ORIGINAL ARTICLE

SILENT CARDIAC ISCHEMIA IN TYPE II DIABETES MELLITUS: PREVALENCE, RISK FACTORS, AND PREDICTORS IN 205 PATIENTS

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ABSTRACT

Background: Silent cardiac ischemia (SCI) is a common but underdiagnosed cardiovascular complication in patients with type II diabetes mellitus (T2DM). SCI increases the risk of adverse cardiovascular events due to its asymptomatic nature.

Objective: To determine the prevalence and risk factors of SCI in T2DM patients and identify independent predictors using logistic regression analysis.

Methods: A cross-sectional study was conducted on 205 asymptomatic T2DM patients. Comprehensive demographic, clinical, and laboratory data were collected. Patients underwent exercise treadmill testing using the Bruce protocol, with myocardial perfusion imaging for inconclusive cases. Logistic regression analysis was performed to identify independent predictors of SCI.

Results: The mean age of participants was 55.8 ± 9.4 years; 112 (54.6%) were male. The mean diabetes duration was 8.6 ± 5.2 years, and the mean HbA1c was 7.8 ± 1.1%. SCI was detected in 67 patients (32.7%). Significant risk factors included older age, male gender, long diabetes duration, poor glycemic control, hypertension, dyslipidemia, and autonomic neuropathy. Logistic regression identified diabetes duration >10 years (OR 2.3, 95% CI 1.2–4.2), autonomic neuropathy (OR 3.1, 95% CI 1.6–6.0), and HbA1c >8% (OR 2.0, 95% CI 1.1–3.8) as independent predictors.

Conclusion: SCI is prevalent in asymptomatic T2DM patients. Long-standing diabetes, poor glycemic control, and autonomic neuropathy are strong predictors. Targeted screening of high-risk patients may enable early intervention and reduce adverse outcomes.

Keywords: Silent cardiac ischemia, type II diabetes mellitus, prevalence, risk factors, asymptomatic coronary artery disease, predictors

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INTRODUCTION

Type II diabetes mellitus (T2DM) is a global health challenge, with rising cardiovascular morbidity and mortality[1]. Coronary artery disease (CAD) is often silent in these patients due to diabetic autonomic neuropathy, making early detection difficult[2,3]. Silent cardiac ischemia (SCI) refers to objective evidence of myocardial ischemia in the absence of chest pain or angina-equivalent symptoms and is associated with increased risk of myocardial infarction and sudden cardiac death[4,5].

Studies report SCI prevalence ranging from 15–40% among asymptomatic T2DM patients, depending on diagnostic modalities used[6,7]. Risk factors include age, male gender, long duration of diabetes, poor glycemic control, hypertension, dyslipidemia, obesity, and autonomic neuropathy[8–11]. Identifying high-risk patients is crucial to prevent silent progression to major cardiovascular events[12–15].

Despite its significance, SCI is often underdiagnosed due to lack of routine screening. Population-specific data on prevalence and risk factors are essential for designing preventive strategies[14,15].

METHODOLOGY

Cross-sectional, observational study conducted at Services Hospital, Lahore from 1st july 2024 to 31st december

2024. Total 205 asymptomatic T2DM patients, calculated using prevalence-based sample size formula with 95% confidence interval and 5% margin of error.

- **Inclusion criteria:** Adults >18 years, T2DM diagnosis ≥1 year, no history of angina, myocardial infarction, or heart failure.
- **Exclusion criteria:** Known coronary artery disease, valvular heart disease, pregnancy, acute infection, chronic inflammatory disease, or inability to undergo stress testing.

Data Collection

1. **Demographic and lifestyle factors:** Age, sex, BMI, smoking, physical activity, diabetes duration, and family history of cardiovascular disease.
2. **Clinical evaluation:**
   - Blood pressure, heart rate
   - Comorbidities: Hypertension, dyslipidemia, chronic kidney disease
   - Autonomic neuropathy assessment: Heart rate variability, Valsalva ratio, postural hypotension
   - Medications: Antihypertensives, statins, antidiabetic drugs
3. **Laboratory parameters:**
   - Fasting glucose, HbA1c, lipid profile (LDL, HDL, triglycerides), serum creatinine
   - eGFR for renal function assessment
4. **Cardiac assessment:**
   - Exercise treadmill testing using **Bruce protocol**
   - ECG monitoring for ST-segment changes ≥1 mm
   - **Myocardial perfusion imaging** for borderline or inconclusive cases
5. **Definition of SCI:** Objective evidence of ischemia on stress testing or perfusion imaging **without anginal symptoms**

Statistical Analysis:

- Continuous variables: Mean ± SD; categorical variables: frequency and percentage
- Univariate comparisons: t-test for continuous variables, chi-square test for categorical variables
- Multivariate logistic regression: Identify independent predictors of SCI; results expressed as OR with 95% CI
- Significance level: $p<0.05$
- Visualization: Pie chart for SCI prevalence, bar charts for risk factor distribution, forest plot for logistic regression

Ethical Considerations:

- Approved by institutional ethics committee
- Written informed consent obtained from all participants

RESULTS

The study included 205 patients: 112 (54.6%) males and 93 (45.4%) females. The mean age was 55.8 ± 9.4 years. The mean BMI was 28.4 ± 4.1 kg/m². The mean diabetes duration was 8.6 ± 5.2 years, with 83 (40.5%) patients having diabetes >10 years. Mean HbA1c was 7.8 ± 1.1%, with 72 (35.1%) patients having HbA1c >8%. Hypertension in 96 (46.8%), dyslipidemia in 92 (44.9%), autonomic neuropathy in 50 (24.4%), and smoking in 49 (23.9%). (Table 1)

Table 1: Patient Demographics

Variable	Total (n=205)
Age (years)	55.8 ± 9.4
Gender (Male/Female)	112/93
BMI (kg/m²)	28.4 ± 4.1
Diabetes duration >10 yrs	83 (40.5%)
HbA1c >8%	72 (35.1%)
Hypertension	96 (46.8%)
Dyslipidemia	92 (44.9%)
Autonomic neuropathy	50 (24.4%)
Smoking	49 (23.9%)

SCI was detected in 67 patients (32.7%). Prevalence was higher among males (39.3%) than females (25.8%), and in patients with diabetes duration >10 years (49.4%).

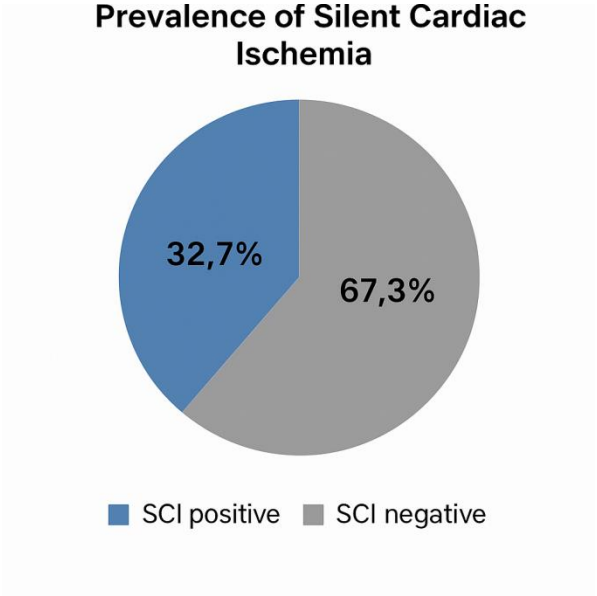

Figure 1: Prevalence of Silent Cardiac Ischemia

- Slice 1: SCI positive = 32.7%
- Slice 2: SCI negative = 67.3%

Risk Factors for SCI: Univariate analysis revealed significant associations between SCI and older age, male gender, diabetes duration >10 years, HbA1c >8%, hypertension, dyslipidemia, and autonomic neuropathy. Smoking was not significantly associated.

Table 2 demonstrates the distribution of SCI risk factors. Older age, male gender, longer diabetes duration, poor glycemic control, hypertension, dyslipidemia, and autonomic neuropathy were significantly higher in SCI patients. Smoking did not show a significant difference.

Multivariate logistic regression analysis identified diabetes duration >10 years, autonomic neuropathy, and poor glycemic control (HbA1c >8%) as independent predictors of silent cardiac ischemia in asymptomatic T2DM patients. Specifically, patients with diabetes duration longer than 10 years had a 2.3-fold increased risk of SCI (95% CI: 1.2–4.2, p=0.01), while those with autonomic neuropathy had the highest risk, with a 3.1-fold increase (95% CI: 1.6–6.0, p<0.001). Poor glycemic control also significantly increased the odds of SCI (OR 2.0, 95% CI: 1.1–3.8, p=0.02). Other factors, including age >55 years, male gender, hypertension, and dyslipidemia, did not reach statistical significance. (Table 3)

Table 2: Risk Factors for SCI

Risk Factor	SCI (n=67)	No SCI (n=138)	p-value
Age >55	43 (64.2%)	52 (37.7%)	<0.001
Male	42 (62.7%)	70 (50.7%)	0.04
Diabetes duration >10 yrs	41 (61.2%)	42 (30.4%)	<0.001
HbA1c >8%	35 (52.2%)	37 (26.8%)	0.01
Hypertension	41 (61.2%)	55 (39.9%)	0.02
Dyslipidemia	39 (58.2%)	53 (38.4%)	0.03
Autonomic neuropathy	28 (41.8%)	22 (15.9%)	<0.001
Smoking	18 (26.9%)	31 (22.5%)	0.48

Table 3: Multivariate Logistic Regression Analysis of Risk Factors for Silent Cardiac Ischemia (SCI) in T2DM Patients (n=205)

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Diabetes duration >10 years	2.3	1.2 – 4.2	0.01
Autonomic neuropathy	3.1	1.6 – 6.0	<0.001
HbA1c >8%	2.0	1.1 – 3.8	0.02
Age >55 years	1.5	0.8 – 2.8	0.18
Male gender	1.2	0.6 – 2.4	0.55
Hypertension	1.3	0.7 – 2.5	0.42
Dyslipidemia	1.4	0.7 – 2.7	0.36

Multivariate logistic regression analysis identified diabetes duration >10 years, autonomic neuropathy, and poor glycemic control (HbA1c >8%) as independent predictors of silent cardiac ischemia in asymptomatic T2DM patients. Specifically, patients with diabetes duration longer than 10 years had a 2.3-fold increased risk of SCI (95% CI: 1.2–4.2, p=0.01), while those with autonomic neuropathy had the highest risk, with a 3.1-fold increase (95% CI: 1.6–6.0, p<0.001). Poor glycemic control also significantly increased the odds of SCI (OR 2.0, 95% CI: 1.1–3.8, p=0.02). Other factors, including age >55 years, male gender, hypertension, and dyslipidemia, did not reach statistical significance.

DISCUSSION

This study demonstrates a high prevalence (32.7%) of SCI among asymptomatic T2DM patients, consistent with other reports (20–40%)[1,6,14,16]. SCI is particularly common in older males, those with long-standing diabetes, poor glycemic control, and autonomic neuropathy, highlighting the need for targeted screening.

Demographics: Older age increases SCI risk due to prolonged exposure to hyperglycemia and accelerated atherosclerosis[17]. Male gender is a known risk factor for CAD and SCI[18].

Diabetes duration and glycemic control: Patients with diabetes >10 years and HbA1c >8% were at higher risk. Chronic hyperglycemia causes endothelial dysfunction, increased oxidative stress, and coronary plaque formation[19,20].

Autonomic neuropathy: Strongly associated with SCI. Autonomic dysfunction blunts anginal pain perception, resulting in silent ischemia[21,22]. This underlines the importance of cardiovascular autonomic function assessment in diabetes clinics.

Hypertension and dyslipidemia: These traditional risk factors were more prevalent in SCI patients. Both contribute to plaque instability and silent ischemia[23].

Clinical Implications:

- Routine screening for SCI should focus on high-risk T2DM patients, especially older males, those with long disease duration, poor glycemic control, and autonomic neuropathy.
- Exercise treadmill testing is practical for first-line screening; myocardial perfusion imaging improves diagnostic accuracy in borderline cases.
- Early intervention, including lifestyle modification, intensive glycemic control, statin therapy, and antiplatelets, may reduce silent cardiovascular morbidity[24,25].

Limitations:

- Single-center design; may limit generalizability.
- Advanced imaging (e.g., coronary CT angiography) could identify additional subclinical cases.
- Cross-sectional design limits causal inference.

CONCLUSION

SCI is prevalent among asymptomatic T2DM patients and strongly associated with diabetes duration, poor glycemic control, and autonomic neuropathy. Targeted screening in high-risk populations is essential for early detection and preventive intervention.

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