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# A STUDY OF TREAD MILLTESTING SCREENING FOR DETECTING SILENT ISCHEMIA AMONG DIABETIC PATIENTS

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**ABSTRACT**
Cardiovascular disease and Diabetes Mellitus (DM) occupy the first and eight places respectively in the list of killer diseases worldwide. Together, they account for over 7, 00,000 deaths a year in the U.S alone. The interplay between the two produces even more disastrous consequences in patients who suffer from both. Early recognition of coronary artery disease in diabetes may therefore be important for prognostic and management purposes. To investigate the usefulness of clinical and ECG findings during Treadmill test in detecting silent ischemic in asymptomatic diabetes and to identify any association between positive Treadmill test and other risk factors of Coronary heart disease. A case series study of 50 patients with diabetes mellitus was included in the study. Socio-demographic profile, clinical profile and risk factor profile of the patients was collected and subjected to Tread Mill testing with simultaneous ECG recording to look for signs of ischemia. Overall proportion of silent ischemia was 28%. A statistically significant association between proportion of silent ischemia and abnormal lipid profile, abnormal waist hip ratio and presence of complications. Diabetes mellitus is an important and major risk factor for silent ischemic heart disease where in Tread Mill Testing is important tool to screen and thereby help in early recognition of silent ischemia.

## INTRODUCTION

Diabetes mellitus is the most common endocrinal disease in the world today. It is major health care problem, not only in developed nations, but also in the developing nations like India. Indeed amongst the various ethnic groups, Asian Indians seem to be at a particularly greater risk of developing diabetes [1].

Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease [2,3]. In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively. According to Wild et al [4] the prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India. It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India, while China (42.3 million) and the United States (30.3 million) will also see significant increases in those affected by the disease [5]. India currently faces an uncertain future in relation to the potential burden that diabetes may impose upon the country.

Cardiovascular disease and Diabetes Mellitus (DM) occupy the first and eight places respectively in the list of killer diseases worldwide. Together, they account for over 7, 00,000 deaths a year in the U.S alone [6]. The interplay between the two produces even more disastrous consequences in patients who suffer from both. The cause of worry is that CHD and DM if taken together, may rival with infectious disease as the leading cause of death in India, and is not too distant future according to a WHO

report on disease control priorities in developing countries [7]. The prevalence of heart disease has also been on the rise in India. The prevalence of CHD among diabetes was estimated to be (17.8%) in a study in South India by Mohan et al. The fact that diabetes has an increased incidence of heart disease and vice-versa indicates that the link between the two is more than a coincidence [8].

Silent Myocardial Ischemia (SMI) has recently caught the attention of physicians and investigators in a big way. Even among the patients with symptomatic coronary artery disease many episodes of silent ischemia have been observed. Diabetes mellitus is an important and major risk factor for both silent and symptomatic ischemic heart disease [9]. Because of its frequency and its role as the cause of deaths in the majority of diabetic patients, the salient features of ischemic heart disease in the diabetic are the subject of this limited study with special reference to the clinical, ECG and exercise ECG profile. Early recognition of coronary artery disease in diabetes may therefore be important for prognostic and management purposes. Utility of Tread Mill test is reported by several studies [10] conducted in France Switzerland and Northern part of India showed it as best noninvasive test for screening and to detect silent ischemia in diabetes. However, there are scant reports about such studies in this part of India more so in Karnataka, hence present study is under taken at VIMS Hospital, Bellary.

## OBJECTIVES

1. To investigate the usefulness of clinical and ECG findings during Treadmill test in detecting silent ischemic in asymptomatic diabetes.
2. To identify any association between positive Treadmill test and other risk factors of Coronary heart disease.

## METHODOLOGY

The present study was conducted at Vijayanagara Institute of Medical Sciences, Bellary. Known patients of Diabetes who were attending outpatient clinic or admitted to Medical wards were taken for this study. It was case series study where in fifty patients of known Diabetes with a duration varying from 1 to 25 years including four patients with Type-I Diabetes. Those patients who had angina pectoris, unstable angina, acute myocardial infarction, abdominal resting ECG suggestive of IHD, Gestational Diabetes excluded from the study. The study included 29 male patients and 21 female patients. Detailed history included about symptoms of Diabetes, its duration, treatment history, and symptoms suggestive of IHD, renal involvement, nervous system involvement, and peripheral vascular involvement. Details about diet, habits such as smoking, alcohol and coffee, family history of Diabetes with IHD, hyperlipidemia and Hypertension. General physical examination and clinical systems review were done according to proforma appended. The disgnosis of Diabetes mellitus was made on the basis of revised criteria for the diagnosis of Diabetes by AMERICAN DIABETES ASSOCIATION which is published in 2006 [11].

### Study variables

1. Family history was considered to be positive if Diabetes was present in a first degree relative. Diabetes history including the staple diet was enquired. History of alcohol consumption if any was enquired with emphasis on quantity, frequency and duration.
2. Height and weight were measured and body mass index (BMI) was calculated using formula.

BMI = Weight (kgs) / Height (In meters) 2

A normal BMI is defined as 18.5 to 24.9 $kg/m^2$.
Over weight is a BMI of 25.0 to 29.9 $kg/m^2$, obesity is BMI of 30.0 to 39.9 $kg/m^2$ and morbid obesity is a BMI > $40kg/m^2$.
3. The waist circumstance was measured with patient standing erect, with the abdomen relaxed, the arms at the side, and the feet together. The tape was placed in a horizontal plane, at the level of the natural waist, which is the narrowest part of the torso as seen from the anterior aspect and was recorded to the nearest 0.1 cm making sure that there was no clothing at the region of the waist.
4. The hip circumstance was measured horizontally, to the nearest 0.1 cm at the level of the maximum extension of the buttocks posteriorly. For the hip measurements, due to the inability to undress the patients completely. Constant subtraction of about 3 cm for the sari in women, and 3 cm for the men's trousers were made.
5. Calculation of the waist – Hip ratio (WHR)
Waist – Hip ratio (HIR) = Waist circumstances (cms) /
Hip circumstances (cms)
6. Blood pressure was recorded in right upper limb in both supine and standing position. Hypertension was defined as BP>140/90 mmHg (JNC-VII). Peripheral pulses were looked in all four limbs. PVD was considered to be present if there was a definite history of intermittent claudication of if one or more peripheral pulses were absent **[12]**
7. Peripheral neuropathy was diagnosed in the presence of paresthesia or loss of impairment of sensation as glove and stocking distribution and loss of ankle Jerk.
8. All patients were examined for visual acuity, presence of cataract and changes in ocular fundus by the ophthalomalogist.
9. Criteria for nephropathy was a 24 hrs protein excretion exceeding 500 mg in the absence of severe hypertension or UTI.
10. A standard 12 lead ECG was taken in all cases to look and exclude for LVH, myocardial ischemia, infarction and arrhythmias.

### Blood examination variables

Blood examination for Hemoglobin estimation was done by sahli's method, total leucocyte count, differential count, ESR by westergrens method were measured in all case.

Blood sugar was estimated in all patients by Folin-wu method / computerized analysis, fasting and 2 hour post pradial venous whole blood glucose were measured at the time of admission and again at discharge time.

Blood urea and serum creatinine was estimated in all patients.

Serum Lipids measured by using Clarkes direct method / Auto analyzer.

Serum total protein and serum albumin was estimated in all patients using Biuret method / computerized chemical analysis.

**Exercise Variables**

Fifty consecutively selected patients who underwent treadmill stress testing in the TMT room attached to ICCU were studied. All the tests were done according to exercise capacity by Bruce/Modified Bruce Protocol [13].

**Protocol [14]**

Patients were instructed to report for their stress tests either after an overnight fast or three hours after a light meal. Routine pre-tests electrocardiogram was taken in every case. Careful consideration was given to rule out any possible contraindication for stress testing. Medications which will interfere with the interpretation of the test (Nitrates, Calcium channel blockers etc) were withdrawn 48-72 hours before procedure whenever possible. All the patients were fully regarding the entire procedure of the exercise ECG test. Necessary cardio-Pulmonary resuscitative equipments including a defibrillator were kept ready for emergencies. Preparation of the subjects included through cleaning of the skin with spirit, application of pre jelled 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 patients how to walk on the treadmill, Blood pressure was recorded at the end of every stage and more frequently. Electrocardiogram (12 lead) was monitored continuously on the screen with frequent 3 lead or 12 lead. Average recordings taken according to the clinical circumstance. Exercise ECG test was terminated when patients developed significant symptoms like increasing giddiness, dyspnoea, exhaustion, pain (symptoms limited) or hypertension, marked ST depression, serious arrhythmias etc. Electrocardiographic monitoring and blood pressure recordings were continued during 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 1 mm or > 80 mm from J point (1.5 mm if it is up sloping).
2. ST segment elevation of 1 mm or more than the control tracking in any lead except AVR. In the presence of ST depression in the control tracking, additional depression of 1.0 mm more than the rest.
3. Other variables like, the heart rate response, blood pressure response, pseudo normalizations changes or R wave amplitude etc, were taken into account in relevant cases.

Out of 50 study subjects, majority of the study subjects were in the age groups of 40-59 years (86%). The mean age of the study sample was 50.34 years with a standard deviation of 4.79 years. A little over half of them were males (58%) and the remaining were females (42%). The proportion of exercise ECG positive subjects were in the age groups of 40-49 years (27.7%) and 50-59 years (36%). The proportion of silent ischemia was slightly more among females (28.5%) compared to males (27.5%) and similarly it was more among subjects with history of diabetes mellitus (40%) and history of smoking (35.7%). However this difference in the proportion of silent ischemia among various study variables of the subjects was not found to be statistically significant. As the duration of diabetes mellitus increased the proportion of subjects with ECG signs of ischemia also increased, however this was not found to be statistically significant. Subjects on insulin treatment (33.3%) had higher proportion of silent ischemia compared to subjects on oral hypoglycemic drugs (26.8%). The proportion of subjects with ECG signs of ischemia was more among subjects with micro-vascular complications like neuropathy (46.6%), retinopathy (66.6%) and nephropathy (66.6%) compared to subjects without complications and this difference was found to be statistically significant (p value <0.05)

As the BMI increased the proportion of subjects with ECG signs of ischemia also increased, however this was not found to be statistically significant. But subjects with abnormal waist hip ratio had higher proportion of silent ischemia both in males (85%) and in female subjects (57%) and this difference was found to be statistically significant (p value <0.05). The proportion of silent ischemia was more among subjects with FBS ≥ 140 mg/dl (33.3%) and PPBS ≥180 (34.3%) compared to subjects who had acceptable and good control over blood glucose levels and this was not found to be statistically significant. The proportion of subjects with silent ischemia was more among subjects with higher cholesterol levels (54.5%) and higher LDL cholesterol level (70%) compared to rest of the groups and this difference this was found to be statistically significant (p value <0.05). Similarly subjects with lower levels of HDL cholesterol had higher proportion of silent ischemia (88.8%) compared with other groups and this difference was found to be statistically significant (p value <0.05).

**Table 1. Other Acceptable Biochemical Parameters**

| Biochemical Parameters | Good | Acceptable | Poor |
|---|---|---|---|
| Venous whole blood | | | |
| Fasting mg/dl | 80-120 | <140 | >140 |
| Postprandial | 120-160 | <180 | >180 |
| Urine Glucose (1%) | 0% | <0.5% | >0.5% |
| Total Cholesterol mg/dl | <200 | 200-240 | >240 |
| HDL (mg/dl) | >45 | 35-45 | <35 |
| LDL (mg/dl) | <130 | 130-160 | >160 |
| Triglycerides (mg/dl) | <150 | 150-200 | >200 |

## RESULTS

**Table 2. Age and sex wise distribution of the study subjects**

| Variables | | Frequency | Percent |
|---|---|---|---|
| **Age group** | 30 - 39 yrs | 3 | 6 |
| | 40 - 49 yrs | 18 | 36 |
| | 50 - 59 yrs | 25 | 50 |
| | > 60 yrs | 4 | 8 |
| **Mean ± SD** | 50.34 ± 4.79 | | |
| **Sex** | Male | 29 | 58 |
| | Female | 21 | 42 |
| **Total** | | **50** | **100** |

**Table 3. Proportion of exercise ECG positive with respect to study variables among study subjects**

| Variables | | Frequency | Percent | P value |
|---|---|---|---|---|
| **Age group** | 30 - 39 yrs (n=3) | 0 | 0 | 0.419 |
| | 40 - 49 yrs (n=18) | 5 | 27.7 | |
| | 50 - 59 yrs (n=25) | 9 | 36 | |
| | > 60 yrs (n=4) | 0 | 0 | |
| **Sex** | Male(n=29) | 8 | 27.5 | 0.939 |
| | Female (n=21) | 6 | 28.5 | |
| **Family h/o of DM** | Yes (n=20) | 8 | 40 | 0.122 |
| | No (n=30) | 6 | 20 | |
| **Smoking** | Yes (n=14) | 5 | 35.7 | 0.448 |
| | No (n=36) | 9 | 25 | |

**Table 4. Proportion of exercise ECG positive with respect to diabetes variables among study subjects**

| Variables | | Frequency | Percent | P value |
|---|---|---|---|---|
| **Duration of DM** | 1 -5 yrs (n=24) | 6 | 25 | 0.556 |
| | 6 - 10 yrs (n=14) | 3 | 21.4 | |
| | 11 -15 yrs (n=4) | 1 | 25 | |
| | 16 - 20 yrs (n=5) | 3 | 60 | |
| | 21 - 25 yrs (n=3) | 1 | 33.3 | |
| **Modality of treatment** | On Insulin (n=9) | 3 | 33.3 | 0.697 |
| | On OHA (n=41) | 11 | 26.8 | |
| **Complications** | Neuropathy (n=15) | 7 | 46.6 | 0.0007 |
| | Retinopathy (n=6) | 4 | 66.6 | |
| | Nephropathy (n=3) | 2 | 66.6 | |
| | No complication (n=26) | 1 | 3.8 | |

**Table 5. Proportion of exercise ECG positive with respect to Anthropometric variables among study subjects**

| Anthropometric variables | | Frequency | Percent | P value |
|---|---|---|---|---|
| **BMI** | < 18.5 (n=2) | 0 | 0 | 0.303 |
| | 18.5 - 24.9 (n=23) | 5 | 22.7 | |
| | 25.0 - 29.9 (n=15) | 4 | 26.6 | |
| | 30.0 - 39.9 (n=10) | 5 | 45.5 | |
| | Mean ± SD | 12.47 ± 10.3 | | |
| **Waist Hip ratio** | | | | |
| **Males** | > 95 (n=22) | 2 | 9.1 | <0.000 |
| | ≤ 95 (n=7) | 6 | 85.7 | |
| **Females** | > 85 (n=14) | 2 | 4.3 | 0.04 |
| | ≤ 85 (n=7) | 4 | 57.1 | |

**Table 6. Proportion of exercise ECG positive with respect to blood glucose levels among study subjects**

| Blood glucose levels | | Frequency | Percent | P value |
|---|---|---|---|---|
| **Fasting blood glucose mg/dl** | Good 80 - 120 (n=13) | 2 | 15.3 | 0.493 |
| | Acceptable < 140 (n=13) | 4 | 30.7 | |
| | Poor ≥ 140 (n=24) | 8 | 33.3 | |
| | Mean ± SD | 127.13 ± 26.1 | | |
| **Post Prandial blood glucose mg/dl** | Good 120 - 160 (n=6) | 1 | 16.6 | 0.933 |
| | Acceptable < 180 (n=12) | 2 | 16.6 | |
| | Poor ≥ 180 (n=32) | 11 | 34.3 | |
| | Mean ± SD | 157.8 ± 30.9 | | |

**Table 7. Proportion of exercise ECG positive with respect to Lipid profile among study subjects**

| Lipid profile | | Frequency | Percent | P value |
|---|---|---|---|---|
| **Serum cholesterol mg/dl** | ≤ 200 (n=28) | 2 | 7.1 | 0.0001 |
| | 200 - 240 (n=22) | 12 | 54.5 | |
| | > 240 (n=0) | 0 | 0 | |
| **HDL cholesterol mg/dl** | > 45 (n=25) | 5 | 20 | 0.001 |
| | 35 - 45 (n=16) | 1 | 6.2 | |
| | < 35 (n=9 | 8 | 88.8 | |
| **LDL cholesterol mg/dl** | < 120 (n=25) | 4 | 16 | 0.004 |
| | 120 - 160 (n=15) | 3 | 20 | |
| | > 160 (n=10) | 7 | 70 | |

**Table 8. The incidence of silent ischemia in Diabetes were by various observers**

| Other Studies | Percentages |
|---|---|
| Samuel Billet et al 1967[15] | 22.3% |
| Margolis et al 1973[16] | 20.5% |
| Kennel et al 1979[17] | 39.1% |
| R.Gupta et al 1983[18] | 15.5% |
| R.Gupta et al 1996[19] | 26.7% |
| S.B.Gupta and Pandit et al 1986[20] | 36.3% |
| Premalatha G et al 1995[21] | 26.5% |
| Present study 2005 | 28.0% |

## DISCUSSION

In this study of 50 (fifty) diabetes mellitus patients who were asymptomatic for ischemic heart disease and had a normal base line ECG were considered. The present study includesd patients with Diabetes mellitus admitted to the medical wards or outpatient department (Exercise ECG positive considered as silent ischemia or latent coronary artery disease).

### Incidence and prevalence

The incidence of silent ischemia diabetic study subjects was (28%) in this study. The incidence of silent ischemia in Diabetes were reported by other observers is as follows.

This study is not very different from the observation In Indian population of Diabetes by various observers. Kennel et al [17] and Gupta et al [20] reported higher incidence (39.1%) and (36.3%) respectively. This is because they have included angiographic correlation also.

### Age of patients and silent ischemia as shown in exercise E.C.G

In the present study ischemia was noted in 27.7% of subjects in the age group 40-49 years and 36% in the age group of 50-59 years. Gupta et al 1986 **[20]** in their study of asymptomatic ischemia heart disease in Diabetes mellitus comparing with the controls have reported that exercise induced ischemia was noticed in (32%) of Diabetes and (12%) of controls in the age of group of 41-50 years. The present Study also shows that exercise positive E.C.G. is noticed in (27.5%) in age group 40-49, this indicates that silent ischemia occurs more frequently in diabetics at younger age groups.

### Sex of patients and silent ischemia as shown in exercise E.C.G

In the present study, exercise ECG positive for ischemia noted in (27.5%) of males and (28.5%) of female. though it seems to be higher in female, it is statistically not significant. Many authors have reported higher incidence of silent ischemia in males. Root et al [22] male (38.2%), female (32.3%), R.Gupta et al [18] male (18.8%), female (10.5%).

### Duration of diabetes and silent ischemia as shown in exercise E.C.G

In the present study the mean duration of diabetes mellitus with exercise ECG Positive Patients is

(13.53+5.11) years, whereas exercise ECG negative patients mean duration (11.90+8.97) years and it is statistically significant ($p<0.05$), indicates that as duration of diabetes increased of IHD also increased. R. Gupta et al 1986 [23] have shown similar results 31% (9of29) with disease of 3 to 5 years, 66% (2of3) 6to 10 years and 50%92of4) with duration more than 10 years. Mohan et al [24] reported prevalence of IHD increased with duration. The prevalence increased to (40.1%) in those with duration of diabetes of more than 20 years. Ramachandran et al [24] 2000 reported that IHD could occur in relation to the duration.

**Hypertension and silent ischemia as shown in exercise E.C.G**

In the present study associated hypertension with diabetes was found in 6 patients (12%) out of 50 patients. Silent ischemia was found in 4 patients (66.6%) out of 6 patients. Hence hypertension in association with diabetes is a strong risk factor for ischemia heart disease. Ramachandran et al [12] in their studies 1999 have reported that hypertension in diabetes mellitus as a strong risk factor for ischemia heart disease.

**Treatment of Diabetes and silent ischemia as shown in exercise E.C.G:** In the study higher incidence of exercise ECG positive on insulin therapy patients noticed (33.33%) compared to OHA (26.83%).but patients who were on insulin therapy were on irregular treatment. Hence silent ischemia was more in those who were on insulin therapy.

**Smoking and silent ischemia as shown in exercise E.C.G**

In this study of 50 patients of diabetes, 14 patients (28%) were smoker and 5 (35.7%) of them had signs of silent ischemia. Smoking is a risk factor for IHD. If smoker is a diabetic the coronary heart disease risk further increases as it is observed in the present study. Similar observation s have been reported by G.R.Sridhar et al [26] in 1998 (22.4%) and also by Menu Walia et al [26] in 1999.

**Family history of diabetes mellitus and silent ischemia as shown in exercise ECG**

It is observed that 20 patients (40%) out of 50 patients' diabetes had family history of diabetes. 8 patients (40%) of 20 showed positive exercises ECG. This denoted that ischemia is more frequent in diabetics those who had family history of diabetes. Menu walia et al [27] in 1999 have reported that (66.67%) of male and (50%) of female with coronary heart disease had family history of diabetes mellitus. No significant changes noticed in those who had family history of ischemia heart disease and family history of hypertension in the present study. However, Menu Walia et al [26] in 1999 have reported higher incidence of ischemia in diabetics who had family history of ischemic heart disease.

**Correlation of anthropometric parameters with Exercise ECG changes in diabetes**

Body mass index (BMI) is a major risk factor for IHD, hypertension and diabetes mellitus. In the study of 50 diabetes mellitus patients for silent myocardial ischemia, 15 out of 50 (30%) had body mass index of more than 25, out of 15 patients 4 (26.66%) had positive exercise ECG changes. On further analysis 5 (45.45%) showed exercise ECG positive in body mass index of 30.0-39.9. mean with standard deviation of body mass index of (20.42+3.28) showed higher incidence of exercise induced ischemia. The incidence of silent myocardial ischemia is directly proportional to the increase in body mass index. Sheetal kaul et al [6] in 1998 have reported that obesity in the form of increased body mass index is a major risk factor for IHD. Studies by diabetic research center, Madres have shown higher incidence (27.5%) of IHD in obese diabetics. Waist-hip ratio (WHR of less than 95 in male and less than 85 in female is considered as central obesity. Menu walia ET al [27] in 1999 has reported that WHR was a significant predictor of cardiovascular risk factor than over all obesity. In the present study of 50 cases of diabetes mellitus 7 males had WHR of <95 and 7 female had WHR <85=. Out of 7 males with <95=WHR, 6 (85.71%) had positive exercise ECG changes and out of 7 females with <85 WHR <4 (57.14%) had positive exercise ECG changes. This denotes that central obesity in the form of less WHR is a major risk factor for silent ischemia in diabetes mellitus.

**Glycemic control of diabetes mellitus and silent ischemia as shown in exercise ECG**

It is observed that there is increased incidence of silent ischemia in those patients who had higher glycemic levels. It is more than 140 mg of fasting blood glucose level. Mean value with standard deviation of exercise ECG positive patients is (160.10+51.30), where as in exercise ECG negative patients, it is (138.62+28.31). Even with post prandial glucose levels same response is observed. The mean with standard deviation of post prandial blood glucose exercise ECG positive patients is (206+29), whereas exercise ECG negative (197.6+27.33). Indicates poor control of both FBS and PPBS is associated with high incidence of silent ischemia.

**Serum cholesterol and silent ischemia in exercise ECG**

While correlating with serum cholesterol levels, it was observed that in those patients with the cholesterol level of 200-240 mg%, the incidence of exercise ECG positive ischemia was 12(54.54%), where as it is only 2 (7.14%) in those who had serum cholesterol level of less than 200 mg%. This clearly shows that increased cholesterol level is a major risk factor for IHD in diabetes and was statistically significant. William B kennel et al **[27]** in 2001 have reported that the incidence of IHD is more in those who have higher cholesterol level and it is three fold more in diabetics with higher cholesterol levels.

**Serum HDL- cholesterol and silent ischemia in exercise ECG**

It is observed in this study that incidence of silent myocardial ischemia was8 (88.88%) in those who had HDL levels of less than 35mg%, I (6.25%) in those with HDL level of 35-45 mg% and it is was only 5 (20%) in those who had HDL level of more than 45 mg%. There is inverse relationship between the serum level of high density lipoprotein (HDL) and the incidence of silent ischemia proved by exercise ECG positive changes and it was found to be statistically significant. William P Castelli et al **[28]** in Framingham study in 1986 and menu walia et al **[26]** 1999 have also reported the same results as observed in the present study.

**Serum LDL- cholesterol and silent ischemia in exercise ECG**

It is observed in this study that incidence of silent myocardial ischemia was 7 (70%) in those who had LDL level>than 160 mg%, 3 (20%) in 120-160 mg/dl and only 4 (16%) with LDL of < 120 mg%. There was direct relationship between high level of LDL and the silent ischemia proved by exercise test and was found to be statistically significant. William P Catelli et al **[28]** have also shown similar results.

**Limitations of treadmill testing [29]**

In spite of being easily available, best noninvasive tool TMT has got its own limitations. False negative are more common in patients with circumflex coronary artery obstruction because posterior portion of the heart is supplied by this vessel and is not well represented in 12 lead ECG. Sensitivity of TMT is (68%) and specificicity is (77%) compared with other screening modalities. In presence of unstable plaque with patent arteries it may show false negative results which may be dangerous. In that case we may need other sensitive tools like intra coronary ultrasonography or perfusion scans. Because of its sub optimal sensitivity, low detection rates in single vessel disease, poor specificity in pre-menopausal women.

## CONCLUSION

Diabetes mellitus is an important and major risk factor for silent ischemic heart disease where in 28% of the diabetics had ECG changes of silent ischemia for which Tread Mill Testing is important tool to screen and thereby help in early recognition of silent ischemia.

## LIMITATIONS

In our study we have limitations in confirming the sensitivity of exercise ECG results which we have got, because of small study group. The patients were chosen consecutively on the account that some of the patients were discharged due to various reasons before full battery of investigations could be done. Certain investigation like urine for persistent Microalbuminuria, Glycosylated Hemoglobin could not be done due to cost. Special investigation like 2D ECHO, coronary angiography could not be done due to non-availabilities and affordability of patient.

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