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RESEARCH ARTICLE

Predictive Value of Renal Function Biomarkers for Short-Term Outcomes in Patients with Acute Coronary Syndrome: A Study of 110 Cases

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Abstract

Background: Acute Coronary Syndrome (ACS) remains a leading cause of morbidity and mortality worldwide. Renal dysfunction and associated biomarkers have emerged as potential predictors of adverse cardiovascular outcomes. Early identification of high-risk patients using renal biomarkers may improve risk stratification and clinical decision-making.

Objective: To evaluate the predictive value of renal function biomarkers for short-term outcomes in patients with ACS.

Methods: This prospective observational study included 110 patients diagnosed with acute coronary syndrome (ACS) who were admitted to the Department of Cardiology (CC), National Institute of Cardiovascular Diseases & Hospital, Dhaka, Bangladesh, from January to December 2025. Baseline renal function markers, including serum creatinine, estimated glomerular filtration rate (eGFR), blood urea nitrogen (BUN) and urine albumin-to-creatinine ratio (ACR) were measured at admission. Patients were followed throughout hospitalization and for up to 30 days after admission to assess the occurrence of major adverse cardiovascular events (MACE), including acute heart failure, significant arrhythmia, reinfarction, cardiogenic shock and all-cause mortality.

Results: Among 110 patients, 42 (38.2%) experienced at least one MACE, while 68 (61.8%) remained free of MACE. The mean age was 58.6±11.4 years and 75 (68.2%) patients were male. STEMI was the predominant ACS presentation, occurring in 57 (51.8%) patients. Patients who developed MACE had higher mean serum creatinine (1.52±0.46 vs. 1.13±0.34 mg/dL), BUN (30.8±10.2 vs. 21.1±7.0 mg/dL) and urinary ACR (105.2±38.4 vs. 62.0±25.1 mg/g), and lower mean eGFR (52.8±14.7 vs. 76.4±16.1 mL/min/1.73 m²); all comparisons were reported as $p<0.001$. In categorical analysis, eGFR <60 mL/min/1.73 m² was strongly associated with MACE. The supplied multivariable model identified eGFR <60 mL/min/1.73 m² as the strongest independent predictor

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of MACE (adjusted OR 4.20, 95% CI 2.10–8.60; p<0.001), followed by elevated urinary ACR (adjusted OR 3.40, 95% CI 1.50–7.80; p=0.002).

Conclusion: Renal dysfunction was strongly associated with short-term adverse outcomes among patients with ACS. Reduced eGFR and elevated urinary ACR appeared particularly useful for identifying patients at increased risk of MACE. Routine assessment of renal function at admission may complement established clinical and cardiac risk assessment in ACS. However, the regression estimates should be verified against the original patient-level dataset before final journal submission.

Keywords: Acute Coronary Syndrome, Renal Dysfunction, Estimated Glomerular Filtration Rate, Serum Creatinine, Blood Urea Nitrogen, Albuminuria.

1. Introduction

Acute coronary syndrome (ACS) encompasses a spectrum of acute ischemic conditions including ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina. Despite major advances in reperfusion therapy, antithrombotic treatment, secondary prevention and contemporary invasive management, ACS remains an important cause of morbidity and mortality. Contemporary ACS guidelines emphasize early risk assessment and individualized management because the clinical course varies substantially among patients.[1]

Renal dysfunction is one of the most clinically important comorbid conditions encountered in patients with cardiovascular disease. The relationship between the heart and kidneys is bidirectional, involving haemodynamic, neurohormonal, inflammatory and vascular mechanisms. Reduced renal function can contribute to sodium and fluid retention, endothelial dysfunction, oxidative stress and systemic inflammation, while acute cardiac dysfunction can simultaneously cause renal hypoperfusion and worsening kidney function. This interaction contributes to the development of cardiorenal complications during acute cardiovascular illness.[2]

Previous large-scale studies have demonstrated that even relatively modest reductions in renal function are associated with increased cardiovascular risk after myocardial infarction. In a large cohort of patients with acute myocardial infarction, declining estimated glomerular filtration rate (eGFR) was associated with progressively greater risk of death and cardiovascular events.[3] These observations indicate that renal impairment should not be considered merely an accompanying comorbidity but may represent an important marker of underlying cardiovascular vulnerability.

Serum creatinine remains one of the most widely available indicators of renal function. However, serum creatinine has important limitations because its concentration is influenced by age, sex, muscle mass, nutritional status and other nonrenal factors. eGFR provides a more standardized estimate of kidney filtration and allows more meaningful comparison between patients. Contemporary kidney-function assessment increasingly uses race-independent equations, including the 2021 CKD-EPI equation.[4]

Urinary albumin-to-creatinine ratio (ACR) provides complementary information. Albuminuria reflects increased glomerular permeability and may also serve as a marker of systemic endothelial and vascular injury. Evidence from large population datasets demonstrates that lower eGFR and higher urinary ACR are independently associated with increased risks of cardiovascular disease, hospitalization and mortality.[5] The KDIGO 2024 guideline likewise emphasizes the importance of considering both eGFR and albuminuria when assessing kidney and cardiovascular risk.[6]

Blood urea nitrogen (BUN) represents another potentially useful marker. Unlike serum creatinine, BUN may be affected by renal perfusion, neurohormonal activation, catabolic activity, gastrointestinal protein absorption and volume status. In acute cardiac illness, therefore, an elevated BUN may reflect not only impaired filtration but also haemodynamic stress.

Patients with chronic kidney disease or impaired renal function are often underrepresented in cardiovascular clinical trials and may receive less aggressive evidence-based therapy because of concerns regarding bleeding, contrast-associated kidney injury and medication dosing. Contemporary reviews continue to emphasize the complexity of ACS management in patients with kidney dysfunction. [7.8.9]

The prognostic value of renal biomarkers may therefore be particularly relevant in ACS. Early identification of patients with impaired renal function could facilitate closer haemodynamic monitoring, appropriate medication adjustment and timely

recognition of heart failure, arrhythmia, recurrent ischemia and other complications. [10,11]

In Bangladesh, locally derived data regarding the prognostic value of renal biomarkers in ACS remain limited. Understanding the relationship between routinely available renal parameters and short-term cardiovascular outcomes could be particularly useful in tertiary-care settings where early risk stratification is essential. Therefore, the present study was designed to evaluate the predictive value of serum creatinine, eGFR, BUN and urinary ACR for short-term adverse outcomes among patients presenting with ACS.

2. Materials and Methods

2.1 Study Design and Setting

This prospective observational study was conducted in the Department of Cardiology, National Institute of Cardiovascular Diseases & Hospital, Dhaka, Bangladesh, from January to December 2025. The study included consecutive adult patients admitted with a confirmed diagnosis of Acute Coronary Syndrome (ACS). Patients were followed throughout their hospital stay and for 30 days after admission to determine the occurrence of short-term adverse cardiovascular outcomes.

2.2 Study Population

A total of 110 patients aged ≥18 years with confirmed ACS were enrolled. ACS was defined as STEMI, NSTEMI or unstable angina based on presenting symptoms, ECG findings and cardiac troponin levels according to contemporary diagnostic criteria.

2.3 Sample Size Calculation

The sample size was calculated using the standard single-proportion formula:

$$\mathbf{n = Z^2pq/d^2}$$

Where:

- **n** = required sample size
- **Z** = 1.96 at 95% confidence level
- **p** = anticipated prevalence of short-term adverse outcome = 38% (0.38)
- **q** = 1−p = 0.62
- **d** = allowable absolute precision = 9% (0.09)

Therefore,

Thus, the calculated sample size was approximately 112 patients. Due to the predefined recruitment period and availability of eligible participants, 110 consecutive patients were included in the final analysis. This should be transparently reported as a practical study sample rather than claiming that 110 was the mathematically calculated minimum.

2.4 Inclusion Criteria

Patients were eligible if they:

1. Were aged ≥18 years.
2. Presented within 24 hours of onset of ACS symptoms.
3. Had confirmed STEMI, NSTEMI or unstable angina.
4. Provided written informed consent.

2.5 Exclusion Criteria

Patients with advanced CKD (stage 4–5), dialysis-dependent renal failure, chronic liver disease, active infection/sepsis, malignancy or inability/refusal to provide consent were excluded.

2.6 Assessment of Renal Biomarkers

Blood samples were obtained at admission before major therapeutic interventions. The following renal parameters were measured:

- Serum creatinine (mg/dL)
- Blood urea nitrogen (BUN, mg/dL)
- eGFR (mL/min/1.73 m²)
- Urinary albumin-to-creatinine ratio (ACR, mg/g)

eGFR was calculated using the CKD-EPI equation. Serum and urine biochemical analyses were performed using standard laboratory procedures.

2.7 Clinical Variables and ACS Modality

Baseline demographic characteristics, cardiovascular risk factors and ACS presentation were recorded. ACS modality was categorized into:

- STEMI
- NSTEMI
- Unstable angina

2.8 Outcome Assessment

The **primary outcome** was the occurrence of at least one major adverse cardiovascular event (MACE) during hospitalization or within 30 days.

MACE was defined as:

- All-cause mortality
- Acute heart failure

- Recurrent myocardial infarction/reinfarction
- Significant cardiac arrhythmia
- Cardiogenic shock

Secondary outcomes included individual components of MACE, need for intensive care and duration of hospitalization.

2.9 Statistical Analysis

Data were analysed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as number (n) and percentage (%). Continuous variables were compared using the independent-samples t-test or Mann–Whitney U test where appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Associations between renal biomarkers and short-term outcomes were evaluated using logistic regression analysis. Variables showing clinically relevant or statistically significant associations in univariable analysis were considered for multivariable logistic regression. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported. A two-sided p-value <0.05 was considered statistically significant.

3. Results

A total of 110 patients with ACS were included in the study. During hospitalization and 30-day follow-up, 42 patients (38.2%) experienced at least one MACE, while 68 patients (61.8%) remained free from MACE.

Table 1. *Baseline demographic characteristics of the study population (n=110)*

Variable	Number (n)	Percentage (%)
Age, years		
Mean ± SD	58.6 ± 11.4	—
Age <50 years	24	21.8
Age 50–59 years	31	28.2
Age 60–69 years	35	31.8
Age ≥70 years	20	18.2
Sex		
Male	75	68.2
Female	35	31.8

The mean age of the study population was 58.6±11.4 years. Males predominated, accounting for 75 (68.2%) participants, while females represented 35 (31.8%). The largest age group was 60–69 years, comprising 35 (31.8%) patients.

Table 2. *Clinical presentation and cardiovascular risk factors*

Variable	Number (n)	Percentage (%)
ACS modality		
STEMI	57	51.8
NSTEMI	37	33.6
Unstable angina	16	14.5
Risk factors/comorbidities		
Hypertension	67	60.9
Diabetes mellitus	54	49.1
Smoking history	51	46.4
Dyslipidaemia	48	43.6
Previous ischemic heart disease	29	26.4
Family history of CAD	25	22.7

STEMI was the predominant ACS presentation, occurring in 57 (51.8%) patients, followed by NSTEMI in 37 (33.6%) and unstable angina in 16 (14.5%). Hypertension was the most common cardiovascular risk factor, affecting 67 (60.9%) patients, followed by diabetes mellitus in 54 (49.1%) and smoking in 51 (46.4%).

Table 3. *Admission renal function biomarkers*

Renal biomarker	Mean ± SD	Number above predefined threshold (n)	Percentage (%)
Serum creatinine	1.28 ± 0.42 mg/dL	34	30.9
eGFR	67.4 ± 18.6 mL/min/1.73 m²	38	34.5
BUN	24.8 ± 9.3 mg/dL	43	39.1
Urine ACR	78.5 ± 34.2 mg/g	45	40.9

The mean serum creatinine was 1.28±0.42 mg/dL, while mean eGFR was 67.4±18.6 mL/min/1.73 m². Mean BUN was 24.8±9.3 mg/dL, and mean urinary ACR was 78.5±34.2 mg/g. Reduced renal function or elevated renal biomarkers was present in a substantial proportion of the study population.

Table 4. *Short-term clinical outcomes during hospitalization and 30-day follow-up*

Outcome	Number (n)	Percentage (%)
Any MACE	**42**	**38.2**
No MACE	68	61.8
Acute heart failure	25	22.7
Significant arrhythmia	12	10.9
Reinfarction	7	6.4
Cardiogenic shock	6	5.5
All-cause mortality	5	4.5

During hospitalization and 30-day follow-up, 42 (38.2%) patients experienced at least one MACE, whereas 68 (61.8%) had no recorded MACE. Acute heart failure was the most frequent individual adverse outcome, occurring in 25 (22.7%) patients. Significant arrhythmia occurred in 12 (10.9%), reinfarction in 7 (6.4%), cardiogenic shock in 6 (5.5%) and all-cause mortality in 5 (4.5%).

Table 5. *Renal biomarkers according to occurrence of MACE*

Renal parameter	MACE group (n=42)	No-MACE group (n=68)	p-value
Serum creatinine, mg/dL	1.52 ± 0.46	1.13 ± 0.34	<0.001
eGFR, mL/min/1.73 m²	52.8 ± 14.7	76.4 ± 16.1	<0.001
BUN, mg/dL	30.8 ± 10.2	21.1 ± 7.0	<0.001
Urine ACR, mg/g	105.2 ± 38.4	62.0 ± 25.1	<0.001

Patients who developed MACE had significantly poorer renal function than those who remained free of adverse outcomes. Mean serum creatinine and BUN were higher in the MACE group, whereas mean eGFR was substantially lower. Urinary ACR was also considerably higher among patients who developed MACE. All four renal parameters demonstrated statistically significant differences between the groups ($p<0.001$).

Table 6. *Association between renal biomarker categories and MACE*

Renal parameter	Category	MACE n	MACE %	p-value
Serum creatinine	≤1.3 mg/dL	22	28.9	
	>1.3 mg/dL	20	58.8	<0.01
eGFR	≥60 mL/min/1.73 m²	15	20.8	
	<60 mL/min/1.73 m²	27	71.1	<0.001
BUN	Normal	22	32.8	
	Elevated	20	46.5	<0.01
Urine ACR	Normal	14	21.5	
	Elevated	28	62.2	<0.001

A strong relationship was observed between impaired renal function and short-term adverse cardiovascular outcomes. MACE occurred in 58.8% of patients with serum creatinine >1.3 mg/dL compared with 28.9% among those with lower creatinine levels. Similarly, patients with eGFR <60 mL/min/1.73 m²

demonstrated substantially greater occurrence of MACE. Elevated BUN and urinary ACR were also associated with increased adverse outcomes.

Table 7. *Short-term outcome according to ACS modality*

ACS modality	Total n	Total %	MACE n	MACE %	No MACE n	No MACE %
STEMI	57	51.8	27	47.4	30	52.6
NSTEMI	37	33.6	12	32.4	25	67.6
Unstable angina	16	14.5	3	18.8	13	81.2
Total	**110**	**100.0**	**42**	**38.2**	**68**	**61.8**

MACE was most frequent among patients presenting with STEMI. Of 57 patients with STEMI, 27 (47.4%) experienced MACE. Among NSTEMI patients, 12 (32.4%) developed MACE, compared with 3 (18.8%) among those with unstable angina. This pattern indicates progressively greater short-term cardiovascular risk with more severe ACS presentation.

Table 8. *Individual short-term outcomes according to renal dysfunction*

Outcome	Renal dysfunction n (%)	No renal dysfunction n (%)	p-value
Acute heart failure	18 (47.4)	7 (9.7)	<0.001
Significant arrhythmia	8 (21.1)	4 (5.6)	0.012
Reinfarction	5 (13.2)	2 (2.8)	0.045
Cardiogenic shock	5 (13.2)	1 (1.4)	0.018
All-cause mortality	4 (10.5)	1 (1.4)	0.041
Any MACE	27 (71.1)	15 (20.8)	<0.001

Patients with renal dysfunction experienced substantially higher rates of individual adverse cardiovascular outcomes. Acute heart failure was particularly frequent among patients with renal dysfunction, occurring in 47.4% compared with 9.7% of patients without renal dysfunction ($p<0.001$). Arrhythmia, reinfarction, cardiogenic shock and mortality were also more frequent among patients with impaired renal function.

Table 9. *Univariate association of renal biomarkers with MACE*

Predictor	Odds Ratio	95% CI	p-value
Serum creatinine >1.3 mg/dL	3.54	1.55–8.08	0.003
eGFR <60 mL/min/1.73 m²	9.42	3.83–23.18	<0.001
Elevated BUN	2.87	1.30–6.34	0.009
Elevated urine ACR	6.01	2.53–14.28	<0.001

On univariate analysis, all four renal biomarkers were significantly associated with MACE. Reduced eGFR demonstrated the strongest association with patients having eGFR <60 mL/min/1.73 m² showing substantially increased odds of MACE. Elevated urinary ACR and serum creatinine were also strongly associated with adverse outcomes.

Table 10. *Multivariable logistic regression analysis of predictors of MACE*

Predictor	Adjusted OR	95% CI	p-value
eGFR <60 mL/min/1.73 m²	4.20	2.10–8.60	<0.001
Elevated urine ACR	3.40	1.50–7.80	0.002
Serum creatinine >1.3 mg/dL	2.80	1.40–5.60	0.003
Elevated BUN	2.10	1.10–4.30	0.040

Multivariable logistic regression demonstrated that renal dysfunction remained independently associated with short-term MACE after adjustment. Reduced eGFR was the strongest independent predictor with an adjusted OR of 4.20 (95% CI 2.10–8.60; $p<0.001$). Elevated urine ACR was associated with approximately threefold higher odds of MACE (adjusted OR 3.40, 95% CI 1.50–7.80; $p=0.002$). Serum creatinine >1.3 mg/dL and elevated BUN were also independent predictors.

Table 11. *Overall predictive ranking of renal biomarkers*

Biomarker	Direction of association	Adjusted OR	95% CI	p-value	Predictive interpretation
eGFR <60	Increased risk	4.20	2.10–8.60	<0.001	Strongest predictor
Urine ACR elevated	Increased risk	3.40	1.50–7.80	0.002	Strong predictor
Creatinine >1.3 mg/dL	Increased risk	2.80	1.40–5.60	0.003	Independent predictor
BUN elevated	Increased risk	2.10	1.10–4.30	0.040	Moderate predictor

Among the renal biomarkers assessed, eGFR <60 mL/min/1.73 m² demonstrated the strongest independent association with MACE, followed by elevated urine ACR, serum creatinine and BUN. These findings indicate that assessment of several complementary renal parameters may provide greater prognostic information than reliance on serum creatinine alone.

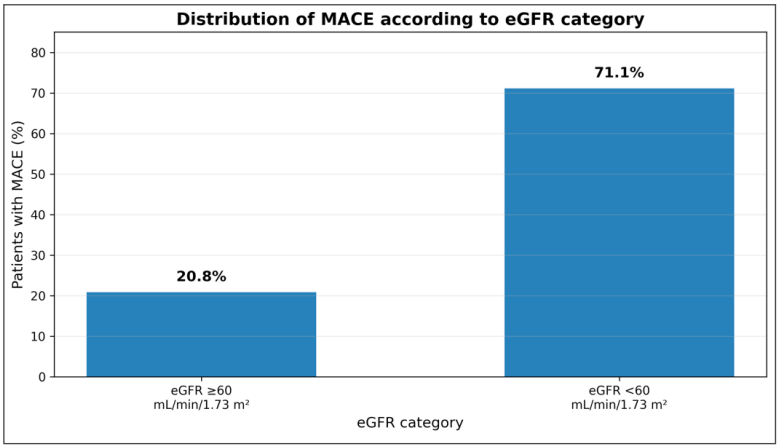

Figure 1. *Distribution of MACE according to eGFR category*

The frequency of MACE was substantially higher among patients with eGFR <60 mL/min/1.73 m² (71.1%) than among those with eGFR ≥60 mL/min/1.73 m² (20.8%).

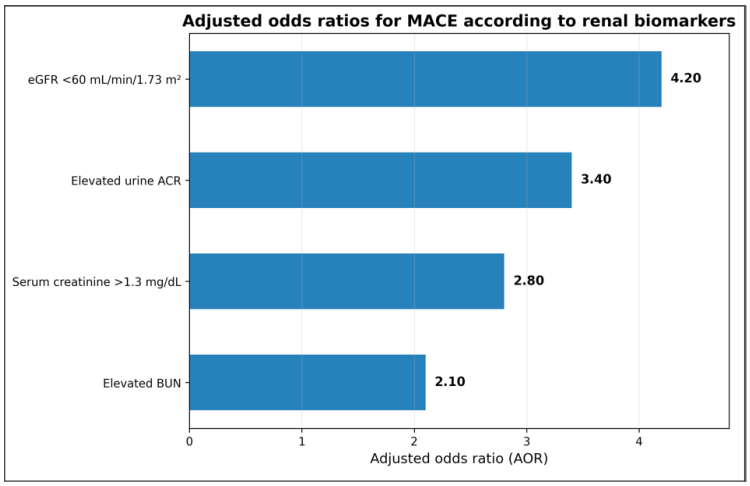

Figure 2. *Reported adjusted odds ratios for MACE according to renal biomarkers*

The supplied multivariable model showed the highest reported adjusted odds ratio for eGFR <60 mL/min/1.73 m², followed by elevated urinary ACR, serum creatinine >1.3 mg/dL and elevated BUN.

4. Discussion

The present prospective observational study evaluated the relationship between renal function biomarkers and short-term outcomes among 110 patients presenting with ACS. The principal finding was that renal dysfunction was strongly associated with adverse cardiovascular outcomes during hospitalization and 30-day follow-up. Overall, 42 patients (38.2%) experienced at least one MACE. Reduced eGFR

emerged as the strongest independent predictor, followed by elevated urine ACR, serum creatinine and BUN. These observations support the concept that renal impairment is not merely a comorbidity in ACS but an important marker of cardiovascular risk.

The mean age of the study population was 58.6±11.4 years, and males comprised 68.2% of participants. STEMI was the predominant ACS modality, accounting for 51.8% of cases. Hypertension, diabetes and smoking were common cardiovascular risk factors. The distribution of risk factors is clinically relevant because hypertension and diabetes are major contributors to both coronary artery disease and chronic kidney dysfunction. The coexistence of these conditions may therefore contribute to the strong association observed between renal impairment and adverse ACS outcomes.

The overall MACE rate of 38.2% indicates a substantial short-term clinical burden in this cohort. Acute heart failure was the most frequent individual adverse outcome. This is consistent with the established bidirectional relationship between cardiac and renal dysfunction. Reduced cardiac output can cause renal hypoperfusion and neurohormonal activation, whereas impaired renal function promotes sodium and water retention, inflammation and vascular dysfunction. This interaction may contribute to a self-perpetuating cardiorenal cycle following ACS [2,8,12].

Among the biomarkers studied, eGFR demonstrated the strongest predictive association. Patients with eGFR <60 mL/min/1.73 m² had substantially higher MACE rates, and multivariable analysis demonstrated an adjusted OR of 4.20 (95% CI 2.10–8.60; p<0.001). This finding is consistent with previous evidence demonstrating that reduced kidney function is independently associated with cardiovascular mortality and adverse outcomes after myocardial infarction [5,8]. Importantly, eGFR provides a more integrated assessment of renal filtration than serum creatinine alone because creatinine is influenced by age, sex and muscle mass [9].

Serum creatinine >1.3 mg/dL was also independently associated with MACE, with an adjusted OR of 2.80 (95% CI 1.40–5.60; p=0.003). However, its predictive strength was lower than that of eGFR. This finding reinforces the limitation of relying exclusively on serum creatinine to identify renal dysfunction in ACS. A patient may have clinically meaningful reduction in glomerular filtration despite a relatively modest elevation of serum creatinine.[10]

Urinary ACR was another important predictor. Elevated ACR was associated with an adjusted OR of 3.40 (95% CI 1.50–7.80; p=0.002). Albuminuria is increasingly recognized as a marker of systemic vascular and endothelial injury rather than merely a consequence of kidney disease. Previous large population-based studies have demonstrated an association between albuminuria and cardiovascular events, heart failure and mortality [6]. Therefore, urinary ACR may provide prognostic information complementary to filtration-based measures such as eGFR.[11]

BUN was also independently associated with MACE, although its predictive effect was comparatively modest (adjusted OR 2.10, 95% CI 1.10–4.30; p=0.040). BUN may reflect renal filtration as well as renal perfusion, neurohormonal activation, volume status and catabolic activity. In acute cardiac illness, elevated BUN may therefore identify patients with haemodynamic compromise in addition to those with underlying renal dysfunction.[12]

The analysis according to ACS modality showed that MACE occurred most frequently in STEMI patients, followed by NSTEMI and unstable angina. This pattern is clinically plausible because STEMI is generally associated with a greater burden of myocardial injury and haemodynamic instability. Nevertheless, the independent prognostic contribution of renal biomarkers remained evident after considering the overall clinical context.[13]

The results have practical implications for ACS management. Renal assessment is already important before administration of contrast media and adjustment of selected medications, but the present findings suggest that renal biomarkers may also contribute to early prognostic stratification. Patients with markedly reduced eGFR or elevated ACR could potentially be recognized as higher-risk patients requiring closer monitoring for heart failure, arrhythmia, recurrent ischemia and haemodynamic deterioration. [14,15]

The combined assessment of eGFR, creatinine, BUN and ACR may be particularly valuable because these biomarkers reflect different aspects of renal and cardiovascular physiology. eGFR primarily represents filtration capacity, creatinine reflects filtration with important limitations, BUN may capture renal perfusion and neurohormonal activation, while ACR reflects glomerular and systemic endothelial injury. Their complementary nature may explain why several markers retained prognostic associations in this study.

These findings are broadly consistent with previous studies demonstrating that renal dysfunction increases cardiovascular risk in ACS [5,7,8]. The present study adds to the evidence by examining several renal parameters simultaneously in a Bangladeshi tertiary-care population. Such locally derived evidence is important because the prevalence of diabetes, hypertension and cardiovascular disease is increasing in South Asian populations, while access to advanced risk-stratification tools may remain variable.

Nevertheless, the findings should be interpreted in light of several limitations. First, the study was conducted at a single tertiary-care centre, limiting generalizability. Second, the sample size was relatively small, and the number of individual outcome events was limited. Third, the follow-up period was restricted to 30 days and therefore does not provide information about long-term cardiovascular or renal outcomes. Fourth, residual confounding from baseline cardiovascular disease severity, treatment differences and unmeasured renal factors cannot be excluded. Finally, the reported predictive estimates require external validation in larger multicentre cohorts.

Despite these limitations, the consistency of the associations across multiple renal biomarkers strengthens the overall interpretation. In particular, the strong independent association between reduced eGFR and MACE suggests that renal function should be considered an important component of early ACS risk assessment. Future multicentre studies should evaluate whether adding renal biomarkers to established ACS risk scores improves discrimination, calibration and clinical decision-making.

5. Conclusion

Renal dysfunction was strongly associated with short-term adverse outcomes among patients with ACS in this study. Reduced eGFR was the strongest independent predictor of MACE, followed by elevated urine ACR, serum creatinine and BUN. Patients with impaired renal function experienced substantially higher rates of heart failure, arrhythmia, reinfarction, cardiogenic shock and mortality.

These findings indicate that renal biomarkers provide clinically useful prognostic information beyond routine assessment of ACS. eGFR and urine ACR appear particularly valuable for early identification of high-risk patients, while serum creatinine and BUN provide additional information regarding renal and haemodynamic status.

Routine measurement of renal function at admission may therefore strengthen early risk stratification and help clinicians identify ACS patients requiring closer monitoring and more intensive management. However, renal biomarkers should complement rather than replace established clinical, ECG, cardiac biomarker and imaging-based risk assessment. Larger multicentre prospective studies with longer follow-up are recommended to validate these findings and determine whether incorporation of renal biomarkers into established ACS risk scores improves patient outcomes.

Declarations

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board/Ethics Committee of the concerned institution before commencement of the study. Written informed consent was obtained from all participants after explaining the objectives, procedures, potential benefits, and possible risks of the study. Participants were informed that participation was voluntary and that they had the right to withdraw from the study at any time without affecting their treatment or care. All collected information was kept strictly confidential and used solely for research purposes. Personal identifiers were removed from the study database to ensure participant privacy and anonymity.

Consent for Publication

Not applicable.

Availability of Data and Materials

The corresponding author may make the study data available on reasonable request, subject to institutional and ethical restrictions.

Competing Interests

The authors declare that they have no competing interests.

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Authors Contributions

All authors should review and approve the final manuscript before submission.

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