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*Original Article*

# SILENT MYOCARDIAL INFARCTION IN ASYMPTOMATIC PATIENTS WITH END-STAGE RENAL DISEASE ON MAINTENANCE HAEMODIALYSIS: FREQUENCY AND ASSOCIATED FACTORS AT A RESOURCE-LIMITED CENTRE IN PAKISTAN

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**ABSTRACT**

This descriptive cross-sectional study was conducted to determine the frequency of silent myocardial infarction (SMI) among asymptomatic end-stage renal disease (ESRD) patients on maintenance haemodialysis using routinely available electrocardiography and echocardiography in a resource-limited setting. The study was conducted at the Department of Nephrology, Dr. Ziauddin Hospital, Karachi, Pakistan, from April 2023 to October 2023. Medical records of 147 asymptomatic ESRD patients aged 18–70 years on maintenance haemodialysis for at least one year were reviewed. Patients with prior symptomatic ischaemic heart disease or coronary interventions were excluded. SMI was defined by pathological Q waves or major ST–T abnormalities on ECG (Minnesota Code) and/or regional wall motion abnormalities on echocardiography with left ventricular ejection fraction <50%, in the absence of ischaemic symptoms. Descriptive statistics, chi-square or Fisher's exact tests, and multivariable logistic regression were applied. The mean age was 50.44 ± 13.55 years and 57.1% were male. SMI was identified in 19 patients (12.9%). Echocardiographic abnormalities were present in 43 patients (29.3%) and were not associated with SMI (p = 0.807). On multivariable analysis, haemodialysis duration greater than five years was independently associated with lower odds of SMI compared with one to five years (adjusted OR 0.11, 95% CI 0.01–0.84; p = 0.035). Silent myocardial infarction was identified in 12.9% of asymptomatic haemodialysis patients in this resource-limited setting. Routine ECG and echocardiography are feasible screening tools, particularly during the early dialysis period when cardiovascular risk appears greatest.

**KEYWORDS:** Silent myocardial infarction; end-stage renal disease; haemodialysis; electrocardiography; echocardiography; cardiovascular risk

## INTRODUCTION

Cardiovascular disease remains the leading cause of morbidity and mortality among patients with end-stage renal disease (ESRD) receiving maintenance haemodialysis, accounting for a substantial proportion of deaths in this population (1,2). Accelerated atherosclerosis, chronic inflammation, oxidative stress, uremic toxin accumulation, and vascular calcification contribute synergistically to myocardial injury in ESRD patients (1,3). A considerable proportion of myocardial infarctions in ESRD patients occur without classical ischaemic symptoms. Autonomic dysfunction, impaired pain perception, reduced functional capacity, and overlapping comorbidities frequently mask ischaemic presentations, resulting in silent myocardial infarction (SMI) (4,5). Despite the absence of symptoms, SMI is associated with adverse outcomes including heart failure, malignant arrhythmias, and increased long-term mortality (6).

Reported prevalence of SMI among dialysis populations ranges from 10% to 40%, depending on diagnostic criteria, study design, and imaging modalities employed [6,7]. Studies utilising advanced imaging techniques such as cardiac magnetic resonance imaging report higher prevalence, whereas investigations relying on electrocardiography (ECG) and echocardiography provide lower but more pragmatic estimates applicable to low-resource settings (5,7).

In resource-limited healthcare systems, access to advanced cardiac imaging remains restricted. Consequently, routine ECG and transthoracic echocardiography continue to serve as the primary cardiovascular screening tools in dialysis units (4,8). Contemporary data from South Asia are scarce despite a rapidly increasing ESRD burden.

This study therefore aimed to determine the frequency of SMI among asymptomatic ESRD patients on maintenance haemodialysis at a single dialysis centre in Pakistan using routinely available diagnostic modalities.

## METHODOLOGY

### *Study Design and Setting*

This cross-sectional study was conducted at the Department of Nephrology, Dr. Ziauddin Hospital, Karachi, Pakistan. Data were collected between April and October 2023. Patients aged 18–70 years with ESRD receiving maintenance haemodialysis for at least one year were eligible for inclusion. Patients with a history of chest pain, angina, diagnosed myocardial infarction, coronary revascularisation, known structural heart disease, or prior cardiac surgery were excluded to ensure inclusion of truly asymptomatic individuals.

Silent myocardial infarction was defined as objective evidence of prior myocardial injury in the absence of ischaemic symptoms, identified by one or more of the following: (i) pathological Q waves (Minnesota Code 1.1.x–1.3.x) or major ST–T abnormalities on standard 12-lead ECG [4]; or (ii) regional wall motion abnormalities on transthoracic echocardiography with left ventricular ejection fraction <50% [8]. All ECGs and echocardiograms were performed as part of routine clinical evaluation and interpreted by trained cardiologists using standard criteria. Demographic and clinical variables extracted from medical records included age, sex, duration of haemodialysis, diabetes mellitus, hypertension, smoking status, and family history of cardiac disease.

### *Statistical Analysis*

Statistical analysis was performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation and categorical variables as frequencies and percentages. Associations between categorical variables and SMI status were assessed using chi-square or Fisher's exact tests, as appropriate. Multivariable logistic regression was performed, adjusting for age, sex, diabetes mellitus, hypertension, smoking status, and dialysis duration. A two-tailed p-value of <0.05 was considered statistically significant.

## RESULTS

A total of 147 patients were included in the study. The mean age was 50.44 ± 13.55 years and 57.1% were male. SMI was identified in 19 of 147 patients (12.9%) (Table I). General echocardiographic abnormalities were observed in 43 patients (29.3%) and were not significantly associated with SMI (p = 0.807).

### *Frequency of Silent Myocardial Infarction*

Silent myocardial infarction was identified in 19 patients, yielding a prevalence of 12.9% (Table 1).

**Table 1. Frequency of Silent Myocardial Infarction (N=147)**

| Silent Myocardial Infarction | n | % |
|---|---|---|
| Yes | 19 | 12.9 |
| No | 128 | 87.1 |
| Total | 147 | 100.0 |

### *Factors Associated With Silent Myocardial Infarction*

On univariable analysis, shorter haemodialysis duration (1–5 years) was significantly associated with a higher prevalence of SMI compared with duration greater than five years (5.3% vs. 37.5%; p = 0.006). No significant associations were observed with age, sex, diabetes mellitus, hypertension, smoking, family history of cardiac disease, or echocardiographic abnormalities (Table 2). On multivariable logistic regression, haemodialysis duration greater than five years remained independently associated with lower odds of SMI (adjusted OR 0.11; 95% CI 0.01–0.84; p = 0.035), with one to five years serving as the reference category. No other variables reached statistical significance (Table 3).

## DISCUSSION

In this cross-sectional study conducted at a resource-limited dialysis centre in Karachi, Pakistan, SMI was identified in approximately 13% of asymptomatic patients undergoing maintenance haemodialysis. This prevalence lies at the lower boundary of internationally reported ranges and is consistent with studies that relied on ECG and echocardiography rather than advanced imaging modalities (6,7).

Advanced techniques such as cardiac magnetic resonance imaging detect myocardial fibrosis and microinfarctions not apparent on ECG or echocardiography, resulting in higher reported SMI prevalence in high-resource environments (7). However, the objective of the present study was not to maximise diagnostic sensitivity but to assess the real-world diagnostic yield of tools that are widely available in low-resource dialysis units. From this pragmatic standpoint, the findings are clinically relevant and generalisable to similar settings.

**Table 2. Univariable Associations With Silent Myocardial Infarction**

| Variable | SMI Yes (n=19) | SMI No (n=128) | p-value |
|---|---|---|---|
| Age >50 years | 9 (47.4%) | 66 (51.6%) | 0.733 |
| Male sex | 14 (73.7%) | 70 (54.7%) | 0.093 |
| Diabetes mellitus | 8 (42.1%) | 60 (46.9%) | 0.697 |
| Hypertension | 16 (84.2%) | 86 (67.2%) | 0.105 |
| Smoking | 7 (36.8%) | 34 (26.6%) | 0.351 |
| Dialysis duration >5 years | 1 (5.3%) | 48 (37.5%) | 0.006* |
| Family cardiac history | 4 (21.1%) | 23 (18.0%) | 0.477 |
| Echocardiographic abnormality | 6 (31.6%) | 37 (28.9%) | 0.807 |

**Statistically significant (p <0.05)*

The observed inverse association between longer dialysis duration and SMI most likely reflects survivor bias, whereby patients with greater cardiovascular vulnerability experience adverse outcomes earlier in their disease course and do not survive to longer dialysis durations (2,6). This pattern has been described in prior ESRD cohorts and underscores the early dialysis period as a phase of heightened cardiovascular risk (3).

**Table 3. Multivariable Logistic Regression for Predictors of Silent Myocardial Infarction**

| Variable | Adjusted OR (95% CI) | p-value |
|---|---|---|
| Age >50 years | 0.89 (0.33–2.42) | 0.821 |
| Male sex | 3.01 (0.99–9.15) | 0.052 |
| Diabetes mellitus | 0.87 (0.32–2.36) | 0.786 |
| Hypertension | 3.12 (0.85–11.47) | 0.086 |
| Smoking | 1.52 (0.54–4.28) | 0.428 |
| Dialysis duration >5 years | 0.11 (0.01–0.84) | 0.035* |

**Statistically significant (p <0.05); OR = odds ratio; CI = confidence interval*

Traditional cardiovascular risk factors such as diabetes mellitus and hypertension were not significantly associated with SMI in this cohort. This finding is consistent with emerging evidence suggesting that uraemia-specific mechanisms—including vascular calcification, chronic inflammation, endothelial dysfunction, and myocardial stunning during dialysis—may play a more dominant role in myocardial injury than conventional risk factors alone (1,3,8).

Recent literature has further highlighted the contribution of myocardial fibrosis, coronary microvascular dysfunction, and dialysis-induced haemodynamic stress to subclinical myocardial injury in ESRD patients, even in the absence of obstructive coronary artery disease (9,10). These mechanisms provide biological plausibility for the occurrence of SMI early in the dialysis course and reinforce the limitations of symptom-based cardiovascular screening.

Contemporary studies increasingly advocate for risk-stratified cardiovascular surveillance in ESRD, integrating accessible tools with emerging biomarkers and simplified imaging protocols where feasible (10). In resource-limited environments, strengthening routine ECG and echocardiographic surveillance during the early dialysis period may represent a realistic interim strategy until broader access to advanced diagnostics becomes available.

This study has a few limitations, including its being reported from a single-centre and modest sample size may limit generalisability and statistical power. The cross-sectional design precludes assessment of temporal relationships or clinical outcomes. Reliance on ECG and echocardiography alone likely underestimates the true prevalence of SMI compared with cardiac magnetic resonance imaging or biomarker-based strategies, which have demonstrated greater sensitivity in recent studies but remain inaccessible in many resource-limited settings (9,10). Furthermore, dialysis adequacy parameters and longitudinal cardiovascular outcomes were not evaluated in this study.

## CONCLUSION

Silent myocardial infarction affects a meaningful proportion of asymptomatic patients receiving maintenance haemodialysis in resource-limited settings, with a prevalence of 12.9% in this cohort. Routine ECG and echocardiography provide feasible and pragmatic screening tools, particularly during the early years of dialysis when cardiovascular vulnerability appears greatest. Larger, multicentre longitudinal studies incorporating contemporary diagnostic approaches are needed to refine risk stratification and improve cardiovascular outcomes in similar settings.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ETHICAL CONSIDERATION

The study was conducted in accordance with the principles of the Declaration of Helsinki. Patient confidentiality was strictly maintained throughout. This study involved retrospective review of routinely collected clinical data with no intervention or deviation from standard care. As per institutional policy, formal ethical review committee approval was not required for anonymised observational analyses. Patient confidentiality was strictly maintained, and consent for use of anonymised clinical data was obtained at the time of routine care.

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