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The Neutrophil-to-Lymphocyte Ratio as a Predictive Marker for Acute Kidney Injury in Hospitalized Sepsis Patients

Pudit Chiamwittayanukul, Bancha Satirapoj, Ouppatham Supasyndh,
Paramat Thimachai, Theerasak Tangwonglert, Wisit Kaewput, Narongrit Siriwattanasit
Division of Nephrology, Department of Medicine,
Phramongkutklao Hospital and College of Medicine, Bangkok, Thailand

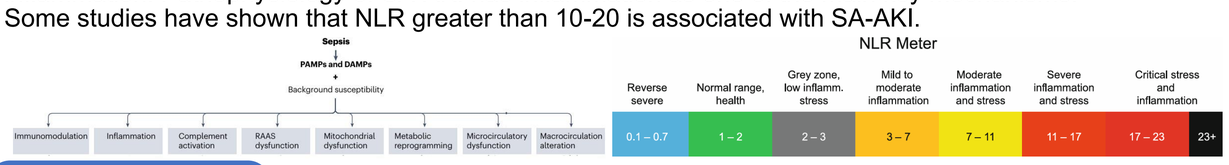
NEPHROLOGY
PHRAMONGKUTKLAO HOSPITAL

Introduction

Sepsis-associated acute kidney injury (SA-AKI). is a common problem in clinical practice, occurring in approximately 30-50% and associated with a mortality rate of up to 40% and 40% of patients require RRT.

Therefore, early diagnosis of AKI in sepsis patients is important. Although serum Cr is the most commonly used marker for renal function, novel biomarkers like NGAL and KIM-1 offer higher sensitivity and specificity. However, these markers are costly and not widely available.

Neutrophil to Lymphocyte Ratio (NLR) is an index reflecting the immune system's response to inflammation. Pathophysiology of SA-AKI has inflammation as one of the main key mechanisms. Some studies have shown that NLR greater than 10-20 is associated with SA-AKI.

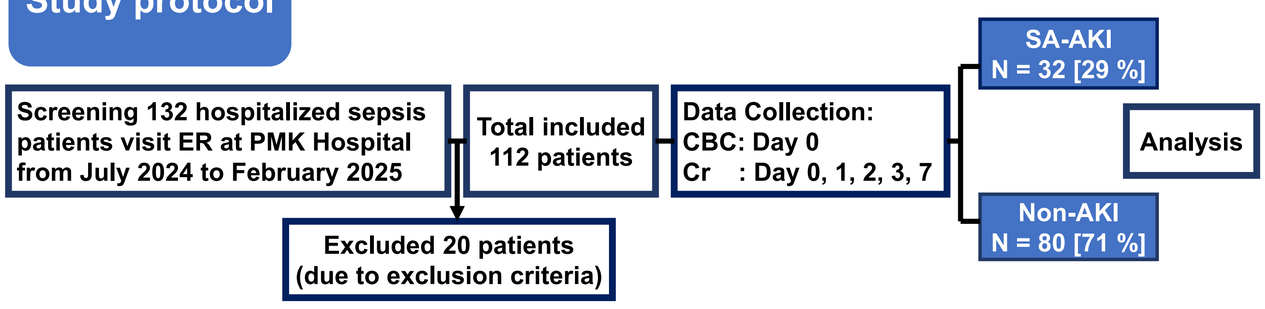


Method

Study design: Prospective diagnostic study included 112 hospitalized sepsis patients from July 2024 to February 2025.

Inclusion Criteria	Exclusion Criteria
- Age ≥ 20 years - Diagnosed with sepsis - Presenting to the emergency department	- Active malignancy - ESRD or history of kidney transplant - Initiation of RRT at initial presentation - Immunocompromised status - Pregnancy - Contrast media exposure within the past 7 days

Study protocol



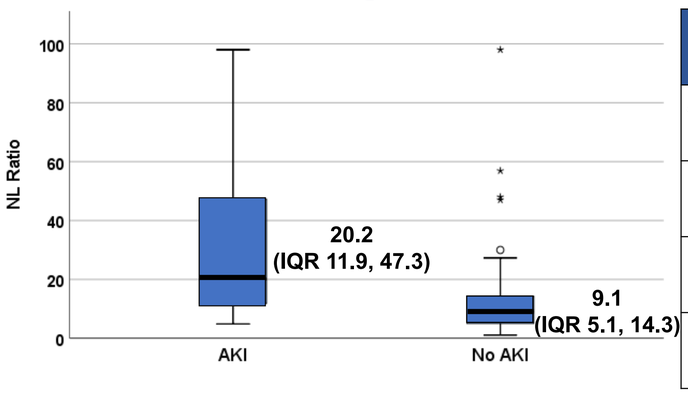
Results

Table 1 : Baseline characteristics

	Total (N=112)	AKI (N=32)	No AKI (N=80)	p-value
Age (years)	76.7 ± 13.0	81.6 ± 10.6	74.7 ± 13.4	0.01
Male (N, %)	62 (55.4%)	15 (46.9%)	47 (58.8%)	0.25
Body mass index (kg/m²)	22.2 ± 4.7	21.4 ± 4.8	22.5 ± 4.7	0.25
Underlying disease (N, %)				
• **Hypertension**	88 (78.6%)	26 (81.3%)	62 (77.5%)	0.66
• **Diabetes mellitus**	50 (44.6%)	14 (43.8%)	36 (45%)	0.90
• **Chronic kidney disease**	30 (26.8%)	12 (37.5%)	18 (22.5%)	0.10
• **Cardiovascular disease**	33 (29.5%)	11 (34.4%)	22 (27.5%)	0.47
Medications (N, %)				
• **RAAS inhibitors**	35 (31.3%)	11 (34.4%)	24 (30%)	0.65
• **Diuretics**	17 (15.2%)	5 (15.6%)	12 (15%)	0.93
Mean arterial pressure (mmHg)	89.2 ± 15.1	74.0 ± 23.6	94.2 ± 9.3	0.43
Baseline creatinine (mg/dl)	1.0 ± 0.6	1.1 ± 0.5	0.9 ± 0.7	0.28
Serum albumin (g/dl)	3.2 ± 0.5	2.8 ± 0.6	3.4 ± 0.5	< 0.001
Serum Lactate (mmol/L)	1.9 (1.3, 2.9)	2.2 (1.6, 3.5)	1.7 (1.2, 2.8)	0.07

Among 112 participants in the study, there were no differences in baseline characteristics. However, in the group that developed AKI, the mean age was significantly higher and serum albumin was significantly lower

Figure 1: NLR in AKI and Non-AKI group



NLR	AKI (n = 32)	No AKI (n = 80)	p-value
All AKI stage	20.2 (11.9, 47.3)	9.1 (5.1, 14.3)	< 0.001
AKIN 1 (44 %)	30.0 (10.0, 47.0)		< 0.001
AKIN 2 (40 %)	18.0 (12.9, 30.3)		0.002
AKIN 3 (16 %)	18.0 (8.2, 48.5)		0.16

AKI occurred in 29% of patients, Among these, AKIN stage 1 was predominant (44%), followed by stage 2 (40%) and stage 3 (16%).

It was found that patients who developed AKI had significantly higher neutrophil-to lymphocyte ratio [20.2 (IQR 11.9–47.3) vs. 9.1 (IQR 5.1–14.3), P < 0.001]

Subgroup analysis revealed that NLR remained a statistically significant in predicting AKI in patients with AKIN stage 1 and 2.

There was no association between NLR and the need for RRT or between NLR and mortality.

Table 2: NLR Cutpoint

NLR Cut off	Sensitivity (95%CI)	Specificity (95%CI)	Accuracy (95%CI)
≥ 9.9	81.25 (63.56 - 92.79)	55 (43.47 - 66.15)	62.5 (52.85 – 71.47)
≥ 12.8	75 (56.6 - 88.54)	72.5 (61.38 - 81.9)	73.2 (64 – 81.1)

The NLR cut-off value of 12.8 demonstrated good discriminatory performance for predicting AKI (AUC = 0.78), with a sensitivity of 75% and a specificity of 72%

Table 3: NLR with variable factors

Variables	AUC (95%CI)	Sensitivity (95% CI)	Specificity (95% CI)	Accuracy (95% CI)
NLR + Albumin	0.83 (0.73 - 0.93)	42.86 (24.46 - 62.82)	89.19 (79.8 - 95.22)	76.47 (0.67-0.84.3)
NLR + Albumin + APACHE	0.86 (0.77 - 0.95)	58.33 (36.64 - 77.89)	89.39 (79.36 - 95.63)	81.11 (0.71 – 88.59)
NLR + Albumin + SOFA	0.84 (0.73 - 0.94)	54.17 (32.82 - 74.45)	90.91 (81.26 - 96.59)	81.11 (0.71– 88.59)
NLR + Albumin + APACHE + SOFA	0.85 (0.76 - 0.95)	62.5 (40.59 - 81.2)	89.39 (79.36 - 95.63)	82.22 (72.74 – 89.48)

When serum albumin level less than 2.9 g/dL was combined with NLR, the specificity for predicting AKI increased to 89%, with an AUC of 0.83. Further combining albumin, APACHE, and SOFA scores increased the AUC to 0.85

Table 4: Parameters

	Total (N=112)	AKI (N=32)	No AKI (N=80)	p-value
• **Creatinine (mg/dl)**	1.3 ± 0.9	2.0 ± 0.9	1.0 ± 0.7	< 0.001
• **APACHE**	14.7 ± 5.3	17.7 ± 5.1	13.4 ± 4.9	< 0.001
• **SOFA**	2.7 ± 2.6	4.1 ± 2.6	2.1 ± 2.5	0.001
• **ICU admission (n)**	17 (15.2%)	6 (18.8%)	11 (13.8%)	0.505
• **Vasopressor (n)**	15 (13.4%)	8 (25%)	7 (8.8%)	0.023
• **Mechanical ventilation (n)**	28 (25%)	10 (31.3%)	18 (22.5%)	0.334
• **Length of hospital stay (n)**	7.5 (4, 12)	11 (6, 14)	7 (4, 10.5)	0.039
• **Mortality (n)**	10 (8.9%)	5 (15.6%)	5 (6.3%)	0.116

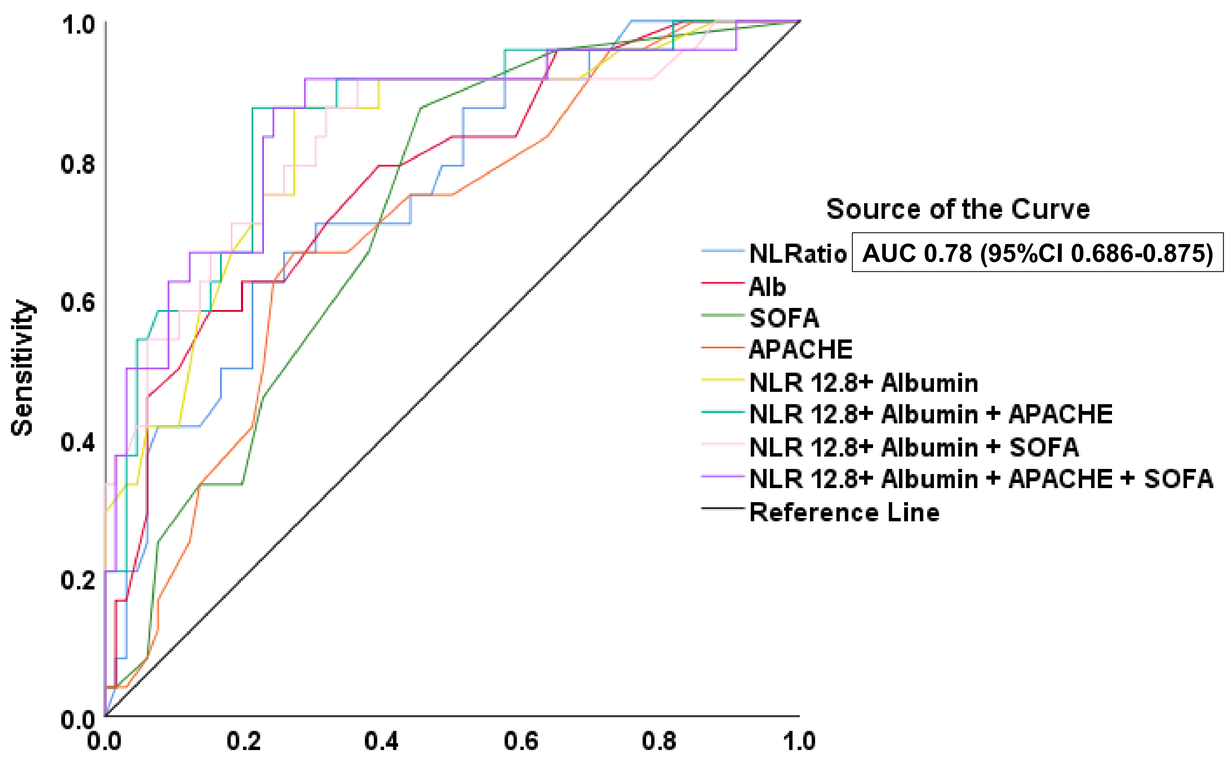
AKI occurred in 29% of patients, with an average serum creatinine of 2 mg/dL
Patients with AKI had significantly higher APACHE and SOFA scores, greater vasopressor use, and a longer LOS

Table 5: Multivariate logistic regression analysis of diverse factors for predicting AKI

	Univariate		Multivariate	
	RR (95%CI)	p-value	Adjusted RR (95%CI)	p-value
NLR	7.91 (3.09 ,20.22)	< 0.001	5.01 (1.75, 14.35)	0.003
Serum albumin	0.14 (0.05 ,0.37)	< 0.001	0.19 (0.06, 0.58)	0.004
Age	1.05 (1.01 ,1.10)	0.010	1.03 (0.98, 1.09)	0.250
Use vasopressor	3.48 (1.14, 10.59)	0.030	1.49 (0.38, 5.80)	0.570
Serum lactate	1.22 (0.98 ,1.52)	0.070	1.22 (0.94 ,1.58)	0.130
Use RAS inhibitors	1.22 (0.51 ,2.92)	0.650	2.76 (0.73 ,10.50)	0.140

Multivariate logistic regression analysis identified NLR as an independent predictor of AKI, with a relative risk of 5.01 (95% CI: 1.75–14.35, P = 0.003), and serum albumin level as another significant factor, with a relative risk of 0.19 (95% CI: 0.06–0.58, P = 0.004)

Figure 2: AUC for AKI prediction



Conclusion

Neutrophil to Lymphocyte Ratio (NLR) offers simple and readily available tool for early AKI prediction in sepsis patients. It might be useful in clinical settings to facilitate timely interventions and improve outcomes, particularly in resource limited environments.