Research Brief

Prognostic utility of neutrophil gelatinase associated lipocalin in cardiac ICU: A prospective study

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ABSTRACT

Our study aims to evaluate the role of neutrophil gelatinase associated lipocalin (NGAL) as an early surrogate marker in predicting acute kidney injury (AKI) and mortality in cardiac ICU patients. The study was conducted at SRN Hospital, excluding those with known renal diseases. Out of 152 patients, 56 developed AKI (cases) and 96 were our controls. Higher NGAL was associated with increased mortality rates ($P = 0.0201$ and 0.0255 for serum and urinary NGAL respectively). Our study concluded that NGAL measurement at admission may be a boon in improving the outcome of cardiac ICU patients.
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1. Introduction

The epidemiology of acute kidney injury (AKI) in cardiac ICU has been reported uptil 50% in few studies,[1] which was also associated with increased mortality. In the recent years, Neutrophil gelatinase associated lipocalin (NGAL) has been shown to be a potential marker and has been compared to be as important as troponin in cardiac diseases. It has been studied to be a potential biomarker in various diseases such as-after cardiac surgery,[2] post Cardiopulmonary Bypass,[3] contrast induced nephropathy,[4] following ECMO (Extra Corporeal Membrane Oxygenation).[5]

The aim of this study is to evaluate the role of NGAL as a surrogate marker for predicting AKI and mortality in cardiac ICU patients, earlier than traditional indicators.

2. Materials and methods

This study was designed as a prospective cohort analysis in patients admitted to cardiac ICU from 1st August 2020 to 15th March, 2021 at a tertiary care hospital in India. The patients were followed during the hospital stay and their outcomes were noted.

Inclusion criteria comprised of age >18 years (male or female), patients of cardiac disease, while patients with eGFR (estimated glomerular filtration rate) < 90 mL/min, CKD (Chronic kidney disease) were excluded.

Samples for NGAL were collected within 8 h of admission to ICU and tested by ELISA kit- ELABSCIENCE® (USA). Laboratory parameters were measured for the duration of hospital stay. The primary outcome (AKI) and secondary outcome (mortality) were noted. AKI was defined using the KDIGO criteria[6] (Increase in S. Creatinine ≥ 0.3 mg/dL within 48 h or ≥ 1.5 times baseline within 7 days or urine volume <0.5 mL/kg/h for 6 h)

SPSS 23 was used for statistical analyses.

3. Results

A total of 165 patients admitted in cardiac ICU were enrolled, out of which 13 patients were excluded owing to the exclusion criteria. Table 1 shows the demographic profile and outcomes of the patients. 56 patients (36.84%.) developed AKI.

Fig. 1 A shows ROC curves which demonstrate role of NGAL in predicting AKI. AUC for serum and urinary NGAL was 0.869 (95% CI -0.720 - 0.956; *p* value < 0.001) and 0.899 (95% CI -0.757 to 0.973; *p* value < 0.001) respectively. The cutoffs for seum and urinary NGAL for predicting AKI were >42.5 ng/mL and >40.5 ng/mL respectively. Kaplan−Meier survival curves (Fig. 1B and C) portray that patients with lower NGAL (less than median) had better prognosis.

Table 1

| SN	Characteristic	AKI ($n = 56$)		Non AKI ($n = 96$)		
A: Baseline demographic characteristics ($n = 152$)						
1.	Mean Age ± SD (years)	65.143 ± 18.2709		54.750 ± 17.1648		
2.	Sex- Male	40 (71.43%)		76 (79.16%)		
	Female	16 (28.57%)		20 (20.83%)		
3.	Etiology					
	Heart Failure (HF)	16(28.57%)		24(25%)		
	Acute coronary syndrome (ACS)	24(42.85%)		32(33.33%)		
	Valvular heart disease	12(21.42%)		28(29.16%)		
	Others	4(7.14%)		12(12.5%)		
B: Correlation between treatment outcomes and AKI ($n = 152$)						
SN	Characteristic	AKI ($n = 56$)		Non AKI ($n = 96$)		Statistical significance
1.	Dialysis need	12 (25%)		0		$\chi^2 = 5.429$; $p = 0.0198$
2.	Hospital stay (days)	11.929	4.8590	11.125	5.8407	P value = 0.667
3.	Mortality	24 (42.85%)		8 (8.33%)		$\chi^2 = 6.714$; $p = 0.0130$
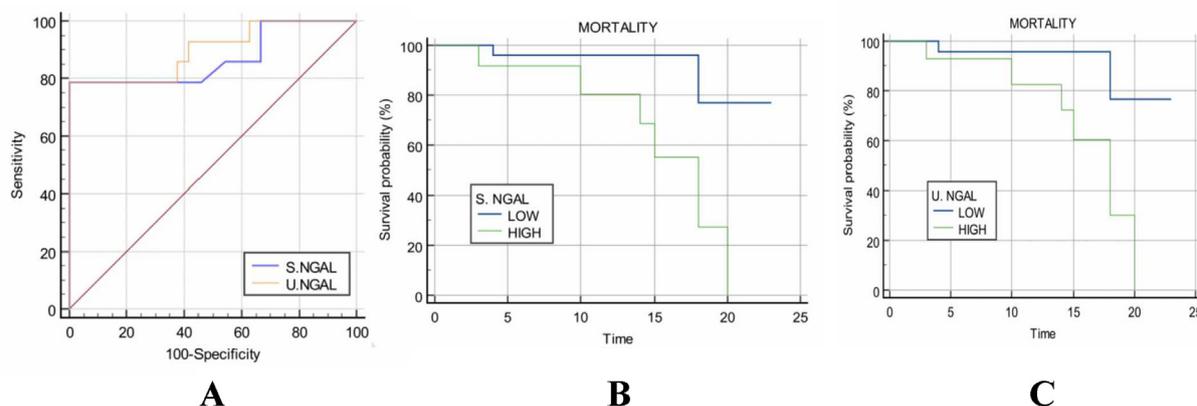
Fig. 1. A- ROC Curve of serum and urinary NGAL for predicting AKI; B & C- Kaplan Meier Survival analysis curves showing raised mortality with higher serum and urinary NGAL (Neutrophil gelatinase associated lipocalin).

4. Discussion

In our study, a total of 56 patients (36.84%) developed AKI. We observed that patients of ACS (42.8%) had the highest development of AKI. Ghonemy et al[7] found similar results in his study (45%).

Our data revealed that NGAL values were significantly higher in patients who developed AKI than in those without AKI. Mosa[8] did a similar study in patients of open heart surgery and found that baseline serum NGAL values were higher in the AKI group compared to the non-AKI group ($p < 0.01$). Haase-Fielitz et al[9] found similar performance of NGAL in patients of cardiac surgery.

Our study clearly demonstrated that raised NGAL was significantly associated with a poorer prognosis and increased mortality, which was irrespective of development of AKI. Van Deursen et al[10] found that raised NGAL was associated with increased mortality in HF (P-0.023).

This is a pilot study evaluating the performance of NGAL in cardiac ICU (Intensive care unit) patients. The study was ended prematurely due to the havoc caused by the COVID-19 pandemic. Hence, further studies with larger sample sizes are recommended.

5. Conclusion

It is a well established fact that NGAL correlates with development of AKI and we have reinstated this in our study. Furthermore, mortality was found to be associated with development of AKI and raised NGAL, irrespective of AKI. Thus, judicious use of NGAL can be used to decrease morbidity and mortality in patients admitted in cardiac ICU.

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