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Prevalence and impact of silent myocardial ischemia in diabetic patients

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Abstract:
Silent myocardial ischemia (SMI) is a frequent, unrecognized complication in patients with type 2 diabetes mellitus (T2DM) that significantly increases adverse cardiovascular risk despite the absence of typical anginal symptoms. Therefore, it is of interest to evaluate the prevalence of SMI and identified its associated clinical risk factors within a diabetic cohort. A total of 240 patients with T2DM were enrolled in this cross-sectional study and baseline demographics, clinical histories and laboratory parameters were systematically analyzed to identify predictors of SMI. Data show that 132 (55.0%) males and 108 (45.0%) females, with statistical analysis revealing that poor glycemic control, longer duration of diabetes, hypertension and dyslipidemia were significant independent predictors of SMI within this population. Thus, SMI is strongly linked to preventable metabolic and clinical markers in T2DM patients, emphasizing the urgent clinical need for targeted screening strategies to enable early detection and aggressive cardiovascular risk reduction.

Keywords: Silent myocardial ischemia (SMI); diabetes mellitus (DM); cardiovascular risk factors; glycemic control; screening

Background:
Diabetes mellitus markedly increases cardiovascular morbidity through endothelial dysfunction and accelerated atherosclerosis **[1]**. Silent myocardial ischemia (SMI) represents transient ischemia without anginal symptoms and is disproportionately prevalent in diabetics **[2]**. Autonomic neuropathy blunts pain perception, delaying recognition of ischemia and infarction **[3]**. Epidemiological data confirm higher mortality in diabetics with unrecognized ischemia than in non-diabetics **[4]**. Large cohorts demonstrate SMI prevalence ranging from 20% to 35% in type 2 diabetes depending on age and comorbid burden **[5]**. Hypertension, dyslipidemia, renal dysfunction and smoking are consistent predictors of SMI in diabetic patients **[6]**. SMI is independently associated with adverse outcomes including heart failure, arrhythmia and sudden cardiac death **[7]**. Current guidelines recommend risk stratification of asymptomatic diabetics, yet clinical adoption remains inconsistent **[8]**. Therefore, it is of interest to report the prevalence and impact of silent myocardial ischemia among diabetic patients.

Methods:
This cross-sectional study was carried out in the Department of Cardiology at a tertiary care teaching hospital over a period of 12 months. Patients with type 2 diabetes mellitus, aged between 30 and 70 years, who provided informed consent were included. Individuals with a history of myocardial infarction, coronary revascularization, symptomatic angina, or known coronary artery disease were excluded. Silent myocardial ischemia was initially assessed using a standard exercise treadmill test. Patients unable to perform treadmill testing underwent pharmacological stress evaluation with echocardiography. Positive tests were defined according to established electrocardiographic or imaging criteria. Demographic details, duration of diabetes and comorbid conditions such as hypertension, dyslipidemia and smoking status were recorded. Laboratory investigations included fasting blood glucose, glycated hemoglobin (HbA1c), lipid profile and renal function tests. Body mass index and blood pressure were measured for all participants. Sample size was calculated using an anticipated prevalence of 25–30% silent myocardial ischemia in diabetics, with a 95% confidence interval and 5% margin of error. Patients were recruited using convenience sampling based on hospital outpatient attendance. Data analysis was performed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were analyzed using the Chi-square test. Multivariate logistic regression was applied to identify independent predictors of silent myocardial ischemia. A p-value <0.05 was considered statistically significant.

Results:
A total of 240 patients with type 2 diabetes mellitus were enrolled, including 132 (55.0%) males and 108 (45.0%) females. The mean age of the study population was 55.6 ± 9.3 years and the mean duration of diabetes was 9.4 ± 5.1 years. Silent myocardial ischemia was identified in 67 patients, yielding an overall prevalence of 27.9% **(Figure 1)**. Patients with SMI had a significantly longer duration of diabetes (11.2 ± 4.6 vs. 8.1 ± 5.2 years, $p = 0.03$) and higher HbA1c levels (8.6 ± 1.2 vs. 7.5 ± 1.0, $p < 0.01$) compared with patients without SMI. Hypertension and

dyslipidemia were also significantly more common among patients with SMI (68.0% vs. 42.2%, p = 0.01 and 71.2% vs. 46.8%, p = 0.02, respectively). No significant differences were observed with respect to age, sex, smoking status, or body mass index between the two groups **(Table 1)**.

Table 1: Baseline characteristics and risk factors in diabetic patients with and without silent myocardial ischemia

Variable	SMI (n=67)	Non-SMI (n=173)	p-value
Age (years, mean ± SD)	56.2 ± 8.7	55.3 ± 9.6	0.54
Male gender (%)	56.7	54.9	0.81
Duration of diabetes (years)	11.2 ± 4.6	8.1 ± 5.2	0.03*
HbA1c (%)	8.6 ± 1.2	7.5 ± 1.0	<0.01*
Hypertension (%)	68	42.2	0.01*
Dyslipidemia (%)	71.2	46.8	0.02*
Smoking (%)	28.4	20.2	0.19
BMI (kg/m²)	27.8 ± 3.5	26.9 ± 3.8	0.21

**Statistically significant*

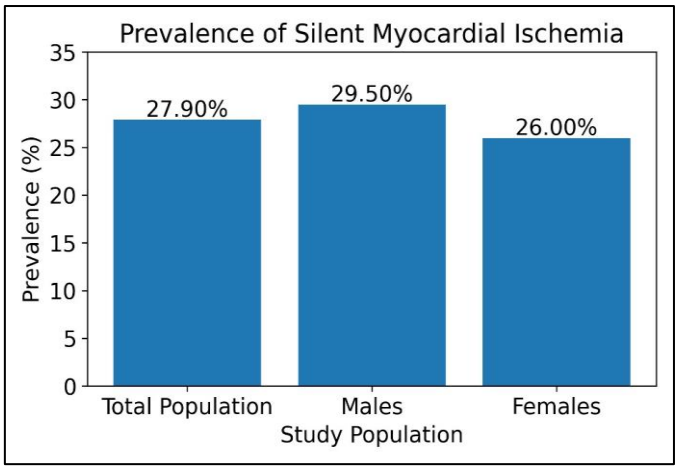

Figure 1: Prevalence of silent myocardial ischemia in the study population

Discussion:

The prevalence of SMI in our cohort (27.9%) is consistent with prior reports in diabetic populations **[1, 9]**. Similar studies confirm that nearly one-third of asymptomatic diabetics harbor occult ischemia, highlighting its silent epidemic **[2, 10]**. Poor glycemic control significantly predicted SMI, aligning with evidence linking HbA1c with microvascular and macrovascular dysfunction **[11]**. Longer diabetes duration increased risk; supporting data that chronic hyperglycemia accelerates endothelial injury **[12]**. Hypertension emerged as an independent predictor, consistent with findings in essential hypertension cohorts **[8, 13]**. Dyslipidemia was highly prevalent among SMI cases, corroborating prior work on atherogenic profiles in diabetics **[14]**. Autonomic neuropathy contributes to pain unawareness, delaying ischemia detection and worsening prognosis **[3, 15]**. Our results reaffirm that SMI is strongly linked to heart failure, arrhythmia and sudden cardiac death **[7, 16]**. Screening asymptomatic diabetics remains debated due to cost-effectiveness, yet selective testing may be beneficial in high-risk groups **[17]**. Advanced imaging such as stress echocardiography and nuclear scans improve detection compared to treadmill testing alone **[18]**. Despite guideline recommendations, adherence to routine SMI evaluation is inconsistent across clinical practice **[8, 19]**. Large cohort analyses confirm that undetected ischemia contributes to excess cardiovascular mortality in diabetes **[4, 20]**. Our study emphasizes the combined role of glycemic control, hypertension and dyslipidemia as modifiable predictors of SMI **[13, 21]**. The findings align with Framingham data, which first established diabetes as a major cardiovascular risk factor **[22]**. Diabetic cardiomyopathy further complicates ischemic burden, even in absence of obstructive coronary disease **[23]**. Oxidative stress and inflammatory pathways also mediate vascular injury and silent ischemic changes **[24]**. Our findings are further supported by the recent study by Goyal *et al.*, who reported a comparable prevalence of silent myocardial ischemia among asymptomatic patients with type 2 diabetes mellitus in North India. The authors also observed significant associations between SMI and poor glycemic control, longer duration of diabetes, hypertension and dyslipidemia, emphasizing the importance of targeted cardiovascular screening and aggressive risk-factor modification in high-risk diabetic populations **[25]**. Overall, the present study demonstrates that silent myocardial ischemia remains a common yet frequently overlooked cardiovascular complication among patients with type 2 diabetes mellitus. The observed associations between SMI and poor glycemic control, longer duration of diabetes, hypertension and dyslipidemia underscore the cumulative impact of metabolic and cardiovascular risk factors on the development of occult ischemic disease. These findings are consistent with previous literature and reinforce the importance of comprehensive cardiovascular risk assessment in diabetic patients, even in the absence of typical symptoms. Early identification of high-risk individuals through appropriate screening strategies may facilitate timely intervention, improve risk-factor modification and ultimately reduce the burden of adverse cardiovascular outcomes in this vulnerable population. Further multicenter prospective studies with larger sample sizes are warranted to validate these findings and refine screening approaches for asymptomatic diabetic patients.

Conclusion:

Silent myocardial ischemia is highly prevalent among diabetic patients and often remains undetected. Poor glycemic control, hypertension and dyslipidemia emerged as key independent predictors. Targeted screening and early intervention may reduce cardiovascular risk in this vulnerable population.

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