countries. The World Health Organisation predicts that by 2020 CAD will become the world's most important cause of death and disability. In today's world, most deaths are attributable to non-communicable diseases; 32 million and just over half of these, 16.7 million are as a result of CAD. More than one-third of these deaths occur in middle aged adults. In developed countries heart disease is the first cause of death for adult men and women [1, 2]. India is facing an epidemiological transition for prevalence of CAD. Prevalence of urban population increased from 3.5% in 1960s to 10.5% in 1990s and the corresponding change for the rural population was from 2% to 4%. The rates appear to be highest in South India which had the highest number of deaths in the world due to CAD in 2002 – nearly 1.5 million and which is expected to double by 2015 [3].

Coronary artery disease (CAD), also called heart disease or ischemic heart disease, results from a complex process known as atherosclerosis, fatty deposits (plaques) of cholesterol and other cellular waste products build up in the inner linings of heart's arteries. It is the failure of coronary circulation to supply adequate blood to cardiac muscles and surrounding tissues. The American Heart Association has identified several risk factors. Some of them can be modified, treated, or controlled, but some cannot. The modifiable risk factors are tobacco smoke, high blood cholesterol, high blood pressure, physical inactivity, obesity and overweight, diabetes mellitus, and stress. The non-modifiable risk factors are increasing age, sex, and heredity [4]. The incidence of CAD in young adults is increasingly mainly due to tobacco consumption, lack of physical activity, sedentary lifestyle, and obesity. This includes history of one or more risk factors, mainly smoking (76.8%), obesity (20%), hypertension (19%), hypercholesterolemia (18.5%), diabetes mellitus (17%), and family history of previous myocardial infarction [5].

2. Methodology

Patients were instructed to report for their stress tests either after on overnight fast of three hours after a light meal. Detailed history was taken and thorough clinical examination was done as per the proforma with particular reference to coronary risk factors. Relevant biochemical investigations and risk factor stratification was carried out in every case of IHD. Routine pre-test electrocardiogram was taken in every case. Careful consideration was given to rule out any possible contraindication for stress testing. Medications which would interfere with the interpretation of the test (Digitalis, Nitrates, Calcium channel blockers etc.,) were withdrawn 48-72 hours before the procedure wherever possible.

All the patients were fully instructed regarding the entire procedure of the exercise ECG test. Necessary cardio-pulmonary resuscitative equipments including a defibrillator were ready for emergencies. Preparation of the subjects included through cleaning of the skin with sprit, application of prejelled self-adhesive chest electrodes after mild dermal abrasion, so as to ensure electrocardiographic signals free from electrical disturbances.

Electrocardiogram and blood pressure recordings were taken at rest in both supine and standing posture. The recordings were repeated after hyperventilation for 30 seconds. After demonstrating to the patient how to walk on the treadmill, the exercise was started using the standard preselected protocol. Blood pressure was recorded at the end of every stage and more frequently, if needed according to the clinical circumstances. Electrocardiogram (12- lead) was monitored continuously on the screen with frequent 3- lead or 12- lead average recordings taken according to the clinical circumstances.

Exercise ECG test was terminated when patient developed significant symptoms like increasing chest pain, giddiness, dyspnoea, exhaustion (symptom-limited) or hypotension, marked ST depression, serious arrhythmias etc.,

Electrocardiographic monitoring and blood pressure recordings were contained during the recovery period for a minimum period of 6 minutes or till the abnormal changes reverted back to resting state.

ST-segment response was interpreted according to the standard criteria. The following ST segment changes were considered significant:

1. Horizontal or down sloping ST depression of 1mm or greater at (08ms) from the J point (1.5mm if it is up sloping)
2. ST-segment elevation of 1mm or more the control tracing in any lead except aVR.
3. In the presence of ST-depression in the control tracing, additional depression of 1.0mm more than the rest.

Other variables like, Heart rate response, Blood pressure response, pseudonormalisations, changes is R wave amplitude etc. Were taken into account in relevant cases.

After interpreting the stress test as normal or abnormal, appropriate advice was given to the patients.

Selected patients were later subjected to CORONARY ANGIOGRAPHY to assess the coronary anatomy and left ventricular function. Patients with significant Coronary artery disease (CAD) underwent REVASCULARISATION procedures like coronary artery by-pass grafts and percutaneous Tran's luminal coronary angioplasty at higher centres.

3. Results

Table 1: Age distribution and its correlation with test results.

Age (Yrs.)	Total No.	Negative	Positive (%)
21-30	1	1	---
31-40	8	7	1(12.5)
41-50	21	13	8 (38.09)
51-60	10	4	6 (60)
> 60	10	3	7 (70)
Total	50	28	22 (44%)

The above table shows maximum number of patients were in age group 51-60 years. The percentage of positive tests in >60 years and then 41-50 years of age.

Table 2: Sex distribution and its correlation with test results.

Sex	Total No.	Negative	Positive (%)
Male	39	20	19 (48.7%)
Female	11	8	3 (28.2%)

The sex distribution in the study revealed a male to female ratio of 3.5:1. In the group positive for IHD male to female ratio was 6.3:1. Overall 48.7% of male patients and 27.2% of female patients were positive for IHD (1.79:1).

Table 3: Correlation of physical activity of the patients with the test results.

Activity	Total No.	Negative	Positive
Sedentary	11	5	6 (54.5%)
Moderately			
Active	19	10	9 (47.3%)
Active	20	13	7 (35%)
	50	28	22

It is observed that maximum positive results for IHD were encountered in the sedentary individuals (54.5%).

Table 4: Correlation of Blood Pressure response

BP response	Total	Negative	Positive
Normal	28	17	11 (39.28%)
Flat	5	0	5 (100%)
Hypotensive	3	0	3 (100%)
Hypertensive	14	11	3 (21.42%)

All the patients with hypotensive and flat or non-raising blood pressure response were positive for IHD while 39.28% and 21.42% of patients with normal and hypertensive response were positive for IHD.

Table 5: Correlation of resting ECG changes with the results.

Resting ECG	Total	Negative	Positive
Normal	44	27	17 (38.63%)
ST-T Changes	6	1	5 (83.33%)

38.63% of the patients were positive for ischaemia when resting ECG was normal and 83.33% of patients were positive for ischaemia even though their resting ECG showed ST-T changes.

Table 6: Correlation with recovery time.

Time in minutes	Positive
4-6	5
7-8	8
>9	9

This result shows 9 positive cases out of 22 cases taken more than 9 minutes and 8 cases taken 7-8 minutes and 5 cases 4-6 minutes from ST depression to normal ST pattern.

Table 7: Correlation with DBP

Diastolic	Total No.	Negative	Positive
72-78	4	2	2 (50%)
80-88	15	8	6 (40%)
90-98	18	12	6 (33.3%)
100-110	13	5	8 (61.5%)

Diastolic pressure 70-78mm Hg shows 50% of positive tests and 100-110 shows 61.5% of positive tests.

Table 8: Correlation with SBP

Systolic	Total No.	Negative	Positive
110-118	2	1	1 (50%)
120-128	5	3	2 (40%)
130-138	7	4	3 (42%)
140-148	12	9	3 (25%)
150-158	10	6	4 (40%)
160-168	7	4	3 (42%)
170-178	3	1	2 (66%)
180-188	1	0	1 (100%)
190-200	2	0	2 (100%)
> 210	1	0	1 (100%)

Systolic pressure 170-210 mm Hg shows 100% positive tests and 120-160mm Hg shows increasing positive tests as increasing the pressure except for 140-148 mm Hg and 110-118 shows 50% positive tests.

Table 9: Correlation with duration

Duration in years	Total No.	Negative	Positive
1-5	8	7	1 (12.5%)
6-10	7	5	2 (28.57%)
11-15	10	7	3 (30%)
16-20	12	6	6 (50%)
21-25	10	3	7 (70%)
> 25	3	0	3 (100%)

This result shows chances of IHD increases with duration of hypertension.

4. Discussion

Arterial hypertension is a well-documented risk factor for cardiovascular diseases but other factors also contribute to increased CVD risk. All the known CVD associated factors should be regarded as ingredients in a total CVD risk profile. Many studies have been shown that the same risk factors known to operate in normotensives and untreated hypertensives are also operative is treated hypertensives.

Despite the favorable effort of antihypertensive treatment on overall CVD morbidity both total mortality and CVD morbidity remain higher in treated hypertensive than in normotensives and in the total population whether this is due to inadequate blood pressure control inadequate interventions on other risk factor, negative effects on CVD risk from antihypertensive drugs or starting intervention too late in life is unknown.

Most investigators have found that angina pectoris is more frequently found in hypertensive than in normotensive persons and this association increase continuously as blood pressure level increase. Hypertension is present in about 50% of men with angina this percentage is higher is women Eppinger and Levine in 1934 considered the rarity of normal blood pressure is women with angina pectoris helpful in diagnosis of the presence of angina preceding the first diagnosed acute myocardial infarction about 50% had a history of systemic hypertension.

In our study 27(54%) patients had typical angina and 17 patients out of 27 had positive test for ischaemia. Out of 39 males 19 (48.7%) had angina and out of 11 femals 8 (72.7%) had angina. William J. Elliot in 1983 analysed risk factors in 112 patients [6].

Table 10: Comparison

Risk factor	IHD		Non IHD	
	Elliots Present		Elliots Present	
Hypertension	48.14%	44%	45.16%	56%

Prevalence of IHD in hypertension less in present study than Elliots study and non IHD is more than elliots study compared to present study.

A 12 years follow up study by primary prevention trial in Goleberg Sweden for treated hypertensives surprisingly showed systolic and diastolic BP there seemed to be a level (Approximately 150 and 85mm Hg respectively) below which further reduction of BP had no additional benefit from treatment [7]. And a study by John M. Cruickshank and his Associates from clatterbridge Hospital England had also showed that lowering a raised diastolic blood pressure to below 85 mmHg may be associated with an increase in coronary artery disease may be harmed by a lowering of blood pressure [8].

In present study diastolic blood pressure in treated patients 70-78 mmHg shows 50% of positive tests and 80-88 mmHg shows 40% of positive tests and 90-98 mmHg shows only 33.3% positive tests and 100-110 mmHg shows 61.5% of positive tests. And is systolic blood pressure 110-118 shows 50% of positive test and 150-158 shows only 40% of positive tests and above 158 mmHg shows increasing percentage of positive test with increasing systolic pressure.

In present study correlation with duration of hypertension, positive tests. Percentage increase with the duration of hypertension. 1 to 5 years of duration of hypertension shows 12.5% of positive tests and 16-20 years 50% and 21-25 years 70% and >25 years 100% of positive test.

Patients those are taking antihypertensive treatment shows 40.5% positive tests and those who are not on treatment shows 62.5% of positive tests. This definitely shows risk of ischaemic heart disease is proportional to the level of the blood pressure.

Other risk factors of IHD are diabetes, smoking, raised cholesterol and family history of hypertensive. A comparison with Willaim J. Elliot study[6] and present study is as follows.

Risk Factors	IHD		Non IHD	
Diabetes	23.45%	75%	12.90%	25%
Raised cholesterol	29.63%	58.8%	12.90%	41.17%
Smoking	28.02%	69.3%	51.61%	30.7%
F/H of HTN	45.60%	57.2%	41.93%	42.8%

Present study shows hypertension, with other risk factors definitely contributing to increased risk of coronary artery disease. Hypertension associated with other risk factors almost doubled the risk of ischaemic heart disease.

To improve the prognostic outlook in hypertensives one should aim to improve all the risk factors interventions considering the total cardiovascular risk profile.

CVD morbidity is still highest in the hypertensives compared with the normotensive because the risk of CVD is multifactorial. So care of hypertensive subjects should be improved.

5. Conclusion

The risk of complications of systemic hypertension is proportional to the level of the blood pressure and lowering the level decreases the frequency of complications of hypertension.

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