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Prevalence of Silent Ischemia in Diabetic Patients with Coronary Artery Disease

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ABSTRACT

Background: Silent myocardial ischemia, defined as objective evidence of myocardial ischemia without anginal symptoms, is commonly observed in patients with diabetes mellitus due to autonomic neuropathy and vascular dysfunction. **Objective:** To determine the prevalence of silent myocardial ischemia in diabetic patients with angiographically confirmed coronary artery disease and to assess its association with clinical and metabolic risk factors. **Methods:** This cross-sectional observational study was conducted at Social Security Teaching Hospital Lahore from August 2024 to January 2025. A total of 205 patients were added to the study. Data were collected through a detailed clinical assessment of patients, including history, physical examination, and evaluation of cardiovascular risk factors (hypertension, dyslipidemia, smoking status, family history of CAD, etc.). Glycemic control was assessed using fasting plasma glucose and HbA1c levels. **Results:** Silent ischemia was detected in 84 patients, indicating a prevalence of 41.0%. The condition was more prevalent among patients with HbA1c ≥8.0% (47.2%) compared to those with HbA1c <8.0% (33.7%), although the association was not statistically significant ($p = 0.4335$). A higher prevalence was observed in patients with longer duration of diabetes (>10 years: 49.4%) and those with diabetic neuropathy (54.3%). Myocardial perfusion imaging yielded a higher detection rate (50.7%) compared to ETT (35.6%). Silent ischemia was significantly more common in patients with multiple cardiovascular risk factors (≥3 risk factors: 51.7%). **Conclusion:** It is concluded that silent myocardial ischemia is highly prevalent among diabetic patients with CAD, particularly those with poor glycemic control, long-standing diabetes, neuropathy, and multiple risk factors.

INTRODUCTION

Cardiovascular disease remains the principal cause of death and disability in patients with diabetes mellitus, particularly type 2 diabetes. People with diabetes experience a higher incidence of coronary artery disease (CAD) because hyperglycemia and dyslipidemia as well as hypertension and systemic inflammation, drive atherogenesis at a faster rate. A substantial number of CAD patients experience silent myocardial ischemia with no noticeable symptoms, particularly when they have diabetes, because deprived myocardial oxygen leads to no apparent clinical features [1]. The major challenge with silent ischemia arises because patients may not receive a proper diagnosis until they experience a catastrophic cardiac event such as myocardial infarction or sudden cardiac death [2]. The occurrence of silent myocardial ischemia happens more frequently among people with diabetes than in the broader population. The main cause behind elevated silent myocardial ischemia rates among diabetics relates to diabetic autonomic neuropathy, which creates impaired pain signals and reduces standard myocardial perfusion indicators, including chest pain [3]. Coronary event detection in diabetic patients requires evidence beyond symptoms since these assessments prove insufficient for proper cardiological diagnosis. Epidemiological research shows that the occurrence of silent ischemia appears between 20 to 50 percent when examining diabetic patients with CAD, depending on what diagnostic methods research teams use and what patient demographics they study [4]. Screening methods and population health characteristics drive the broad range of detected silent ischemia prevalence between 20 to 50 percent. Research shows that silent ischemia diagnosis in this patient population leads to worse results which raises their chance of suffering myocardial infarction and heart failure, with death as their main cause. Unnoticed ischemia serves as a warning sign that points to substantially blocked coronary arteries while exposing myocardial tissue to danger [5]. Silent ischemia occurs in diabetic patients because multiple factors contribute to its development. The continuous presence of elevated blood sugar levels creates problems in the blood vessels, combined with enhanced oxidation damage, while promoting blood clotting [6]. The combination of insulin resistance and lipid abnormalities and these metabolic processes, speeds up the development of atherosclerotic plaques as well as causing impairment of blood flow through coronary arteries [8]. Autonomic nervous system dysfunction interferes with heart rate regulation, combined with vascular tone control thus restricting the body's physical heart oxygen reaction. Multiple factors come together to make diabetic patients prone to the development of silent and slowly progressing myocardial ischemic complications [9]. The identification of silent ischemia during its early stages remains essential to diminish major cardiovascular risks faced by diabetic patients. Medical technology now enables healthcare providers to detect heart conditions through treadmill exercise electrocardiography, along with MPI and stress echocardiography and continuous ambulatory ECG monitoring to evaluate asymptomatic patients [10]. Cardiac magnetic resonance imaging and computed tomography coronary angiography represent newer imaging systems which provide enhanced detection ability for perfusion deficits along with anatomical coronary lesions [11].

Objective
To determine the prevalence of silent myocardial ischemia in diabetic patients with angiographically confirmed coronary artery disease and to assess its association with clinical and metabolic risk factors.

METHODOLOGY
This cross-sectional observational study was conducted at Social Security Teaching Hospital Lahore from August 2024 to January 2025. A total of 205 patients were added in the study.

Inclusion Criteria
Patients aged between 40 and 75 years with a minimum duration of diabetes of five years and angiographically confirmed CAD were included in the study. Only patients who were clinically stable and able to perform a treadmill stress test or undergo equivalent diagnostic procedures were considered eligible.

Exclusion Criteria
- Overt symptoms of angina or history of recent chest pain suggestive of ischemia
- Severe left ventricular dysfunction (ejection fraction < 30%)
- History of cardiac arrhythmias or conduction abnormalities that would interfere with diagnostic testing
- Physical or neurological impairments limiting ability to undergo stress testing

Data Collection
Data were collected through a detailed clinical assessment of patients, including history, physical examination, and evaluation of cardiovascular risk factors (hypertension, dyslipidemia, smoking status, family history of CAD, etc.). Glycemic control was assessed using fasting plasma glucose and HbA1c levels. The presence of silent myocardial ischemia was evaluated using either an exercise treadmill test (ETT) based on the Bruce protocol or pharmacological stress myocardial perfusion imaging (MPI) using technetium-99m sestamibi single-photon emission computed tomography (SPECT), depending on the patient's functional capacity. Ischemia was defined by the presence of horizontal or downsloping ST-segment depression of at least 1 mm during ETT or reversible perfusion defects on MPI. Silent ischemia was diagnosed when these ischemic changes occurred without any subjective symptoms such as chest pain or shortness of breath during the procedure.

Data Analysis
Data were analyzed using SPSS v26. Categorical variables were analyzed using the chi-square test, while continuous variables were evaluated using the independent t-test. A p-value less than 0.05 was considered statistically significant.

RESULTS
Data were collected from 205 patients with a mean age of 59.8 ± 8.2 years; 60.5% were male and 39.5% were female. The average duration of diabetes was 11.2 ± 4.6 years. Silent myocardial ischemia was observed in 84 patients, accounting for a prevalence of 41.0%. Detection rates were higher in patients with longer diabetes duration (>10 years: 49.4%) and poor glycemic control (HbA1c ≥8.0%: 47.2%) compared to those with better control (HbA1c <8.0%: 33.7%). Silent ischemia was more frequent in individuals with multiple cardiovascular risk factors, reaching 51.7% in those with three or more, compared to 28.3% in those with fewer than three.

Table 1

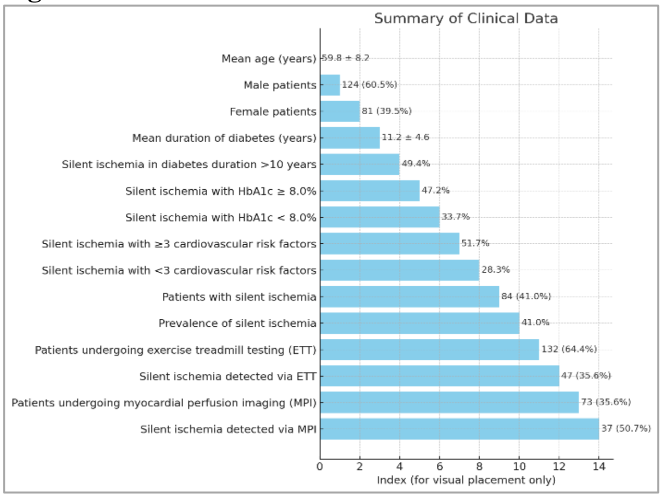
Demographic and Clinical Risk Factors

Variable	Value or N (%)
Mean age (years)	59.8 ± 8.2
Male patients	124 (60.5%)
Female patients	81 (39.5%)
Mean duration of diabetes (years)	11.2 ± 4.6

Silent ischemia in diabetes duration >10 years	49.4%
Silent ischemia with HbA1c ≥ 8.0%	47.2%
Silent ischemia with HbA1c < 8.0%	33.7%
Silent ischemia with ≥3 cardiovascular risk factors	51.7%
Silent ischemia with <3 cardiovascular risk factors	28.3%
Patients with silent ischemia	84 (41.0%)
Prevalence of silent ischemia	41.0%
Patients undergoing exercise treadmill testing (ETT)	132 (64.4%)
Silent ischemia detected via ETT	47 (35.6% of ETT group)
Patients undergoing myocardial perfusion imaging (MPI)	73 (35.6%)
Silent ischemia detected via MPI	37 (50.7% of MPI group)

Among the diagnostic methods, 132 patients underwent exercise treadmill testing (ETT), with a positivity rate of 35.6%, while 73 underwent myocardial perfusion imaging (MPI), which detected silent ischemia in 50.7% of cases.

Figure 1



Among patients with neuropathy, 54.3% exhibited silent ischemia, compared to 33.1% in those without neuropathy.

Table 2

Association Between Diabetic Neuropathy and Silent Ischemia

Presence of Diabetic Neuropathy	Prevalence of Silent Ischemia (%)
Yes	54.3%
No	33.1%

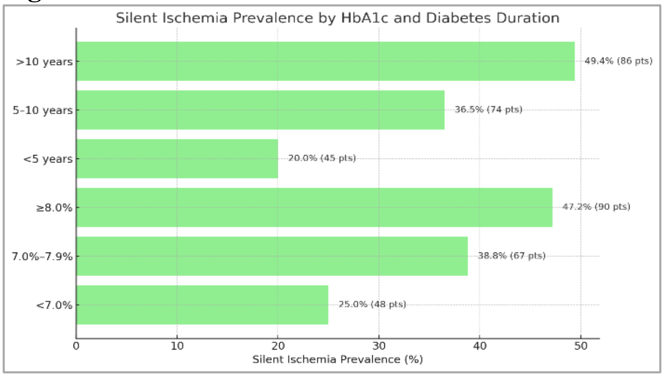
Patients with better glycemic control (HbA1c <7.0%) had the lowest prevalence of silent ischemia at 25.0%, which increased to 38.8% in those with HbA1c between 7.0%–7.9%, and further to 47.2% in patients with HbA1c ≥8.0%. Similarly, the duration of diabetes showed a progressive rise in silent ischemia prevalence: 20.0% in patients with diabetes for less than 5 years, 36.5% in those with 5–10 years of diabetes, and 49.4% in those with a duration exceeding 10 years.

Table 3

Glycemic Control and Silent Ischemia

HbA1c Category	Number of Patients	Silent Ischemia Prevalence (%)
<7.0%	48	25.0%
7.0%–7.9%	67	38.8%
≥8.0%	90	47.2%
Duration of Diabetes		
<5 years	45	20.0%
5–10 years	74	36.5%
>10 years	86	49.4%

Figure 2



Among patients with hypertension alone, the prevalence was 29.6%, which rose to 38.1% in those with both hypertension and dyslipidemia, and to 42.9% in those with hypertension and smoking history. The highest prevalence (51.7%) was observed in patients presenting with three or more cardiovascular risk factors.

Table 4

Cardiovascular Risk Factor Profile and Silent Ischemia

Risk Factor Profile	Number of Patients	Silent Ischemia Prevalence (%)
Hypertension only	54	29.6%
Hypertension + Dyslipidemia	63	38.1%
Hypertension + Smoking	28	42.9%
Three or more risk factors	60	51.7%

Among those with HbA1c ≥8.0%, 37 patients had silent ischemia, while 53 did not. In contrast, among patients with HbA1c <8.0%, 40 had silent ischemia and 75 were free of it. Although the chi-square test did not reveal statistical significance ($p = 0.4335$), the numerical trend supports the association between poor glycemic control and increased prevalence of silent ischemia in diabetic individuals with coronary artery disease.

Table 5

Association Between HbA1c and Silent Ischemia (Chi-Square Test)

HbA1c Category	Silent Ischemia Present (n)	Silent Ischemia Absent (n)
<8.0%	40	75
≥8.0%	37	53

Degrees of freedom (df): 1
P-value: 0.4335

DISCUSSION

The present study investigated the prevalence and clinical correlates of silent myocardial ischemia in a cohort of 205 patients with type 2 diabetes mellitus and angiographically confirmed coronary artery disease. The study confirmed that silent ischemia occurred in 41.0% of participants, while previous studies indicate it affects between 20% and 50% of similar high-risk population groups. The high proportion of patients with silent ischemia requires all diabetic patients to undergo regular heart health assessments, particularly when they have documented coronary artery disease [12]. Exercise treadmill testing (ETT) and myocardial perfusion imaging (MPI) showed different diagnostic capabilities according to our study findings. Validated diagnostic results from MPI showed a positive detection rate at 50.7% which was higher than what ETT produced at 35.6%. There exists a probable connection between the unfavorable disease status and functional decline of exercise-intolerant diabetic patients which supports the integration of MPI-based tests for this specific patient group [13].

A substantial amount of silent ischemia affects people who struggle to maintain proper blood sugar regulation. Among patients with HbA1c levels at or above 8.0%, the occurrence of silent myocardial ischemia measured 47.2%, although those with better glycemic control exhibited 33.7% prevalence [14]. Although the statistical significance was not reached ($p = 0.4335$), the observed trend supports the hypothesis that persistent high blood glucose levels play a role in vascular impairment as well as autonomic neuropathy, which are central mechanisms leading to silent ischemia [15]. Patients suffering from diabetes for more than ten years showed a 49.4% prevalence of silent ischemia, while individuals with diabetes duration shorter than five years had a 20.0% prevalence. The additional analysis of cardiovascular risk elements demonstrates that silent ischemia occurs through a variety of factors [16]. Research demonstrated that silent ischemia increased progressively based on the number of risks factors a patient had. The highest rate of 51.7% occurred when patients presented with hypertension along with dyslipidemia and smoking [17]. The prevalence of silent ischemia reached 54.3% in patients who also presented diabetic neuropathy, since impaired nociceptive signaling acts as a key factor in hiding ischemic symptom presentation. Screening autonomic and peripheral neuropathy in diabetic patients who undergo cardiovascular risk assessments becomes significant because those patients with neuropathic complications face an elevated risk of experiencing silent undetected heart events. This study offers important findings but it contains identifiable drawbacks [18]. The study presents limitations as a single-center cross-sectional assessment which prevents causal connections from being proven and limits generalization to all diabetic individuals. The practical approach of using non-invasive testing fails to provide accurate readings of true ischemic burden compared to invasive imaging procedures like cardiac MRI and coronary CT angiography [19]. The study managed to expose important concerns despite its restrictive nature. The medical condition known as silent ischemia affects diabetic patients with coronary artery disease yet remains a commonly overlooked diagnosis in their case. Data from this study demonstrate the need for increased screening techniques because many patients with diabetes show extensive coronary artery disease mainly when they have inadequate blood glucose control or persistent diabetes coupled with multiple heart disease risk factors. An investigation of standard screening practices together with post-screening treatments for cardiovascular risks requires additional prospective research about this at-risk demographic.

CONCLUSION

It is concluded that silent myocardial ischemia is a highly prevalent but underdiagnosed condition among diabetic patients with established coronary artery disease. In this study, 41% of asymptomatic diabetic individuals demonstrated evidence of silent ischemia, highlighting the importance of proactive cardiovascular evaluation in this high-risk group. The prevalence was notably higher among patients with poor glycemic control (HbA1c ≥8.0%), longer duration of diabetes, multiple cardiovascular risk factors, and those with diabetic neuropathy.

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