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# SILENT MYOCARDIAL ISCHEMIA AMONG ASYMPTOMATIC TYPE-2 DIABETIC PATIENTS

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## ABSTRACT

**Objective:** To determine the frequency of silent myocardial ischemia among asymptomatic type-2 diabetes mellitus patients.

**Methodology:** This was a crossectional descriptive study conducted, after approval from the institutional ethical and research committee. A total of 90 asymptomatic type-2 diabetic patients were recruited for the present study. After informed written consent participants were subjected to a symptom-limited exercise tolerance test to detect the presence of silent myocardial ischemia. Descriptive statistics were applied to find frequencies and percentages for qualitative variables, and mean and standard deviation was used for quantitative variables. SPSS version22 was used for data analysis.

**Results:** Among 90 type-2 asymptomatic diabetic patients, the frequency of silent myocardial ischemia was 36.7% (n=33). The frequency of silent myocardial ischemia among males and females was 57.6% and 42.4% respectively. Frequency of silent myocardial ischemia was found significantly more among patients with family history of CAD (60.6% vs 39.4%; p=0.029), prolonged duration of diabetes (15.2% vs 22.2% vs 63.6%; p=0.026) and group of patients with older age (9% vs 39.4 vs 51.6%; p=0.034). With respect to hypertension, smoking, obesity, and gender didn't show statistically significant variation in the occurrence of silent myocardial ischemia.

**Conclusion:** More than one third patients of asymptomatic type-2 diabetes mellitus had silent myocardial ischemia. Those with a family history of CAD, prolonged duration of diabetes, and participants with older age were more at risk of underlying silent myocardial ischemia.

**Keywords:** Myocardial ischemia; Diabetes mellitus; Exercise test; Coronary artery disease.

## INTRODUCTION

Worldwide prevalence of diabetes mellitus is on the rise affecting 8.5% of adults according to a report in 2014. A total of 90 to 95% of adults with diabetes suffer from type 2 Diabetes. Insulin resistance is the hallmark of Type-2 diabetes (T2DM) which increases the risk of vascular inflammation and atherogenesis exponentially, resulting in major micro and macrovascular complications like cardiovascular ischemia.[1]

Coronary artery disease (CAD) may remain asymptomatic, particularly in patients with T2DM, and these patients are less likely to survive the first attack of myocardial infarction making it imperative to screen such patients for the presence of clandestine ischemia or silent ischemia. Silent myocardial ischemia is the objective evidence of ischemia in patients without subjective evidence of ischemic symptoms.[2] Patients may demonstrate ischemic ECG changes, wall motion abnormalities on echocardiography, or myocardial perfusion defects on SPECT scan without having chest pain or other symptoms of cardiovascular ischemia. Silent myocardial ischemia could be one atypical presentation of ischemic heart diseases. The overall prevalence of cardiac diseases in patients suffering from type-2 DM is about 55%. The prevalence of cardiovascular ischemia and hence the risk of silent myocardial ischemia increases with increasing age.[3, 4]

In one study the prevalence of silent myocardial ischemia was 23%, using treadmill stress test for detection of silent myocardial ischemia, affecting males more as compared to females. The prevalence of silent myocardial ischemia was 22% in asymptomatic patients with type 2 diabetes (T2DM) on stress myocardial perfusion imaging in the Detection of Silent Myocardial Ischemia in Asymptomatic Diabetics (DIAD) study.[5]In another study 58% of the asymptomatic patients had abnormal stress SPECT scan. In a study conducted by Scognamiglio et al., 60% of diabetic patients who were asymptomatic had an abnormal finding on myocardial contrast echocardiography (MCE) and subsequent coronary angiography found to have CAD in

65% of the patients with an abnormal MCE.[5,6] In a similar study sheikh et al in Pakistan the prevalence of silent ischemia was 19% among the asymptomatic diabetics as compared to non-diabetics.[7]

The presence of silent myocardial ischemia is an independent risk for heightened cardiovascular morbidity and mortality in diabetics. This may in part be due to the delayed presentation, diagnosis, and treatment as compared to the non-diabetics who present early in the course of illness.[8] In a study conducted on individuals with sudden cardiac death 78% were found to have CAD and 71% had sudden cardiac death as the first presentation of their underlying fatal cardiovascular ischemia.[9]Silent myocardial infarction increases the odds of developing heart failure exponentially in patients with unnoticed underlying CAD.[10]

Given the ever-increasing prevalence of diabetes and the consequent silent myocardial ischemia, screening these patients with noninvasive stress testing is imperative to detect silent myocardial ischemia to avert the attendant risks and complications.[11] As mentioned, due to the heightened risk of cardiovascular complications and associated morbidity and mortality silent myocardial ischemia may be integrated into the risk prediction models. Diabetic patients particularly those with prolonged duration, poor glycemic control, associated comorbidities, and those with a family history of CAD need to be screened and treated aggressively to avoid the subsequent risk of cardiac morbidity andmortality.[12]

Different screening tools including a treadmill stress test, contrast myocardial echocardiography, exercise stress echocardiography, myocardial perfusion imaging (SPECT), etc have been used to detect silent myocardial ischemia.[5,6] Studies regarding the utility of different screening tools including an exercise stress test or exercise tolerance test in the detection of silent myocardial ischemia are sparse in our local setup. This study was done to get data regarding the prevalence of silent myocardial ischemia in our local setup using an exercise tolerance test. Furthermore, the exercise tolerance test is a cheap, easily available, and cost-effective tool to screen patients for myocardial ischemia as compared to other modalities.[13] This data will help us to draw future recommendations regarding screening diabetic patients for silent coronary artery disease.

## METHODOLOGY

This was a crossectional descriptive study conducted at the cardiology department of Qazi Hussain Ahmad medical complex Nowshera, from 1st July 2020 to 30th January 2021. Type-2 diabetic patients (n=90) presenting to the out-patients department for clinical follow-up were recruited into the present study based on consecutive nonprobability sampling techniques. A total of 90 patients using 36.5% frequency of silent myocardial ischemia, the margin of error 10% and 95% confidence interval, using WHO sample size calculator were recruited into the present study Patients with an established diagnosis of T2DM of more than 5 years duration, with no history of CAD in the past, with no history of chest pain or angina pectoris, normal ECG and age 30 to 60 years were recruited into the present study.

Patients with a previous history of MI or CAD, abnormal baseline ECG, unable to undergo exercise stress test due to arthritis or disability or peripheral arterial disease, diabetes complicated by microvascular or macrovascular complications, coexisting COPD or Asthma, structural heart diseases and myocarditis, intake of medications causing ECG changes or affecting exercise stress test interpretation like digoxin or beta-blockers were excluded from the present study because these were the confounders and could affect study results.

Ethical approval for the study was taken from the institutional ethical and research board and informed written consent was taken from the patients after thoroughly discussing the aims and objective of the study, the benefits, and risks of the exercise stress test. Patients underwent thorough clinical assessment (history and examination), baseline ECG and Echocardiography were done, and blood samples were taken for glycemic assessment and baseline biochemistry to confirm the diagnosis and rule out confounders. Patients were subjected to symptom-limited exercise stress test with continuous hemodynamic monitoring, ECG recording, and assessment during and after exercise test into the recovery phase.ETT was considered positive if patients developed horizontal or downsloping ST-segment depressions or ST-segment elevations of ≥1mm on ECG or a drop in blood pressure of ≥ 10mmHg from baseline. The exercise stress test was considered inconclusive if patients didn't achieve 85% of the age-predicted maximum heart rate. Age predicted maximum heart rate was calculated as 220-age. Bruce protocol was followed during the exercise tolerance test (treadmill stress test). All the data including patient demographics and baseline characteristics were entered into a performed proforma.

Data analysis was done using SPSS version 22. Descriptive statistics were applied. Frequencies and percentages were computed for qualitative variables like silent myocardial ischemia, age categories, and gender, and mean and standard deviation were computed for quantitative variables like duration of diabetes, age, etc. Prevalence of silent myocardial ischemia was compared among the diabetic patients concerning age, gender, duration of diabetes, obesity, hypertension, smoking, and family history of CAD. For statistical significance, the Chi square test was applied and the p-value was computed, with a p-value less than 0.05 taken significant.

## RESULTS

The mean age was 56 ± 1.26 years. A total of 40 (44.4%) were males and 50 (55.6%) were females. A total of 72 (80%) were married and 30 (30.33%) were smokers. Silent myocardial ischemia was found to be positive in 33 patients (36.7%) among type-2 diabetic patients, while 57(63.3%) did not have silent myocardial ischemia. A family history of coronary artery disease was positive among 41 patients (45.6%). The mean duration of type-2 DM was 14 ±3.77 years, 24 (26.6%) patients had diabetes of 5-10 years duration while 25 (27.8%) and 41(45.6%) patients had diabetes of 11-15years and 16-20 years duration respectively. The frequency of obesity was positive in 44(48.9%) with BMI>30kg/m2. A total of 72 (80%) were measured and 30 (33.3%) were smokers.

Table 1 describes that the prevalence of silent myocardial ischemia was compared with respect to age, gender, BMI, hypertension, family history of CAD, and duration of diabetes. Frequency of silent ischemia was significantly more among the group of patients of older age, prolonged duration of T2DM and family history of CAD. With respect to hypertension, smoking, obesity, and gender didn't show statistically significant variation in the occurrence of silent myocardial ischemia.

## DISCUSSION

In the present study, the frequency of silent myocardial ischemia among 90 T2DM patients was 36.7% and there was a statistically increased frequency of silent myocardial ischemia among the group of patients with a family history of CAD (60.6% vs 39.4%; p=0.029) and those with prolonged duration of T2DM (15.2% vs 22.2% vs 63.6%; p=0.026).

In a similar observational study conducted on 338 patients, a treadmill test was used to screen for the presence of silent myocardial ischemia. The prevalence of silent myocardial ischemia was found to be 23%. The prevalence of silent myocardial ischemia was found to be more among males than among females. At age > 50 years, hypercholesterolemia, and hypertriglyceridemia were shown to be significant determinants of silent myocardial ischemia in asymptomatic diabetics.[4]

Another study used SPECT scan for the detection of silent myocardial ischemia among asymptomatic diabetics. The prevalence of stress-induced perfusion defects and hence silent myocardial ischemia was 37%. Insulin use, nephropathy, and neuropathy were found to be significant determinants of silent myocardial ischemia in asymptomatic diabetic patients(p<0.005). Hypercholesterolemia was not significantly associated with silent myocardial ischemia. Family history of CAD was found to be highly prevalent among asymptomatic diabetic patients (p=0.001).[14] In a study conducted by Sheikh et al, though there was a high proportion of patients suffering from silent myocardial ischemia among the diabetics as compared to the non-diabetics there was no statistically significant difference in the prevalence of silent myocardial ischemia among patients with and without T2DM.[7]

In another study conducted on 128 patients, silent myocardial ischemia could be

Table 1: Stratification of silent myocardial infarction with respect to baseline characteristics of patients. (n=90)

| Variables | | Silent myocardial ischemia | | p-value |
|---|---|---|---|---|
| | | Yes (n=33) | No (n=57) | |
| Age | 30-40 Years | 3 (9%) | 19 (33.3%) | 0.034 |
| | 41-50 Years | 13 (39.4%) | 18 (31.6%) | |
| | 51-60 Years | 17 (51.6%) | 20 (35.1%) | |
| Gender | Male | 19 (57.6%) | 31 (54.4%) | 0.769 |
| | Female | 14 (42.4%) | 26 (45.6%) | |
| Duration of diabetes | 5-10 Years | 5 (15.2%) | 20 (35.1%) | 0.026 |
| | 11-15 Years | 7 (22.2%) | 17 (29.8%) | |
| | 16-20 Years | 21 (63.6%) | 20 (35.1%) | |
| Obesity | Yes | 20 (60.6%) | 24 (42.1%) | 0.091 |
| | No | 13 (39.4%) | 33 (57.9%) | |
| Smoking | Yes | 12 (36.4%) | 17 (29.8%) | 0.522 |
| | No | 21(63.6%) | 40 (70.2%) | |
| Hypertension | Yes | 11 (30.3%) | 20 (35.1%) | 0.629 |
| | No | 22 (69.7%) | 37 (62.9%) | |
| Family history of CAD | Yes | 20 (60.6%) | 21 (36.8%) | 0.029 |
| | No | 13 (39.4%) | 36 (63.2%) | |

detected in 19%–of the patients using an exercise stress test for the detection of silent myocardial ischemia in asymptomatic diabetic patients. Silent myocardial ischemia was significantly more prevalent in those with prolonged duration of diabetes and those with a family history of coronary artery disease.[15]

The prevalence of silent myocardial ischemia ranges from around 20% to 60% according to different studies, depending on the baseline characteristics of the participants[5,6]. Those patients who have a positive family history of coronary artery disease, prolonged duration of T2DM, associated comorbidities like hypertension, nephropathy, neuropathy, dyslipidemia, etc should undergo screening due to possibility of underlying silent myocardial ischemia, as is shown in our study.[16,17]

The exercise tolerance test is easily available and cost-effective modality for screening such patients which can be employed as compared to the other more costly and not so easily available modalities.

## CONCLUSION

More than one third patients of asymptomatic type-2 diabetes mellitus had silent myocardial ischemia, using an exercise tolerance test for the detection of silent myocardial infarction. The frequency of silent myocardial ischemia was significantly more in those with prolonged duration of diabetes, older age group, and those with a positive family history of CAD.

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## Author's Contribution

AI conceived the idea, collected the data, conducted a literature search, and reviewed the paper. SBK contributed to the design, manuscript's intellectual content, and final approval of the article. At the same time, Both authors agree to be responsible for all aspects of the work, including ensuring any questions about the work's accuracy or integrity are thoroughly examined and resolved.

## Conflict of Interest

Authors declared no conflict of interest

## Grant Support and Financial Disclosure

None

## Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.