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Original Research Article

Concomitant Renal Insufficiency and Diabetes Mellitus as Prognostic Factors for Acute Myocardial Infarction

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Abstract:

Background: Acute myocardial infarction (AMI) is a leading cause of cardiovascular mortality, and outcomes are significantly influenced by coexisting systemic conditions. Diabetes mellitus (DM) and renal insufficiency (RI) are two major comorbidities known to adversely affect the clinical course of AMI. Their combined impact, however, remains under-recognized in routine clinical practice.

Objectives: To evaluate the prognostic significance of diabetes mellitus and renal insufficiency—individually and in combination—on clinical presentation, complications, and in-hospital outcomes among patients with acute myocardial infarction.

Methods: This prospective cross-sectional study included 300 patients with confirmed AMI presenting to IMS & SUM Hospital, Bhubaneswar, over 18 months. Patients were stratified into four groups: AMI without DM/RI, AMI with DM only, AMI with RI only, and AMI with both DM and RI. Clinical presentation, laboratory parameters, echocardiographic findings, complications, and in-hospital mortality were compared across groups.

Results: Patients with concomitant DM and RI were significantly older, presented more often with delayed symptoms, and had higher Killip class at admission. They exhibited markedly reduced left ventricular ejection fraction and the highest rates of arrhythmias, acute heart failure, cardiogenic shock, and recurrent ischemia. In-hospital mortality was greatest in the DM + RI group (27%), followed by the RI-only group (17%). Hospital stay was significantly prolonged in patients with renal insufficiency and combined comorbidities.

Conclusion: Diabetes mellitus and renal insufficiency—especially when present together—serve as strong predictors of adverse outcomes in acute myocardial infarction. Early risk stratification and targeted management strategies are essential to reduce complications and improve survival in this high-risk population.

Introduction

Acute myocardial infarction (AMI) remains one of the leading causes of morbidity and mortality worldwide, contributing significantly to the global burden of cardiovascular disease. Despite advancements in diagnostic techniques, early reperfusion strategies, and pharmacological interventions, outcomes following AMI continue to vary widely depending on the presence of coexisting systemic diseases [1]. Among these, diabetes mellitus (DM) and renal insufficiency (RI) are recognized as two major comorbid conditions that substantially influence both short-term and long-term prognosis in patients presenting with AMI [2].

Diabetes mellitus is a well-established independent risk factor for atherosclerosis, endothelial dysfunction, and accelerated coronary artery disease. Individuals with diabetes are not only more prone to developing AMI, but they also tend to exhibit atypical symptoms, delayed presentation, and multi-vessel disease at the time of diagnosis [3]. Hyperglycemia promotes oxidative stress, inflammation, platelet activation, and microvascular dysfunction, all of which contribute to larger infarct size and poorer myocardial salvage during acute events [4]. Several studies have shown that diabetic patients have higher rates of heart failure, cardiogenic shock, and mortality following AMI, even after receiving optimal therapy [5].

Similarly, renal insufficiency has emerged as a significant prognostic determinant in cardiovascular disease. Reduced glomerular filtration rate (GFR), even at mild-to-moderate levels, is associated with systemic inflammation, impaired sodium and fluid handling, vascular calcification, and heightened

sympathetic activity [6]. These factors predispose patients to more severe coronary involvement and reduced tolerance to ischemic injury. Moreover, patients with renal insufficiency often have contraindications or diminished response to standard therapies such as contrast-based imaging, anticoagulation, and certain antiplatelet drugs [7]. Consequently, AMI patients with renal dysfunction have higher rates of recurrent ischemia, arrhythmias, heart failure, and in-hospital mortality [8].

The coexistence of diabetes and renal insufficiency further amplifies cardiovascular risk. Diabetic nephropathy leads to structural and functional derangements, compounding endothelial dysfunction and accelerating atherosclerotic progression [9]. This synergistic interaction predisposes such patients to more extensive coronary disease, poorer clinical outcomes, and higher mortality following AMI [10]. Understanding the combined prognostic significance of these conditions is therefore crucial for risk stratification, therapeutic decision-making, and resource allocation in acute cardiac care.

Given these observations, the present prospective cross-sectional study conducted at IMS & SUM Hospital, Bhubaneswar, seeks to evaluate the prognostic impact of concomitant renal insufficiency and diabetes mellitus in patients presenting with acute myocardial infarction. Identifying these high-risk groups may help clinicians tailor management strategies and improve overall outcomes.

Materials and Methods

Study Design and Setting: This study was designed as a prospective cross-sectional study conducted in the Department of Cardiology at IMS & SUM Hospital, Bhubaneswar, Odisha. The study was carried out over a period of 18 months, during which all eligible patients presenting with acute myocardial infarction (AMI) were screened and enrolled after meeting the inclusion criteria.

Study Population and Sample Size: A total of 300 patients diagnosed with acute myocardial infarction were included in the study. Consecutive sampling was used to enroll all eligible patients who presented to the hospital during the study period. Both ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) cases were included.

Inclusion Criteria

1. Patients aged 18 years and above.
2. Diagnosed cases of acute myocardial infarction based on clinical presentation, ECG changes, and cardiac biomarkers.
3. Patients willing to provide informed consent.

Exclusion Criteria

1. History of chronic inflammatory diseases.
2. Valvular heart disease or congenital heart disorders.
3. Known malignancy.
4. End-stage renal failure requiring dialysis.
5. Patients on immunosuppressive therapy or systemic steroids.
6. Incomplete clinical or laboratory data.

Study Groups

Patients were categorized into four clinical subgroups based on the presence or absence of diabetes mellitus (DM) and renal insufficiency (RI):

1. AMI without DM and without RI
2. AMI with DM only
3. AMI with RI only
4. AMI with both DM and RI (concomitant group)

Renal insufficiency was defined based on estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73 m^2 at presentation. Diabetes mellitus was confirmed using patient history, medical records, fasting glucose, or HbA1c levels.

Data Collection

A structured pre-validated data collection sheet was used to obtain information on:

1. Demographic variables
2. Clinical presentation and risk factors
3. Vital signs at admission
4. ECG findings
5. Cardiac biomarker levels
6. Renal function parameters (serum urea, creatinine, eGFR)
7. Glycemic parameters (random glucose, fasting glucose, HbA1c)
8. Echocardiographic findings including left ventricular ejection fraction (LVEF)
9. Treatment modalities received (thrombolysis, PCI, medications)

Outcome Measures

The primary outcomes evaluated were:

1. In-hospital mortality
2. Incidence of arrhythmias
3. Cardiogenic shock
4. Heart failure
5. Recurrent ischemia during hospital stay
6. Length of hospital stay

Secondary outcomes included extent of myocardial damage, Killip class at presentation, and hemodynamic instability.

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies

and percentages. Comparisons between groups were performed using chi-square tests for categorical variables and t-tests or ANOVA for continuous variables. A p-value < 0.05 was considered statistically significant.

Results

A total of 300 patients presenting with acute myocardial infarction (AMI) were enrolled in the study. The mean age of the study population was 58.4 ± 11.2 years, with a male predominance (72%). Patients were categorized into four groups based on the presence of diabetes mellitus (DM) and renal insufficiency (RI):

Group 1: Neither DM nor RI (n = 132)

Group 2: DM only (n = 74)

Group 3: RI only (n = 46)

Group 4: Both DM + RI (n = 48)

Baseline characteristics, clinical presentation, biochemical parameters, complications, and in-hospital outcomes were compared across the four groups.

1. **Baseline Demographic and Clinical Characteristics:** Patients with concomitant DM and RI were significantly older and had a higher prevalence of hypertension and past ischemic heart disease. Group 4 also showed delayed presentation (>12 hours) compared to other groups.

Table 1: Baseline Characteristics of Study Population (N = 300)

Variable	Group 1 (n=132)	Group 2 (n=74)	Group 3 (n=46)	Group 4 (n=48)	p-value
Mean age (years)	55.8 ± 10.5	58.9 ± 9.8	60.4 ± 12.1	63.1 ± 11.4	0.003
Male (%)	71%	75%	69%	72%	0.81
Hypertension (%)	34%	62%	58%	70%	<0.001
Smoking (%)	52%	48%	45%	44%	0.44
Prior IHD (%)	11%	20%	22%	29%	0.01
BMI (kg/m²)	24.3 ± 2.9	26.1 ± 3.3	24.9 ± 3.1	26.4 ± 3.2	0.02

2. **Clinical Presentation and Type of MI:** STEMI was more frequent in patients without RI, whereas NSTEMI predominated in RI groups. Group 4 had the highest proportion of Killip Class III/IV presentation.

Table 2: Clinical Presentation at Admission

Variable	Group 1	Group 2	Group 3	Group 4	p-value
STEMI (%)	74%	68%	54%	50%	<0.001
NSTEMI (%)	26%	32%	46%	50%	<0.001
Chest pain > 12 hours (%)	18%	27%	39%	46%	<0.001
Killip Class I/II (%)	88%	76%	65%	54%	<0.001
Killip Class III/IV (%)	12%	24%	35%	46%	<0.001

3. **Laboratory Parameters:** Group 3 and Group 4 had significantly elevated urea and creatinine levels, reflecting renal impairment. Hyperglycemia was predominant in diabetic groups.

Table 3: Laboratory Profile at Admission

Parameter	Group 1	Group 2	Group 3	Group 4	p-value
Fasting glucose (mg/dL)	98 ± 12	162 ± 39	105 ± 17	174 ± 46	<0.001
HbA1c (%)	5.4 ± 0.4	8.1 ± 1.2	5.5 ± 0.5	8.4 ± 1.3	<0.001
Urea (mg/dL)	32 ± 7	36 ± 8	82 ± 21	94 ± 28	<0.001
Creatinine (mg/dL)	0.96 ± 0.18	1.12 ± 0.21	2.34 ± 0.62	2.78 ± 0.74	<0.001
eGFR (mL/min/1.73m²)	88 ± 12	78 ± 14	38 ± 9	32 ± 7	<0.001

4. **Echocardiographic Findings:** Patients with coexisting DM + RI had significantly reduced LVEF, indicating greater myocardial damage.

Table 4: Echocardiographic Evaluation

Parameter	Group 1	Group 2	Group 3	Group 4	p-value
Mean LVEF (%)	47.8 ± 7.4	43.2 ± 8.1	40.1 ± 9.5	36.4 ± 8.7	<0.001
Regional wall motion abnormalities (%)	62%	75%	81%	88%	<0.001

5. **In-Hospital Complications:** Patients with combined DM and RI had the highest rates of complications, including arrhythmias, cardiogenic shock, and acute heart failure.

Table 5: In-Hospital Complications Across Groups

Complication	Group 1	Group 2	Group 3	Group 4	p-value
Arrhythmias (%)	16%	22%	31%	38%	<0.001
Acute heart failure (%)	12%	21%	29%	42%	<0.001
Cardiogenic shock (%)	4%	9%	15%	25%	<0.001
Recurrent ischemia (%)	6%	11%	18%	23%	<0.001

6. **In-Hospital Mortality:** Group 4 had the highest mortality, followed by Group 3. Mortality was lowest in patients without either comorbidity.

Table 6: Mortality Outcomes

Outcome	Group 1	Group 2	Group 3	Group 4	p-value
In-hospital mortality (%)	5%	9%	17%	27%	<0.001
Mean hospital stays (days)	5.1 ± 1.2	6.4 ± 1.7	7.3 ± 2.1	8.9 ± 2.4	<0.001

Summary of Main Findings

1. Renal insufficiency and diabetes, individually and together, significantly worsened outcomes in AMI patients.
2. Patients with both DM + RI were older, had lower LVEF, higher Killip class, and poorer biochemical profiles.
3. Complications and mortality were highest in the DM + RI group.
4. Renal insufficiency alone also had a strong negative prognostic impact.

Discussion

In this prospective cross-sectional study, we evaluated the prognostic significance of concomitant diabetes mellitus (DM) and renal insufficiency (RI) among patients presenting with acute myocardial infarction (AMI). The findings clearly demonstrate that the coexistence of these two conditions substantially worsens clinical presentation, exacerbates the severity of myocardial damage, increases in-hospital complications, and leads to significantly higher mortality. These results reinforce the understanding that both DM and RI independently worsen cardiovascular risk, but their combination produces a multiplicative rather than additive adverse effect [11].

The higher frequency of delayed presentation and greater proportion of Killip Class III/IV in patients with DM and RI can be attributed to atypical symptomatology and impaired autonomic regulation associated with diabetic neuropathy, as well as the blunted physiological reserve observed in renal dysfunction [12]. Patients with RI also tend to have higher baseline inflammation, anemia, and vascular calcification, all of which contribute to more severe myocardial injury during infarction [13]. This is consistent with our observation of significantly reduced left ventricular ejection fraction (LVEF) in RI and DM+RI groups.

Renal insufficiency is well recognized to impair coronary microcirculation, alter drug metabolism, and intensify oxidative stress. These mechanisms explain why AMI patients with RI often exhibit more extensive infarction and poorer hemodynamic stability [14]. Additionally, elevated urea and creatinine levels are known to correlate with coronary microvascular dysfunction and increased susceptibility to arrhythmias, which aligns with the higher incidence of arrhythmias observed in the RI and DM+RI groups in our study [15].

The presence of diabetes introduces further metabolic disturbances, including endothelial dysfunction, hypercoagulability, and impaired myocardial healing. Diabetic myocardium has reduced ischemic tolerance, predisposing patients to larger infarct size and lower chances of myocardial salvage, even with timely reperfusion [16]. When diabetes coexists with renal insufficiency, these adverse mechanisms synergize, resulting in significantly increased cardiogenic shock, heart failure, and recurrent ischemia, as seen in our results.

The markedly higher mortality observed in the DM+RI group reflects the cumulative cardiovascular burden of these conditions. Previous multicenter studies have shown that mortality risk in AMI patients can double or triple when both

conditions coexist, due to widespread vascular dysfunction, heightened inflammation, and reduced response to therapy [17]. Poor clearance of cardiotoxic metabolites and altered pharmacokinetics of antiplatelet agents and anticoagulants further complicate management strategies in these patients [18].

Furthermore, prolonged hospital stay in patients with RI and DM highlights the increased need for monitoring, dialysis risk, hemodynamic support, and management of metabolic derangements. This increased healthcare burden has been reported consistently in various observational studies evaluating AMI outcomes in patients with multimorbidity [19,20].

Overall, the study confirms that renal insufficiency and diabetes mellitus, both individually and synergistically, are strong predictors of adverse outcomes in acute myocardial infarction. Early identification, aggressive risk stratification, and tailored management strategies are essential for improving survival in this high-risk population.

Conclusion

The present study demonstrates that both diabetes mellitus and renal insufficiency independently worsen clinical outcomes in patients with acute myocardial infarction, and their coexistence further amplifies adverse events. Patients with combined DM and RI presented with more severe myocardial infarction, greater hemodynamic instability, lower left ventricular ejection fraction, and a higher incidence of complications such as arrhythmias, acute heart failure, cardiogenic shock, and recurrent ischemia. This group also experienced the highest in-hospital mortality and longest duration of hospitalization, highlighting their markedly increased risk profile.

Renal insufficiency alone also emerged as a strong predictor of poor prognosis, reflecting the substantial cardiovascular burden associated with impaired renal function. Similarly, diabetes contributed significantly to worse metabolic and functional cardiac outcomes. When present together, these two conditions produced a synergistic adverse effect, resulting in the most unfavorable clinical course.

Overall, the findings emphasize the importance of early identification, aggressive risk stratification, and tailored management of AMI patients with these comorbidities. Integrating multidisciplinary care—combining cardiology, nephrology, and endocrinology—may help improve survival and reduce complications in this high-risk population. Further multicentric studies with longer follow-up are recommended to strengthen these observations and guide future therapeutic strategies.

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