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Neutrophil/Albumin Ratio: Can using it a predictor tool for mortality in critically Ill patient with acute kidney injury?

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Abstract:
Background: Acute kidney injury (AKI), commonly referred to as acute renal failure (ARF), is the rapid or sudden deterioration of renal filtration capacity. Elevated serum creatinine levels or azotemia (increased blood urea nitrogen [BUN] levels) are prevalent markers of this condition.
Objective: To evaluate the neutrophil/albumin ratio as a predictor of hospital mortality in critically ill patients with acute renal damage.
Methods: Seventy cases necessitated an intensive care unit stay exceeding two days. The Risk, Injury, Failure, Loss, and End-stage renal disease (RIFLE) criteria were employed to ascertain the existence and stage of acute kidney injury in adult patients with AKI.
Results:There is a notable increase in respiratory rate (RR) and heart rate (HR) in the deceased individuals compared to the surviving cases. There was a notable escalation in AKI stages (3rd and 5th), utilization of vasopressors, and renal replacement therapy in deceased participants compared to those who survived. Both SOFA and SAPSII scores were considerably elevated in deceased cases compared to survivors. In the laboratory tests of included survivors and deceased participants, there was no significant variation in glucose levels between the two groups. In the serum electrolytes, there was a notable reduction in sodium and an elevation in potassium and bicarbonate levels in the deceased group. In the CBC, there was a notable reduction in hematocrit and hemoglobin levels in the deceased group. Platelet levels were markedly reduced in the deceased group. Concerning coagulation indices, there was a notable elevation in prothrombin time, APTT, and INR in the deceased group. No statistically significant differences in serum urea levels among the groups. Individuals who did not survive exhibited reduced serum creatinine and albumin levels compared to those who did. A statistically significant rise was observed in the ratio of neutrophil percentage to albumin level in the deceased. A threshold value of 12.14 for the Neutrophil to Albumin Ratio shown a significant correlation with death in patients. Sensitivity attained 95.2% and specificity was recorded at 89.8%. A cutoff value of 3.5 for SOFA and 14 for SAPSII shown a significant correlation with death in patients. Sensitivity attained 10% while specificity was 95.9%. A substantial positive correlation existed between mortality and coronary artery disease, atrial fibrillation, renal and liver diseases, pneumonia, and malignancy.
Conclusion: The results of this experiment indicate that the Neutrophil to Albumin Ratio is an effective predictor of in-hospital death in critically sick patients with AKI. The cutoff value of 12.14 for this ratio demonstrated high sensitivity (95.2%) and moderate specificity (89.8%), signifying its robust capacity to identify patients at risk of mortality.

Keywords:Neutrophil Percentage, Acute Kidney Injury, SOFA score, SAPSII score.

INTRODUCTION

Acute kidney injury (AKI), referred to as acute renal failure (ARF), is the rapid or sudden deterioration of renal filtration capability. Elevated serum creatinine levels or azotemia (increased blood urea nitrogen [BUN] levels) are prevalent indications of this condition **(Kung and Chou, 2023; Turgut et al. 2023).** Blood urea nitrogen (BUN) values may remain normal immediately following a kidney injury, with diminished urine output potentially serving as the sole sign of renal impairment **(Kwiatkowska et al. 2023; Wandile, 2023; Basu et al., 2014).** Many individuals exhibit no symptoms of acute kidney injury (AKI), necessitating that physicians depend on functional indicators such as serum creatinine for diagnosis of this increasingly prevalent illness. Serum creatinine is frequently a delayed and unreliable marker of acute kidney injury due to many causes **(Zou et al., 2022; Dainton, 2024).** In 1863, Florence Nightingale introduced the issue of quantifying the efficacy of medical service. Traditionally, clinicians' judgment has served as the basis for predicting outcomes in critical illness. The rapid expansion of intensive care units (ICUs) has generated a demand for quantitative and clinically relevant surrogate outcome markers to assess treatment success **(Hsiao et al., 2020).**Consequently, various sorts of point systems have been implemented. Various factors regarding the patient's status upon ICU admission and the ensuing ICU trajectory influence the ultimate prognosis **(Desai and Gross, 2010).** This study seeks to evaluate the neutrophil/albumin ratio as a predictor of hospital mortality in critically ill patients with acute renal injury.

PATIENTS AND METHODS

Study design and Ethics approval:

During the initial admission, 70 instances necessitated an intensive care unit stay exceeding 2 days. Healthcare professionals that provide treatment to those aged 18 and older. The data obtained from cases is confidential. No participants will be identified in any report or publication pertaining to this research. The study's objective, nature, and risk-benefit analysis were elucidated to the participants prior to their involvement in the study. Consent was obtained through informed understanding.

All patients were exposed to:

Complete history taking:Personal history includes name, marital status, date of birth, address, employer, and health-related behaviors such as smoking status and duration of complaints. Present history involves an analysis of the individual's current complaint, along with a history of drug sensitivities and past medical history. Surgical history refers to the record of prior procedures.

General examination:To eliminate systemic disorders, vital indicators include ethnicity, systolic blood pressure (SBP), mean blood pressure (MBP), heart rate, respiration rate, vasopressor administration, diastolic blood pressure (DBP), temperature, SPO2, acute kidney injury (AKI) stage, renal replacement treatment, and duration of stay in the ICU. Signs of pallor, jaundice, cyanosis, and lymphadenopathy.

Routine laboratory investigations:Percentage of neutrophils, bicarbonate level, creatinine concentration, albumin level, glucose concentration, hemoglobin level, sodium concentration, hematocrit percentage, platelet count, potassium level, urea concentration, prothrombin time (PT), white blood cell (WBC) count, activated partial thromboplastin time (APTT).

The Neutrophil % to Albumin Ratio measured on admission if the patient was admitted with AKI or after diagnosis of AKI if the patient was admitted without evidence of acute kidney injury.

Blood Specimen Collection and Processing:Every participant in the trial had three milliliters of blood extracted from a vein. The serum was frozen at -80 degrees celsius within 2 hours after collection for subsequent examination.

Sequential organ failure assessment (SOFA) score:The SOFA index consists of six variables, each representing an organ system. Each organ system received a score ranging from 0 (normal) to 4 (severe dysfunction/failure). The most adverse physiological indicators were collected sequentially every twenty-four hours after the patient's admission to the ICU. The "worst" measurement was identified as the one exhibiting the highest point correlation. The SOFA score range extends from 0 to 24.

NPAR (neutrophil percentage to Albumin Ratio):The calculation is performed by dividing the neutrophil count by the blood albumin level. Within 24 hours of ICU admission, we acquired the neutrophil percentage and serum albumin concentration from the initial blood test results.

Simplified acute physiology score II (SAPSII):Twelve physiological parameters and three disease-related variables constitute the SAPS II score. The most severe physiological variables were assessed within the first twenty-four hours of ICU admission. The "worst" measurement was identified as the one with the highest correlation to points. The trial did not calculate SAPS II scores continuously after the initial 24 hours of ICU admission. The SAPS II score ranges from 0 to 163 points.

Outcome Measurements and Follow-up:

The results of the present investigation included as Principal outcomes: To assess the predictive capability of NPAR regarding in-hospital mortality in critically ill patients with AKI. Secondary outcome measures: To evaluate the prognostic efficacy of the neutrophil percentage to albumin ratio vs the SOFA score in anticipating in-hospital death among critically ill patients with AKI. Additionally, to evaluate the predictive efficacy of NPAR in comparison to the SAPS II score for anticipating in-hospital death in critically sick patients with AKI.

Statistical analysis:

Information from the patient's medical history, physical examination, laboratory tests, and results was input into an Excel spreadsheet and labeled for analysis. Data was imported into SPSS 20.0 (Statistical Package for the Social Sciences) for further analysis. Quantitative data is generally described using the mean and standard deviation to represent bigger populations, whereas numbers and percentages are utilized to communicate qualitative information. The statistical tests employed included the independent t-test, Mann-Whitney U test, Chi-square test, ROC curve analysis, and regression analysis. A P value of ≤ 0.05 is regarded as a significant threshold.

RESULTS

There is no significant alteration in gender as well as residence distribution between the surviving and dead cases. However, the mean age of the dead group is greater than that of the surviving group, though the alteration is not statistically significant with a p-value of 0.08575, **(Table 1).**There are significant variances in the distribution of comorbidities among the survived and died groups for the following parameters: CAD (significant decrease in the survived group related to the dyed group), AFIB (significantly lower in the survived group compared to the dyed group), Liver disease (significantly lower in the survived group contrasted with the dyed group), Malignancy (significant reduction in the survived group equated to the dyed group) and Respiratory failure (significant decrease in the survived group likened to the dyed group). There are no significant differences in the distribution of comorbidities between the survived and dead groups for the following parameters: CHF, Stroke, Renal disease, and Pneumonia, **(Table 2).**

Table (1): Demographic data included surviving and dead subjects.

	Survived (N = 49)	Died (N = 21)	*P value*
Male	24 (48.98%)	9 (18.37%)	0.643
Female	25 (51.02%)	12 (24.49%)	
Age (Y)	57.86 ± 7.47	61.38 ± 8.38	0.085
Residence			
Rural	23 (46.94%)	8 (16.33%)	0.501
Urban	26 (53.06%)	13 (26.53%)	

Table (2): Comorbidities distribution among included survived and dead subjects.

	Survived (N = 49)	Died (N = 21)	*P value*
CAD	6 (12.24%)	9 (18.37%)	0.003*
CHF	5 (10.2%)	6 (12.24%)	0.054
AFIB	2 (4.08%)	8 (16.33%)	0.0001*
Stroke	4 (8.16%)	5 (10.2%)	0.074
Renal disease	5 (10.2%)	2 (4.08%)	0.931
Liver disease	1 (2.04%)	5 (10.2%)	0.002*
Pneumonia	20 (40.82%)	9 (18.37%)	0.876
Malignancy	1 (2.04%)	4 (8.16%)	0.010*
Respiratory failure	2 (4.08%)	8 (16.33%)	0.0001*

There is a significant rise in respiratory rate (RR) & heart rate (HR) in the dead cases compared to the surviving cases. No significant differences were found in temperature, MBP, SBP, DBP & SPO2, **(Table 3).** There was a significant increase in AKI stage (3^{rd} and 5^{th} stage), use of vasopressors, and RRT in dead subjects compared to surviving subjects. No significant changes were found in the length of ICU stay, **(Table 4).** Both SOFA and SAPS II scores were significantly increased in dead cases compared with survived cases, SOFA score among included survived and dead subjects through time**, (Figure 1).** SAPS II score among included survived and dead subjects through time, **(Figure 2).**

Table (3): Vital signs evaluations of included survived and dead subjects.

	Survived (N = 49)	**Died (N = 21)**	***P value***
Temperature (^{o}C)	37.04 ± 0.25	37.02 ± 0.29	0.803
RR (cycle/min)	25.51 ± 2.94	27.81 ± 2.84	0.003*
HR (beat/min)	95.24 ± 15.02	105.24 ± 10.73	0.007*
Blood Pressure			
SBP(mmhg)	104.02 ± 13.52	101.19 ± 13.03	0.420
DBP(mmhg)	62.24 ± 8.1	60.24 ± 7.66	0.338
MBP(mmhg)	80.08 ± 6.92	79.1 ± 6.96	0.587
SPO2 (%)	52.26 ± 9.1	48.38 ± 9.5	0.111

Table (4): Clinical data of included survived and dead subjects.

	Survived (N = 49)	**Died (N = 21)**	***P value***
AKI stage	3.67 ± 0.69	4.52 ± 0.6	0.00001*
3^{rd} Stage	22 (44.9%)	1 (2.04%)	0.0008*
4^{th} stage	21 (42.86%)	8 (16.33%)	0.715
5^{th} Stage	6 (12.24%)	12 (24.49%)	0.00004*
RRT	5 (10.2%)	12 (24.49%)	0.00001*
Length of ICU stay (days)	6.86 ± 1.43	6.62 ± 1.72	0.549
Vasopressor use	39 (79.59%)	21 (42.86%)	0.025*

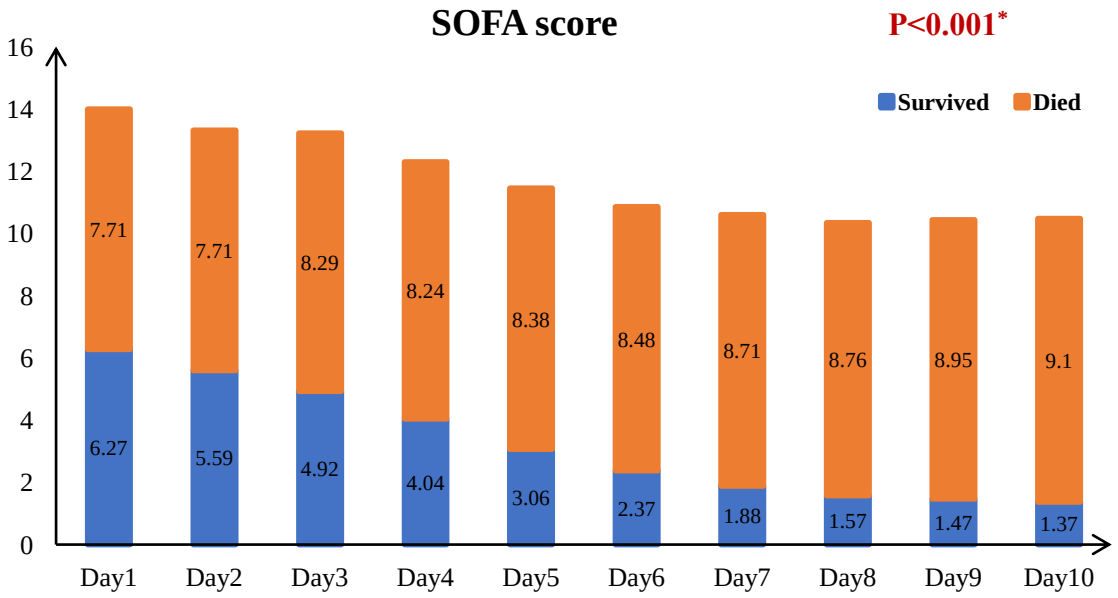

Figure (1): SOFA score among included survived and died subjects through time.

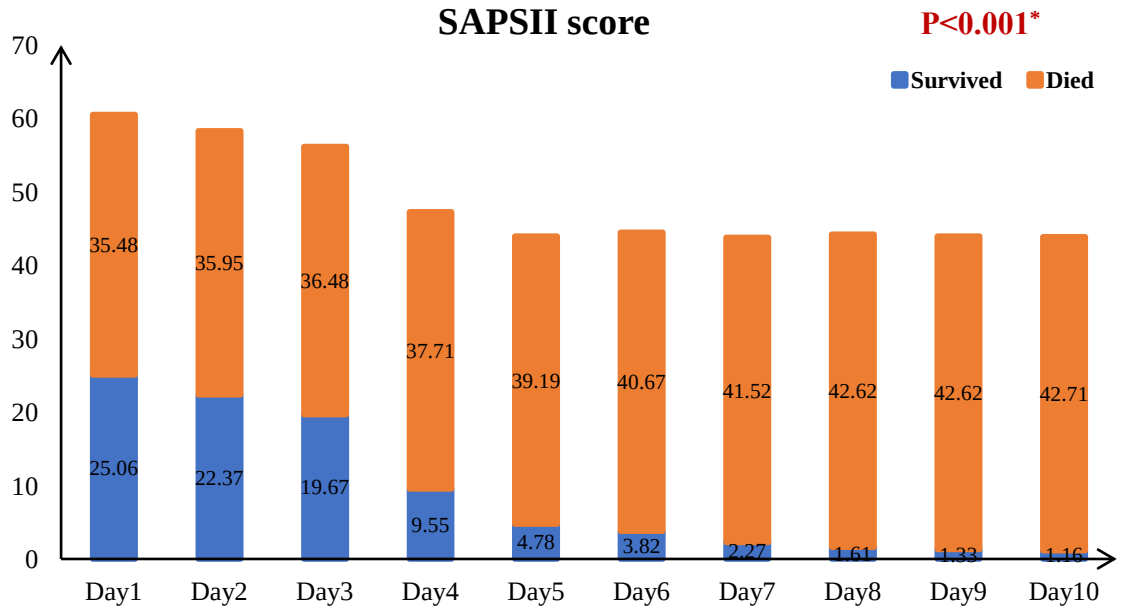

Figure (2): SAPSII score among included survived and died subjects through time.

In the laboratory investigations of included survived and died subjects, there was no significant change in glucose levels amongst the 2 groups. However, in the serum electrolytes, there was a significant decrease in sodium and an increase in potassium and bicarbonate levels in the diet group. In CBC, there was a significant decrease in hematocrit in addition to Hb levels in the dead group. Platelet counts were also significantly lower in the diet group. Regarding coagulation indices, there was a significant increase in prothrombin time, APTT and INR in the dead group, No statistically significant variation in serum urea levels amongst the groups. Those who did not make it had lower levels of serum creatinine and albumin than those who did. There was also a statistically significant increase in the ratio of neutrophil percentage to albumin level in the deceased, **(Table 5).**

Table (5): Laboratory investigations of included survived and died subjects.

	Survived (N = 49)	**Died (N = 21)**	**P value**
Glucose (mg/dl)	95.98 ± 5.55	94.52 ± 6.08	0.331
Na (mEq / L)	134.96 ± 1.29	133.33 ± 1.53	0.00002*
K (mEq/L)	4.22 ± 0.69	5.72 ± 0.62	<0.0001*
Bicarbonate (mEq/L)	21.36 ± 4.05	10.11 ± 0.99	<0.0001*
Hematocrit (%)	36.71 ± 3.75	30.41 ± 2.83	<0.0001*
Hb (gm/dL)	9.63 ± 0.71	7.98 ± 0.74	<0.0001*
WBCs (cell/cmm)	9.49 ± 2.11	10 ± 3.65	0.464
Neutrophil %	59.85 ± 7.18	60.14 ± 8.76	0.885
Platelets (*10^9/cmm)	366.8 ± 52.46	330.67 ± 75.79	0.024*
Prothrombin time (PT) (sec.)	17.91 ± 4.37	23.59 ± 9.83	0.001*
APTT (sec.)	44.87 ± 8.7	58.25 ± 17.98	0.00008*
INR	1.66 ± 0.62	2.16 ± 0.97	0.011*
Serum urea (mg/dl)	124.8 ± 32.17	138.95 ± 36.53	0.109
Serum creatinine (mg/dl)	3.56 ± 1	5.2 ± 1.11	<0.0001*
Albumin (g/dl)	3.95 ± 0.41	2.76 ± 0.66	<0.0001*
(Neutrophil percentage / Albumin) Ratio	15.29 ± 2.38	23.04 ± 6.43	<0.0001*

With a cutoff value of 12.14 for Neutrophil to Albumin Ratio there was significant association with mortality of cases. Sensitivity reached 95.2% and specificity was 89.8%, Cut off value of 3.5 for SOFA and 14 for SAPSII there was a significant association with mortality of cases. Sensitivity reached 10% and specificity was 95.9%, **(Table 6, Figure 3).** There was a significant positive association between mortality with CAD, AFIB, Renal and Liver disease, Pneumonia, and Malignancy, it was the most significant factors affected on hospital mortality in critically Ill patient with acute kidney injury **(Table 7).**

Table (6): Roc curve analysis of Neutrophil to Albumin Ratio, SOFA & SAPSII scores with mortality

	Cut off	*AUC*	*Sensitivity*	*Specificity*	*P value*
Neutrophil to Albumin Ratio	12.14	0.865	95.2%	89.8%	<0.0001*
SOFA	3.5	0.813	100%	95.9%	<0.0001*
SAPSII	14	0.966	100%	95.9%	<0.0001*

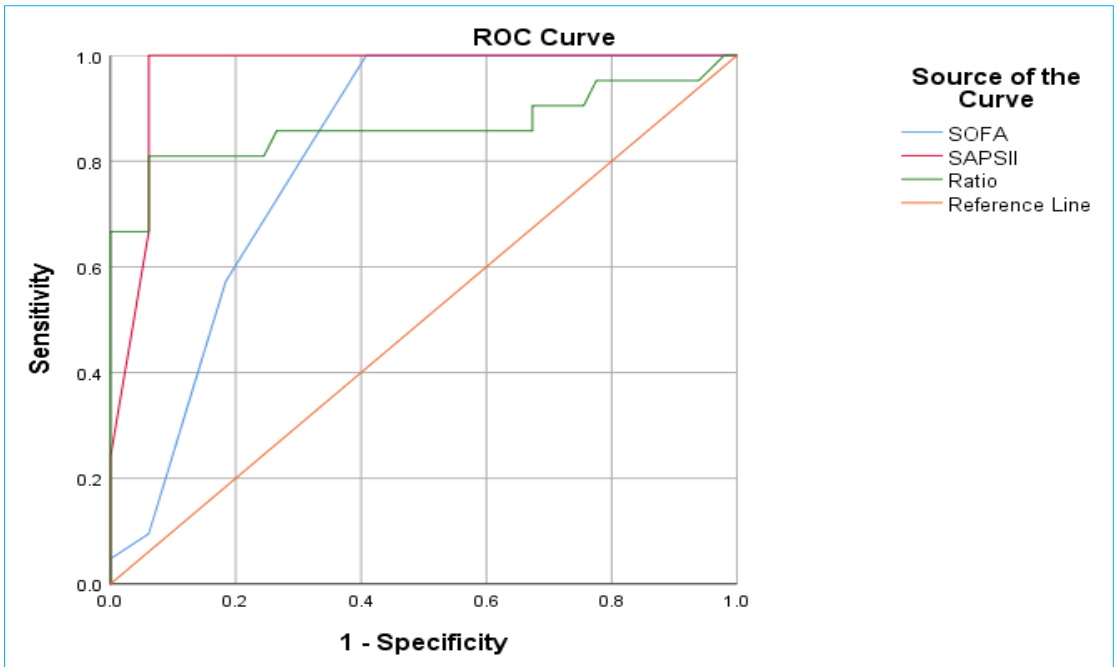

Figure (3): Roc curve analysis of neutrophil to albumin ratio and mortality.

Table (7): Regression analysis of different parameters association with mortality.

	Unstandardized Coefficients (B)	**Std. Error**	**Standardized Coefficients Beta**	**t**	***P value***	**(95%) Confidence Interval for B**	
						Lower Bound	**Upper Bound**
CAD	0.413	0.111	0.328	3.729	0.00044*	0.191	0.635
AFIB	0.384	0.125	0.28	3.057	0.00337*	0.132	0.635
Stroke	0.09	0.134	0.059	0.672	0.504	-0.178	0.357
Renal disease	0.398	0.16	0.243	2.498	0.01535*	0.079	0.718
Liver disease	0.223	0.084	0.24	2.658	0.01013*	0.055	0.391
Pneumonia	0.613	0.156	0.344	3.921	0.00024*	0.3	0.926
Malignancy	0.607	0.136	0.464	4.474	0.00004*	0.336	0.879
Na	0.018	0.012	0.038	1.496	0.146	-0.007	0.043
K	-0.001	0.002	-0.018	-0.557	0.582	-0.006	0.004
Bicarbonate	-0.001	0.007	-0.009	-0.138	0.891	-0.015	0.013
Hematocrit	-0.011	0.034	-0.024	-0.312	0.758	-0.081	0.06
Hb	-0.002	0.012	-0.011	-0.168	0.868	-0.026	0.022
WBCs	0.005	0.004	0.086	1.365	0.183	-0.003	0.013
Neutrophil	1.00E-05	0	0.001	0.045	0.964	0	0
Platelets	7.00E-05	0.002	0.001	0.039	0.969	-0.004	0.004
prothrombin time	0	0.001	-0.008	-0.355	0.725	-0.002	0.001
APTT	0	0.016	0	-0.014	0.989	-0.033	0.033
INR	-4.00E-05	0	-0.003	-0.12	0.906	-0.001	0.001
Serum urea	0	0.015	0	-0.007	0.995	-0.03	0.03
Serum creatinine	-0.09	0.048	-0.144	-1.852	0.075	-0.189	0.01
Albumin	-0.016	0.008	-0.185	-1.897	0.068	-0.033	0.001
Temperature	-0.063	0.206	-0.035	-0.305	0.761	-0.474	0.349
RR	0.033	0.022	0.221	1.505	0.138	-0.011	0.077
HR	0.007	0.005	0.209	1.382	0.172	-0.003	0.016
SBP	-0.008	0.009	-0.23	-0.878	0.383	-0.026	0.01
DBP	0.005	0.015	0.09	0.341	0.734	-0.026	0.036
MBP	0.001	0.011	0.02	0.118	0.907	-0.021	0.024
SPO2	-0.008	0.006	-0.159	-1.374	0.174	-0.019	0.004
AKI stage 3	0.001	0.027	0.001	0.045	0.965	-0.055	0.057
AKI stage 4	0.006	0.068	0.006	0.088	0.931	-0.133	0.145
AKI stage 5	-0.005	0.062	-0.004	-0.074	0.942	-0.132	0.123
RRT	-0.015	0.007	-0.048	-2.034	0.052	-0.029	0
Length of ICU stay	0.003	0.03	0.002	0.094	0.926	-0.059	0.064

Vasopressor use	-0.014	0.026	-0.043	-0.543	0.592	-0.068	0.04
SOFA at Day1	0.031	0.033	0.102	0.938	0.356	-0.037	0.1
SOFA at Day2	0.078	0.033	0.331	2.365	0.0252*	0.01	0.146
SOFA at Day3	-0.016	0.016	-0.081	-0.998	0.327	-0.049	0.017
SOFA at Day4	-0.006	0.017	-0.036	-0.36	0.722	-0.041	0.029
SOFA at Day5	0.024	0.019	0.157	1.269	0.215	-0.014	0.061
SOFA at Day6	-0.029	0.024	-0.214	-1.241	0.225	-0.077	0.019
SOFA at Day7	0.044	0.031	0.34	1.443	0.16	-0.019	0.108
SOFA at Day8	-0.025	0.031	-0.201	-0.823	0.417	-0.088	0.038
SOFA at Day9	0.021	0.024	0.175	0.879	0.387	-0.028	0.071
SOFA at Day10	0.001	0.008	0.011	0.094	0.926	-0.016	0.018
SAPSII at Day1	-0.006	0.01	-0.092	-0.568	0.575	-0.025	0.014
SAPSII at Day2	-0.016	0.008	-0.312	-1.894	0.069	-0.033	0.001
SAPSII at Day3	0.014	0.009	0.414	1.675	0.105	-0.003	0.032
SAPSII at Day4	0.001	0.01	0.023	0.068	0.946	-0.019	0.021
SAPSII at Day5	-0.016	0.01	-0.62	-1.617	0.117	-0.037	0.004
SAPSII at Day6	0.015	0.01	0.614	1.567	0.128	-0.005	0.036
SAPSII at Day7	-0.019	0.017	-0.808	-1.155	0.258	-0.054	0.015
SAPSII at Day8	0.001	0.025	0.053	0.051	0.96	-0.049	0.052
SAPSII at Day9	0.028	0.024	1.167	1.168	0.252	-0.021	0.076
SAPSII at Day10	0	0.001	0.003	0.183	0.856	-0.003	0.003

DISCUSSION

In critically ill patients, acute kidney damage is characterized by a fast deterioration in renal function and is associated with a considerable risk of mortality **(Wang et al., 2020).** Acute kidney injury impacts 6-24% of hospitalized patients in the United States, with a mortality rate of 60%-70%, hence substantially increasing healthcare costs and imposing considerable strain on the healthcare system. **(Khwaja, 2012).** The bleak outlook of AKI in critical illness underscores the necessity of creating novel indications to assess AKI severity and initiating effective treatments promptly to enhance survival chances.

Researchers have sought a limited number of mortality indicators in acute kidney injury (AKI), but their endeavors have largely been unproductive. The precise etiology of AKI remains ambiguous, however systemic inflammatory responses appear to contribute to the disease's onset and advancement. **Jansen et al. (2017).** Neutrophils and various leukocyte types secrete inflammatory mediators, such as cytokines and chemokines, that impair renal function. Albumin, a crucial protein involved in regulating osmotic pressure, exhibiting antioxidant and anti-inflammatory properties, and linked to acute kidney injury (AKI), is no exception **(Yu et al., 2017).** Consequently, we argue that the NPAR may serve as a prognostic indication for inflammation. Research has examined the NAR as a potential biomarker for survival in individuals with rectal cancer and advanced pancreatic cancer **(Tingle et al., 2018).**

The demographic data for the subjects covered shows about equal representation of males and females. The participants had an average age of 58.91 years and a standard deviation of 7.86. Approximately 56% of the patients resided in metropolitan areas, while the remainder were from rural regions. Pneumonia was the most common comorbidity, occurring in 41.43% of the cases. Other prevalent comorbidities comprised CAD in 21.43% of patients, CHF in 15.71%, AFIB in 14.29%, and stroke in 12.86%. Merely 7.14% of individuals have a history of cancer. The findings of the present study aligned with those of **Wang et al. (2020),** who sought to demonstrate the predictive capability of NPAR in instances of AKI. The average age was 62.0 ± 18.1, with 39.7% female and 60.3% male participants. Pneumonia was the most common comorbidity, seen in 28.1% of participants. Other prevalent comorbidities included coronary artery disease (CAD) in 14.4% of patients, congestive heart failure (CHF) in 22.9%, atrial fibrillation (AFIB) in 21.8%, and stroke in 10.3%. Merely 17.1% of individuals possessed a history of cancer. We also observed alignment with the research conducted by **Abu Alfeilat et al. (2018),** which aimed to ascertain if a singular assessment of NLR in the emergency department was adequate for diagnosing AKI. The mean age was determined to be 71.6 ± 16.9, with 39% of the participants being female and 61% male. Coronary artery disease (CAD) was present in 38% of the patients with comorbidities. Congestive heart failure (CHF) accounts for 26%, while cerebrovascular illness constitutes 14%. Our results aligned with those of a separate study **(He et al., 2022)** that sought to ascertain if the NPAR was a dependable predictor of CA-AKI and long-term mortality in patients without chronic renal disease undergoing elective percutaneous coronary intervention. The mean age was reported as 64.6 ± 10.4, with women constituting 20.6% and men 79.4% of the population.

Concerning vital signs, assessments of the included subjects revealed the mean values for temperature, respiration rate, heart rate, diastolic blood pressure, systolic blood pressure, mean arterial pressure, and oxygen saturation. The recorded values were 37.04 ± 0.26 °C, 26.2 ± 3.08 cycles/min, 98.24 ± 14.55 beats/min, 103.17 ± 13.35 mmHg, 61.64 ± 7.97 mmHg, 79.79 ± 6.9 mmHg, and 51.09 ± 9.32%, respectively. The current study concurred with **Fan et al. (2019),** who sought to determine whether NLR may serve as a biomarker for predicting mortality in AKI. The mean heart rate was 86.9 ± 16.7 beats per minute, systolic blood pressure (SBP) was 118.5 ± 17.5 mmHg, diastolic blood pressure (DBP) was 60.4 ± 11.1 mmHg, mean blood pressure (MBP) was 77.5 ± 11.5 mmHg, respiratory rate (RR) was 19.6 ± 4.2 breaths per minute, temperature was 36.8 ± 0.7 °C, and oxygen saturation (SPO2) was 97.0 ± 2.5%. Our investigation corroborated the findings of **Wang et al. (2020),** which reported the following measurements: SBP (mmHg) 119.8 ± 18.2, DBP (mmHg) 62.9 ± 11.9, MBP (mmHg) 79.6 ± 12.1, heart rate (beats/minute) 86.9 ± 17.9, respiratory rate (beats/minute) 19.4 ± 4.3, temperature (°C) 36.9 ± 0.7, and SPO2 (%) 97.0 ± 2.8.

In our study, 32.86% of the individuals exhibited AKI stage 3, 41.43% exhibited stage 4, and 25.71% exhibited stage 5. 24.29% of patients necessitated renal replacement therapy, whereas 85.71% were administered vasopressors. The average duration of ICU admission was 6.79 days. The current study aligns with **Xia et al. (2022),** who sought to investigate the prognostic significance of FAR in forecasting in-hospital death among critically sick patients with AKI. They discovered that 6.3% exhibited AKI Stage One, 21.1% Stage Two, and 72.6% Stage Three. 4.4% of patients necessitated renal replacement therapy, n (%). Furthermore, our investigation concurred with the findings of **Fan et al. (2019)**.They discovered that 26.2% exhibited Acute Kidney Injury Stage 1, 15.7% Stage 2, and 58.1% Stage 3. 8.9% of patients necessitated renal replacement therapy, n (%). Additionally, our study concurred with **Wang et al. (2020).** It was determined that 58.8% exhibited AKI stage 3, 15.5% exhibited stage 2, and 25.7% exhibited stage 1. 8.6% of patients necessitated renal replacement therapy, while 33.7% were administered vasopressors. The average duration of ICU admission was 4.9 days.

In our investigation, both the SOFA score and the SAPSII score exhibited a temporal decline. The present study concurred with **Lee et al. (2018),** which aimed to evaluate the effectiveness of SOFA scores and a biomarker panel in forecasting the development of septic AKI and consequent in-hospital mortality in critically sick surgical patients. The researchers identified a decreasing SOFA score over time. Furthermore, our research corroborated the findings of **Wang et al. (2020).** The average SOFA score was 5.1 ± 3.6, while the average SAPSII score was 37.9±15.5. Furthermore, our investigation concurred with the findings of **Gameiro et al. (2020).** The objective was to evaluate the prognostic utility of the N/LP ratio upon admission in patients with septic acute kidney injury in an intensive care unit. The average SAPSII score was determined to be 50.4±17.3. Our research revealed a glucose level of 95.54±5.71 mg/dL, which is within the usual range. The serum electrolyte analysis indicated that the patients had a mean sodium concentration of 134.47 ± 1.55 mEq/L, falling within the normal range, whereas the potassium concentration was 4.67± 0.96 mEq/L, which was somewhat increased.

The bicarbonate level was high, measuring 17.98± 6.22 mEq/L. The CBC results indicated that the participants exhibited low hematocrit levels (34.82 ± 4.54%), low hemoglobin levels (9.13± 1.05 gm/dL), normal white blood cell counts (9.64 ± 2.65 cell/cmm), a marginally raised neutrophil percentage (59.94 ± 7.62%), and a high platelet count (355.96 ± 62.11*10^9/cmm). The current study concurs with **Yu et al. (2020),** who sought to investigate the correlation between NPAR levels at admission and mortality in critically ill CS patients.What is your inquiry? The median values observed were as follows: Glucose at 113.0 mg/dL (range: 92.0-139.5), BUN at 29.0 mg/dL, Hemoglobin at 9.80 g/dL, and Platelet count at 187.00 x 10^9/L. WBC: 109/L, 14.90. Furthermore, our research corroborated the findings of **Wang et al. (2020).** The mean values observed were as follows: Bicarbonate (mmol/L) 20.7 ± 5.5, Chloride (mmol/L) 100.6 ± 6.8, Glucose (mg/dl) 143.1 ± 50.0, Hematocrit (%) 31.2 ± 6.5, Hemoglobin (g/dl) 10.7 ± 2.3, Platelet (10^9/L) 183.0 ± 99.5, Sodium (mmol/L) 136.3 ± 5.4, Potassium (mmol/L) 3.7 ± 0.6, and WBC (10^9/L) 9.7 ± 12.8.

The present investigation indicates that the average values for prothrombin time (PT), activated partial thromboplastin time (APTT), and international normalized ratio (INR) were 19.61 seconds, 48.88 seconds, and 1.81, respectively. The serum urea concentration is 129.04 ± 33.91 mg/dL, while the serum creatinine level is 4.06 ± 1.27 mg/dL. The albumin concentration was 3.59 ± 0.74 g/dL. The Neutrophil to Albumin Ratio was 17.62 ± 5.36. Concerning the mortality rate, 21 individuals (30%) have deceased, whereas 49 individuals (70%) have survived. The current study is corroborated by **Fan et al. (2019),** who reported that the proportion of renal replacement therapy (RRT) was 8.9%, the mean serum creatinine (SCr) level was 2.0 ± 2.0 mg/dl, the mean blood urea nitrogen (BUN) level was 36.4 ± 27.0 mg/dl, and the in-hospital mortality rate was 16.3%, with 30-day and 90-day mortality rates of 18.9% and 25.9%, respectively. Our investigation corroborated the findings of **Wang et al. (2020),** who reported the following mean values: Neutrophil (%) 65.8 ± 20.3, Albumin (g/dl) 3.8 ± 0.6, BUN (mg/dl) 26.0 ± 21.7, WBC (10^9/L) 9.7 ± 12.8, PT (seconds) 14.8 ± 4.9, APTT (seconds) 30.6 ± 11.8, INR 1.4 ± 0.8, and the percentage of in-hospital mortality (%).

Mortality rates: 30-day (15.5%), 90-day (20.9%), 365-day (28.2%). Our results aligned with those of **Kim and Jang (2010),** who aimed to ascertain the correlation between the inflammatory marker NLR and the severity of ischemic acute kidney injury. The mean values were as follows: Neutrophils, mm^3 8,116±4,096; Total cholesterol, mg/dL 196±98; Serum albumin, g/dL 3.5±0.9; Corrected serum calcium, mg/dL 9.1±0.9. C-reactive protein: 3.15 mg/dL.

This study found that the Neutrophil to Albumin Ratio, with a cutoff value of 12.14, is significantly associated with mortality, exhibiting high sensitivity (95.2%) and intermediate specificity (89.8%). The SOFA score, with a cutoff of 3.5, and the SAPSII score, with a cutoff of 14, demonstrated a substantial correlation with mortality, exhibiting lesser sensitivity (10%) and higher specificity (95.9%). The results indicate that the neutrophil to albumin ratio may serve as a more sensitive predictor of death than the SOFA and SAPSII scores. Consistent results were seen in the current investigation and in **Wang et al. (2020).** The ROC curves and AUCs were documented as 0.693 for NPAR, 0.538 for the percentage of neutrophils, 0.633 for albumin, and 0.758 for the SOFA score. NPAR demonstrated superiority over neutrophil percentage and albumin alone, although was inferior to the SOFA score. Furthermore, our trial corroborated the findings of **He et al. (2022).**

The best NPAR cutoff value for assessing CA-AKI was reported as 15.7, demonstrating a sensitivity of 66.8% and a specificity of 61.9% (AUC=0.679; 95% CI: 0.666-0.691). NPAR had superior AUC values compared to the neutrophil percentage (0.679 vs. 0.634) and the neutrophil-to-albumin ratio (NAR) (0.679 vs. 0.637), but not in comparison to albumin (0.679 vs. 0.652). NRI=0.353, 95% CI: 0.234-0.472; IDI=0.017, 95% CI: 0.010-0.024, Albumin alone demonstrated a net reclassification improvement (NRI) of

0.141 (95% CI: 0.022-0.260) and an integrated discrimination improvement (IDI) of 0.009 (95% CI: 0.003-0.013). Furthermore, we discovered that **Gameiro et al., (2020)** aligned with our conclusions. The N/LP ratio upon ICU admission was a significant predictor of hospital mortality in patients with septic-AKI, according to their findings. The calculation of this ratio is straightforward from a standard blood test for intensive care unit patients and may assist in early mortality identification.

STUDY LIMITATION

It is essential to acknowledge the limits of the research. Initially, we recognize that our research is constrained by its observational characteristics. Secondly, the NPAR was not identified until the patient was transferred to the ICU for additional therapy. Additionally, certain samples went missing, raising concerns regarding selection bias. Third, we lacked access to potentially significant information concerning social support and mortality, such as income, insurance status, and educational background. Fourth, we did not assess the impact of sepsis and shock, which could potentially elevate mortality rates among patients with AKI, due to insufficient data. Ultimately, assessing NPAR in isolation is inadequate; a more comprehensive understanding can be obtained by concurrently evaluating additional inflammatory mediators.

CONCLUSIONS

The results of this experiment indicate that the neutrophil-to-albumin ratio serves as an effective predictor of in-hospital death in critically sick patients with AKI. The threshold value of 12.14 for this ratio demonstrated high sensitivity (95.2%) and moderate specificity (89.8%), signifying its robust capacity to identify patients at risk of mortality. Moreover, the neutrophil-to-albumin ratio was identified as a more sensitive predictor of death than the often-utilized SOFA and SAPS II scores. While the SOFA and SAPS II scores demonstrated a substantial correlation with mortality, they exhibited reduced sensitivity and increased specificity. This indicates that the neutrophil-to-albumin ratio could serve as a more effective metric for identifying individuals necessitating enhanced surveillance and more intensive therapies to avert mortality. Nonetheless, more prospective multicenter investigations are necessary to validate these findings.

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