Original Research

Assessment of Efficacy of NGAL as a Biomarker for Acute Kidney Injury

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Received: 04 December, 2023 Accepted: 27 December, 2023

ABSTRACT

Background: Acute Coronary Syndrome (ACS) poses a significant threat to cardiovascular health, involving sudden reduced blood flow to the heart, encompassing conditions such as unstable angina and myocardial infarction. Acute kidney injury (AKI) is a common complication in ACS patients, necessitating effective biomarkers for early detection.

Methods: We conducted a prospective study involving 70 patients with acute coronary syndrome or heart failure to assess the efficacy of Neutrophil Gelatinase-Associated Lipocalin (NGAL) as a biomarker for AKI. Detailed clinical data, urine samples for NGAL immunoassay, and serum creatinine levels at baseline, 24 hours, and 48 hours were collected. Statistical analysis was performed, with a significance threshold set at $P < 0.05$.

Results: The study population comprised 42 males and 28 females. Serum creatinine levels showed a significant increase over 48 hours. Mean urinary NGAL levels were significantly higher in the AKI group (486.2) compared to the non-AKI group (72.5), indicating a robust correlation ($r = 0.82$, $P < 0.05$) between NGAL and AKI.

Discussion: Unstable angina and myocardial infarction were characterized in the context of ACS. Our findings support the potential of NGAL as a superior biomarker for early AKI detection compared to serum creatinine, aligning with previous research on NGAL's effectiveness, particularly in high-risk scenarios.

Conclusion: This study underscores the significant correlation between urinary NGAL levels and AKI in ACS patients, suggesting NGAL's potential as a valuable early biomarker. However, limitations include a relatively small sample size and six-month study duration, warranting further research with larger cohorts and extended follow-up.

Keywords: Acute Coronary Syndrome, Acute Kidney Injury, Neutrophil Gelatinase-Associated Lipocalin, Biomarker, Serum Creatinine.

Keywords: Gubernaculum, descent of testis, length of gubernaculum, thickness of gubernaculum, ligaments of Lockwood.

INTRODUCTION

Acute Coronary Syndrome (ACS) is a term used to describe a range of cardiovascular conditions that involve sudden, reduced blood flow to the heart muscle. It typically includes conditions such as unstable angina and myocardial infarction (heart attack). ACS is considered a medical emergency and requires prompt medical attention.[1] The underlying cause of ACS is usually the rupture of an atherosclerotic plaque in one of the coronary arteries, which can lead to the formation of a blood clot. This clot can partially or completely block blood flow through the artery, leading to ischemia (lack of oxygen) in the heart muscle. The severity of the condition depends on the degree of blockage and the extent of damage to the heart muscle.[2]Acute kidney injury (AKI), which can occur in 10.0% to 30% of patients hospitalized with an acute myocardial infarction (AMI), is frequent condition. High-risk patients, such as those being treated in hospitals for Sepsis, congestive heart failure, and individuals after heart surgery, AKI is more common between 10.0% and 25.0%.[3]Acute kidney injury has been found to be early predicted by urine NGAL levels. There are currently newer gadgets for early NGAL bedside detection. NGAL may soon replace serum creatinine as an early test for acute kidney injury (AKI), as serum creatinine is known to be a poor and late indicator of the condition.[4] According to recent research, it may serve as a biomarker for a number of

additional renal and non-renal disorders. In the tubules of the injured kidney, NGAL messenger RNA and protein expression are strongly stimulated, leading to increased levels of NGAL in the urine and blood.[5] The present study was conducted to assess efficacy of NGAL as a biomarker for acute kidney injury (AKI).

MATERIALS & METHODS

The present study involved 70 patients with acute coronary syndrome or heart failure, comprising both genders. All participants provided written consent to participate in the study conducted by the Department of Cardiology at GRMC Gwalior (MP). The study duration was from February 2021 to July 2021, spanning a period of six months. Data such as name, age, gender etc. was recorded. Detailed history and thorough examination was done. Urine sample was collected. Urine NGAL immunoassay was measured by a standardized clinical platform. Serum creatinine level was also checked at baseline, after 24 hours and 48 hours. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table: I Distribution of patients

Total- 70		
Gender	**Male**	**Female**
Number	42	28

Table I shows that out of 70 patients, males were 42 and females were 28.

Table: II Assessment of serum creatinine level

Serum creatinine level	Mean	P value
Baseline	1.06	0.02
after 24 hours	1.22	
after 48 hours	1.54	

Table II, graph I shows that mean serum creatinine level at baseline was 1.06 mg/dl, after 24 hours was 1.22 mg/dl and after 48 hours was 1.54 mg/dl. The difference was significant (P< 0.05).

Graph: I Assessment of serum creatinine level

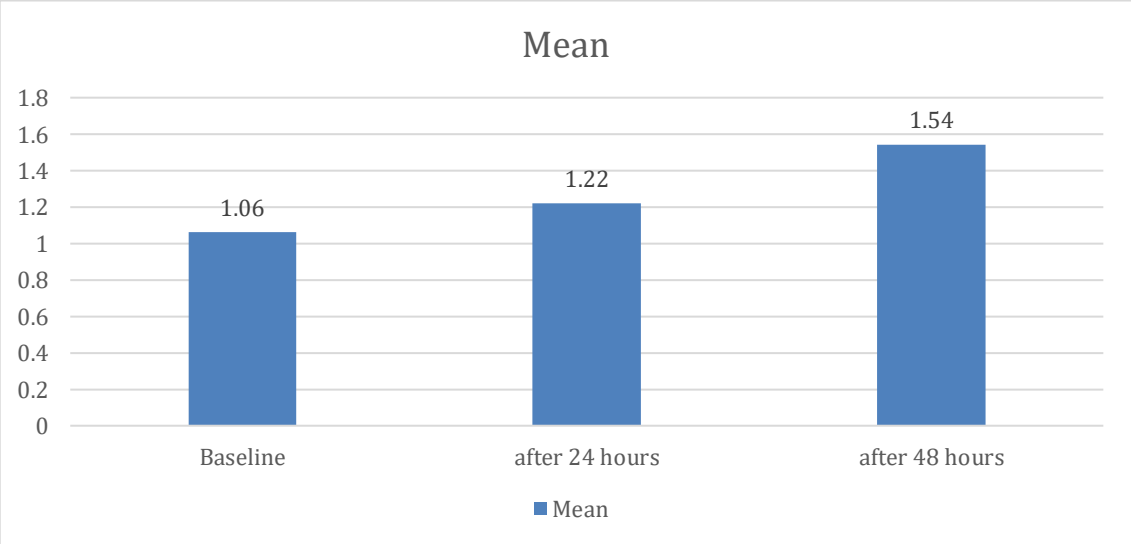

Table: III Urinary NGAL

Groups	Mean	P value
Non AKI	72.5	0.01
AKI	486.2	

Table III shows that mean urinary NGAL level was 72.5 in non AKI and 486.2 in AKI group. The difference was significant (P< 0.05).

Table: IV Correlation between urinary NGAL and AKI

Variable	Value
Pearson Correlation value (r)	0.82
P value	<0.05

Table IV shows the correlation between Urinary NGAL and AKI. This correlation was statistically significant (P<0.05).

DISCUSSION

Unstable Angina is characterized by chest pain or discomfort that occurs at rest or with minimal exertion. The pain can be severe and may last for several minutes.[6] Unlike a heart attack, unstable angina does not cause permanent damage to the heart muscle. In Non-ST Segment Elevation Myocardial Infarction (NSTEMI) there is a partial blockage of a coronary artery, leading to reduced blood flow to a portion of the heart muscle.[7] This results in damage to the heart muscle, but not to the extent seen in a full-blown heart attack.[8] In ST segment elevation myocardial infarction (STEMI), there is a more severe form of ACS where there is a complete blockage of a coronary artery, resulting in a significant portion of the heart muscle being deprived of oxygen.[9] The present study was conducted to assess efficacy of NGAL as a biomarker for acute kidney injury (AKI).

We found that out of 70 patients, males were 42 and females were 28. The mean serum creatinine level at baseline was 1.06 mg/dl, after 24 hours was 1.22 mg/dl and after 48 hours was 1.54 mg/dl. Amin et al[10] found that maximum patients were in the age group of 40 to 60 years, which was 49(61.3%) cases followed by more than 60 years and 20 to 40 years, which were 21 (26.3%) cases and 10 (12.5%) cases respectively. The mean age of the patients was 55.33±11.710 years with the range of 32 to 80 years. In this study, male was predominant than female which was 54(67.5%) cases and 26(32.5%) cases respectively. The ratio of male and female was 2.1:1. The normal value of urinary NGAL was less than 131.7 ng/mL. The mean with SD of normal and abnormal urinary NGAL group were 68.83±44.10 ng/mL and 505.89±305.92 ng/mL respectively. The urinary UNGAL and development of AKI was positively correlated which was weak.We found that the mean urinary NGAL level was 72.5 in non AKI and 486.2 in AKI group. A correlation was found between Urinary NGAL and AKI. Petrova et al[11] found that among patients with a high-risk profile undergoing scheduled coronary angiography and/or angioplasty, plasma NGAL was determined at baseline and at 4th and 24th h after contrast administration. In the CI-AKI group, NGAL increased significantly at the 4th hour (Me 109.3 (IQR 92.1–148.7) ng/mL versus 97.6 (IQR 69.4–127.0) ng/mL, $p = 0.006$) and at the 24th hour. In patients with subclinical CI-AKI, NGAL also increased significantly at the 4th hour (Me 94.0 (IQR 75.5–148.2) ng/mL, $p = 0.002$) and reached levels close to those in patients with CI-AKI. Unlike the new biomarker, however, serum creatinine did not change significantly in this group. The diagnostic power of NGAL is extremely good—AUC 0.847 in CI-AKI and AUC 0.731 in subclinical CI-AKI. NGAL may be a reliable biomarker for the early diagnosis of clinical and subclinical forms of renal injury after contrast angiographic studies.According to Padhy et al[12], serum NGAL is a biomarker with a “narrow diagnostic window” in which peak values can be reached within 4 h after contrast angiography examination and remain significantly higher for up to 24 h but, by 48 h, can be completely normalized. Liao et al[13] reported in their study of 240 patients that the diagnostic power of serum NGAL was extremely good—at six hours after contrast examination, the area under the curve (AUC) was 0.81 ($p = 0.03$), with a sensitivity of 97.64% and a specificity of 67.78% at a cut-off point of 96.35 ng/mL; at the 24th hour, the AUC was 0.89 ($p < 0.01$), and sensitivity 96.63% and specificity 68.72% were at the established reference level of 97.57 ng/mL[14].

CONCLUSION

In conclusion, our study demonstrated a significant correlation between urinary NGAL levels and acute kidney injury (AKI) in patients with acute coronary syndrome or heart failure. The mean urinary NGAL level was significantly higher in the AKI group compared to the non-AKI group, highlighting the potential of NGAL as a valuable biomarker for early detection of AKI. This aligns with previous research indicating NGAL's effectiveness in identifying renal injury, particularly in high-risk scenarios like contrast angiographic studies. The findings suggest that NGAL may offer a more timely and sensitive indicator of AKI compared to traditional measures like serum creatinine.

LIMITATION

However, it is important to acknowledge certain limitations of our study. The sample size was relatively small, and the study duration was limited to six months. Further research with larger cohorts and longer follow-up periods is needed to validate and generalize these findings. Additionally, the study focused on patients with acute coronary syndrome or heart failure, and the applicability of NGAL as a biomarker in other clinical contexts requires exploration. Despite these limitations, our results contribute valuable insights into the potential utility of NGAL in the early detection of AKI in cardiovascular conditions, paving the way for future research and clinical applications in improving patient outcomes.

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