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Uric acid / albumin ratio in acute kidney injury developing in intensive care unit: A case control study

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Abstract

Objective: Various scoring systems and markers are used in intensive care practice, and molecules which can predict mortality and change the course of treatment continue to be researched. We aimed to investigate whether uric acid, albumin, uric acid/albumin ratio and uric acid/creatinine ratio were associated with mortality in intensive care cases.

Materials and Methods: Our study was designed retrospectively and involved 600 cases. The uric acid and albumin values of the cases were recorded at the time of admission were recorded, and the uric acid/albumin ratio and uric acid/creatine ratio were calculated. APACHE-II scores and SOFA scores of all the patients at the time of admission were recorded.

Results: Uric acid, uric/albumin ratio, uric acid/creatinine ratios of Groups AKI and Non-AKI were statistically significant ($p<0.001$, $p<0.001$, $p<0.001$, respectively). When exitus and discharged cases were compared, albumin and uric acid/albumin ratios were statistically significant ($p<0.050$, $p<0.050$, in order). The cut-off value for albumin was found as 2.75. Mortality increases at the values below 2.75. A meaningful difference was detected between the distributions of albumin cut-off value according to the last condition of the patients ($p=0.038$). We discovered a notable correlation between albumin, uric acid/creatinine ratio, APACHE-II, SOFA scores ($p=0.045$; $p=0.012$; $p=0.018$; $p=0.020$, respectively).

Conclusion: Uric acid/albumin ratio may be a useful biomarker in predicting prognosis in cases of acute kidney injury. We believe that our study will shed light on future studies on the uric acid/albumin ratio in larger populations and different patient groups.

Keywords: Intensive care, mortality, uric acid, uric acid albumin ratio, uric acid creatinine ratio

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Introduction

Today, there has been an increase in the need for intensive care as a result of prolonged life expectancy and increased chronic/acute diseases. As a result of this increasing need, medical developments in intensive care are accelerating and reduction of intensive care mortality is put forward as the main objective [1]. Various scoring systems and markers are used in intensive care practice, and molecules which can predict mortality and change the course of treatment continue to be researched. The ideal marker should be cheap and easy to use in daily practice [2,3]. Serum uric acid level can be used to predict intensive care mortality since it meets these criteria and reflects the antioxidant capacity in plasma [4].

Uric acid emerges as the last result of purine metabolism in the human body. Plasma uric acid level is influenced by many factors, and the main reason for the change in uric acid value is overproduction or changes in renal functions. Changes can be observed in uric acid levels resulting from decreased glomerular filtration, renal hypoperfusion, decreased tubular reabsorption and elimination [5]. Even though there were slight differences in the normal uric acid value, it was considered 3.4-7.2 mg/dl in males and 2.4-6.1 mg/dl in females [6]. In the last century, people's uric acid threshold have increased with the changing lifestyle and the relationship of this situation with existing diseases has been reviewed in many different studies. It has been demonstrated in different studies that enhanced uric acid levels are in related to atherosclerosis, hypertension, adiposity, coronary heart diseases, diabetes mellitus, stroke, and malignancy [7].

The results of the studies are in contradiction with each other, and the relevance thereamong uric acid and mortality has not been revealed with certainty. Additionally, there are not enough studies investigating the correlation among uric acid value and period of mechanical ventilation requirement, non-intensive care mortality, re-hospitalization rates, and the need for hemodialysis. Again, the existing scoring systems, which are Acute Physiology and Chronic Health Evaluation-II (APACHE-II) and Sequential Organ Failure Assessment Score (SOFA), are used in the intensive care of our hospital, and there are no studies examining the relationship of these scoring systems with uric acid in the literature.

For this reason, in our study, we aimed at revealing the relationship of uric acid values, uric acid/albumin ratio, and uric acid/creatine ratios of the patients, who were hospitalized to our intensive care unit between January, 2017 –September, 2019, at the time of hospitalization with whether patients had hemodynamic instability, and especially mortality, and comparing them with existing intensive care scoring systems in the prognostic terms.

Materials and Methods

Ethical consent was gained from the Ordu University Clinical Research Ethics Committee for our study (Date: 10/10/2019 Decision Number: 2019/139). The files of the patients who were admitted to Ordu University Education and Research Hospital Anesthesia Reanimation Intensive Care Unit 1 and 2 between January 1, 2017 and September 30, 2019 were retrospectively examined. The data of the patients were collected through intensive care files and the hospital operating system. 600 cases were included in the study. Among whole subjects admitted to the intensive care unit between the given dates, 300 intensive care patients with acute kidney injury and 300 intensive care patients without acute kidney injury were added in the study. Patients below 18 years of age, patients with malignancy, and patients using drugs that may increase uric acid levels (such as ethambutol and pyrazinamide) were excluded from the study. Patients with underlying diseases such as nephrotic syndrome, liver cirrhosis, 2nd and 3rd degree burns, which might affect the plasma albumin levels, were excluded from the study. Hypoalbuminemia was described as plasma albumin level below 3.5 g/dL. Hyperuricemia, on the other hand, was described as plasma uric acid level higher than 7 mg/dL. Demographic data of the patients such as age, gender, underlying diseases, and duration of stay in our intensive care unit were recorded. Acute kidney injury (AKI) has been defined conveniently the guidelines of the kidney disease improving global outcomes (KDIGO) [8,9]. If the serum creatinine heighten was $\geq$0.3 mg/dL within 48 hours according to KDIGO criteria or if the increase in basal creatinine value was $\geq$1.5 times within 7 days; or if urinary output was <0.5 ml/kg/hour in the last 6 hours, a diagnosis of acute kidney injury was established [9]. As intensive care scoring systems, APACHE-II and

SOFA scores were calculated. Routine biochemical values, uric acid levels, albumin, CRP (C-Reactive Protein), procalcitonin values of the patients during hospitalization were recorded. The uric acid/albumin, uric acid/creatinine ratios of each case were calculated.

Statistical Analysis

The data were analyzed using IBM SPSS v23. Compliance with normal distribution was examined with Shapiro-Wilk and Kolmogorov-Smirnov tests. Chi-square test was applied to compare categorical variables according to groups. In the comparison of quantitative variables by binary groups, the Independent two-sample t test was used for data with normal distribution, and the Mann-Whitney U test was performed for data without normal distribution. Spearman's rho correlation coefficient was used to examine the relationship between quantitative variables without normal distribution. According to the exitus condition, ROC (Receiver operating curve) analysis was used to determine the cut-off value for albumin, uric acid and uric acid/albumin. The results of the analysis were presented as mean ± standard deviation and median (minimum – maximum) for the quantitative data, and as frequency (percent) for categorical data. The level of significance was taken as p<0.05.

Table 1. Comparison of the categorical variables according to the groups

	AKI [n=300]	Non-AKI [n=300]	Total	Test Statistics	P
Gender					
Female	110 [36.7]	140 [46.7]	250 [41.7]	χ^2= 0.617	0.432
Male	190 [63.3]	160 [53.3]	350 [58.3]		
Comorbidity					
Diabetes Mellitus	0 [0]	1 0 [3.4]	10 [1.7]	χ^2= 13.820	0.054
Hypertension	30 [10]	20 [6.9]	50 [8.5]		
Congestive Heart Failure	20 [6.7]	10 [3.4]	30 [5.1]		
COPD*	10 [3.3]	40 [13.8]	50 [8.5]		
Cerebro-Vascular Disease	20 [6.7]	100 [34.5]	120 [20.3]		
Mixed Etiology	170 [56.7]	70 [24.1]	240 [40.7]		
Malignancy	40 [13.3]	40 [13.8]	80 [13.6]		
Solitary Kidney	10 [3.3]	0 [0]	10 [1.7]		
Last condition					
Exitus	170 [56.7]	110 [36.7]	280 [46.7]	χ^2=2.411	0.121
Discharged	130 [43.3]	190 [63.3]	320 [53.3]		
Mechanical Ventilation					
No	70 [23.3]	60 [20]	130 [21.7]	χ^2=0.098	0.754
Yes	230 [76.7]	240 [80]	470 [78.3]		
Hemodialysis					
No	120 [46.2]	300 [100]	420 [75]	χ^2=21.538	**<0.001**
Yes	140 [53.8]	0 [0]	140 [25]		
Proteinuria					
No	190 [63.3]	290 [96.7]	480 [80]	χ^2=10.417	**0.001**
Yes	110 [36.7]	10 [3.3]	120 [20]		

x^2: Chi-square test statistics [*]: Chronic Obstructive Pulmonary Disease

Table 2. Comparison of quantitative variables according to the groups

	AKI [n=300]	Non-AKI [n=300]	Total	Test statistics	p
Age	73.97 ± 11.65 77 [48 - 90]	100.21 ± 154.52 77 [20 - 899]	86.86 ± 108.49 77 [20 - 899]	U=424.0	0.867
Total hospitalization days	12.63 ± 13.04 8.5 [3 - 51]	25.3 ± 27.8 13 [3 - 105]	18.97 ± 22.46 10 [3 - 105]	U=325.0	0.064
BUN	95.61 ± 48.76 84.65 [31.2 - 203.8]	27.42 ± 9.93 25.55 [11.3 - 47.3]	61.52 ± 48.98 41.9 [11.3 - 203.8]	U=27.0	**<0.001**
Creatine	4.33 ± 1.71 3.9 [1.59 - 8.35]	0.81 ± 0.21 0.84 [0.45 - 1.24]	2.57 ± 2.14 1.42 [0.45 - 8.35]	t=11.203	**<0.001**
Glucose	186.93 ± 84 187 [72 - 317]	169.73 ± 73.49 155.5 [70 - 381]	178.33 ± 78.73 162.5 [70 - 381]	U=400.0	0.460
Calcium [Ca]	7.9 ± 1.24 7.85 [5.6 - 10.5]	8.1 ± 0.89 8.3 [5.1 - 9.2]	8 ± 1.08 8.05 [5.1 - 10.5]	t=-0.705	0.484
Sodium [Na]	131.86 ± 5.17 132 [119 - 140]	139.03 ± 6.81 138.5 [129 - 158]	135.51 ± 7.01 135 [119 - 158]	U=168.5	**<0.001**
Potassium [K]:	5.35 ± 1.15 5.2 [3 - 8.39]	3.85 ± 0.75 3.8 [2.33 - 5.27]	4.58 ± 1.22 4.58 [2.33 - 8.39]	U=88.5	**<0.001**
Albumin [Alb]	2.68 ± 0.53 2.65 [1.9 - 3.6]	2.81 ± 0.39 2.9 [2 - 3.6]	2.74 ± 0.46 2.75 [1.9 - 3.6]	t=-1.083	0.284
Procalcitonin	14.34 ± 33.86 1.72 [0.13 - 155]	10.62 ± 18.94 1.63 [0.06 - 84.4]	12.48 ± 27.26 1.72 [0.06 - 155]	U=435.0	0.824
C-Reactive Protein [CRP]	19.04 ± 14.08 15.15 [1.52 - 45.8]	14.47 ± 10.96 10.4 [2.7 - 42]	16.76 ± 12.72 13.95 [1.52 - 45.8]	U=386.5	0.348

t: Independent two-sample t test, U: Mann-Whitney U test, mean ± s. deviation, median [minimum - maximum]

Results

The comparison of categorical variables according to the groups is given in Table 1.

The comparison of quantitative variables according to the groups is given in Table 2.

Comparison of other quantitative variables according to groups is presented in Table 3.

A meaningful difference was detected between the medians of the BUN and creatinine values according to the groups (p<0.001, p<0.001). Similarly, there is a meaningful difference between the medians of Na, K values according to the groups (p<0.001, p<0.001). There is a meaningful difference between the medians of PH values, HCO3 values, BEecf values according to the groups (p<0.001, p<0.001, p<0.001). Again similarly ,there is a meaningful difference between the medians of uric acid values, uric acid/albumin ratio values, uric acid/creatinine values according to the groups (p<0.001,p<0.001,p<0.001). The comparison of albumin, uric acid, uric acid/albumin ratio and mean arterial pressure values according to the last condition of the patients are presented in Table 4.

There is a meaningful difference between the mean values of albumin, uric acid/albumin ratio and mean arterial pressure according to the last condition of the patients [p=0.05; p=0.05; p=0.005, respectively]. The average of exitus cases was obtained as 66.88, and the

Table 3. Comparison of quantitative variables according to the groups [continued]

	AKI	NON-AKI	Total	Test statistics	p
APACHE-II score	21.17 ± 7.41 21 [6 - 36]	18.63 ± 6.78 20 [8 - 35]	19.9 ± 7.16 20 [6 - 36]	t=1.382	0.172
SOFA score	8.57 ± 3.23 8 [4 - 16]	7.37 ± 2.77 6.5 [4 - 14]	7.97 ± 3.05 7 [4 - 16]	U=342.0	0.108
PH	7.23 ± 0.22 7.3 [6.81 - 7.51]	7.44 ± 0.11 7.46 [7.1 - 7.6]	7.33 ± 0.2 7.4 [6.81 - 7.6]	U=161.5	**<0.001**
PO2	99.69 ± 42.52 93.85 [10 - 228]	101.79 ± 36.94 91.1 [40.3 - 194]	100.74 ± 39.5 92.75 [10 - 228]	U = 431.0	0.779
PCO2	41.04 ± 12.29 36.95 [23.9 - 76.1]	40.25 ± 9.67 38.3 [21 - 67.7]	40.64 ± 10.97 38.15 [21 - 76.1]	U=421.0	0.668
HCO3	18.16 ± 6.7 20.95 [5.4 - 28.1]	40.39 ± 68.25 27.5 [12 - 399.2]	29.27 ± 49.37 23.1 [5.4 - 399.2]	U=170.5	**<0.001**
SO2	94.91 ± 5.23 96.65 [81.5 - 100]	95.86 ± 6.57 97.25 [63.5 - 100]	95.39 ± 5.91 97.05 [63.5 - 100]	U=386.5	0.348
BEecf	-8.67 ± 9.52 -4.7 [-28.9 - 4]	2.65 ± 14.1 3.45 [-52 - 19.1]	-3.01 ± 13.22 -1.8 [-52 - 19.1]	U=177.5	**<0.001**
Uric acid	6.65 ± 0.7 6.84 [5.23 - 8]	4.73 ± 0.59 4.74 [3.9 - 5.9]	5.69 ± 1.16 5.65 [3.9 - 8]	U=19.5	**<0.001**
Uric acid / albumin ratio	2.56 ± 0.47 2.55 [1.82 - 3.57]	1.73 ± 0.41 1.65 [1.11 - 2.8]	2.14 ± 0.6 2.03 [1.11 - 3.57]	t = 7.302	**<0.001**
Uric acid / Creatine ratio	1.82 ± 0.82 1.53 [0.83-3.71]	6.16 ± 1.68 5.75 [3.8 - 11.15]	3.99 ± 2.55 3.76 [0.83 - 11.15]	U=0.0	**<0.001**
MAP [Mean Arterial Pressure]	73.37 ± 17.29 73.33 [46.67 - 113.33]	72.23 ± 14.25 73.33 [50 - 100.67]	72.8 ± 15.72 73.33 [46.67 - 113.33]	t=0.277	0.783

t: Independent two-sample t test, U: Mann-Whitney U test, mean ± s. deviation, median [minimum - maximum]

average of discharged cases was 77.98. This difference results from the fact that the mean arterial pressure average of those who died was lower than the average of those who were discharged.

The consequences of the ROC analysis for uric acid/albumin ratio, albumin and uric acid according to the exitus status are given in Table 5.

The cut-off value for albumin was found as 2.75. Mortality increases with values below 2.75. When the cut-off value for albumin was taken as 2.75, the area under the curve (AUC) was found as 0.653. This value is statistically significant (p=0.042). When the cut-off value was taken as 2.75, the sensitivity was obtained as 64.3% and the specificity as 62.5%. No significant cut-off values were obtained for uric acid/albumin ratio and uric acid (p>0.050).

ROC curves drawn for uric acid/albumin ratio, albumin and uric acid according to the exitus status of the cases are demonstrated Figure 1, Figure 2 and Figure 3.

The comparison of the albumin cut-off values of the AKI and Non-AKI group and in accordance with the exitus status is presented in Table 6.

Table 4. Comparison of albumin, uric acid, uric acid/albumin ratio, uric acid/creatinine ratio and mean arterial pressure values according to the last condition of the patients

	Exitus	Discharged	Total	Test statistics	P
Albumin	2.62 ± 0.5 2.6 [1.9 - 3.6]	2.85 ± 0.41 2.9 [2 - 3.6]	2.74 ± 0.46 2.75 [1.9 - 3.6]	t=-1.982	**0.05**
Uric acid	5.82 ± 1.16 5.9 [3.9 - 8]	5.57 ± 1.17 5.35 [3.99 - 7.9]	5.69 ± 1.16 5.65 [3.9 - 8]	U=405.0	0.524
Uric acid / albumin ratio	2.3 ± 0.64 2.26 [1.37 - 3.57]	2 ± 0.54 1.93 [1.11 - 3.32]	2.14 ± 0.6 2.03 [1.11 - 3.57]	t=1.973	**0.05**
Uric acid/creatinine ratio	3.5 ± 2.37 2.82 [0.84 - 8.65]	4.42 ± 2.66 4.51 [0.83 - 11.15]	3.99 ± 2.55 3.76 [0.83 - 11.15]	U=361.0	0.197
Mean Arterial Pressure	66.88 ± 13.27 65.83 [46.67 - 100.67]	77.98 ± 16.05 80 [50 - 113.33]	72.8 ± 15.72 73.33 [46.67 - 113.33]	t=-2.894	**0.005**

t: Independent two-sample t test, U: Mann-Whitney U test, mean ± s. deviation, median [minimum - maximum]

Table 5. ROC analysis results for uric acid/albumin ratio, albumin and uric acid according to exitus status

	AUC [95% CI]	P	SH	Cut-off value	Sensitivity	Specificity
Uric acid / albumin ratio	0.647 [0.506 - 0.788]	0.051	0.072	≥2.0313	0.607	0.594
Albumin	0.653 [0.51 - 0.796]	**0.042**	0.073	≤2.75	0.643	0.625
Uric acid	0.548 [0.399 - 0.697]	0.524	0.076	≥5.65	0.571	0.562

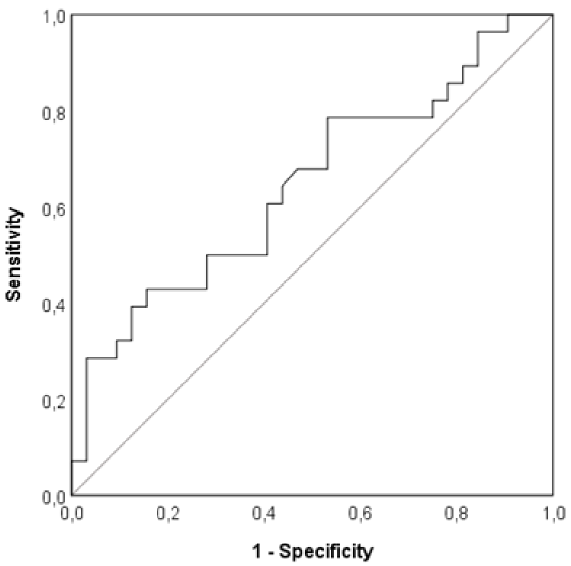

Figure 1. ROC curve for Uric acid/albumin ratio according to the exitus status

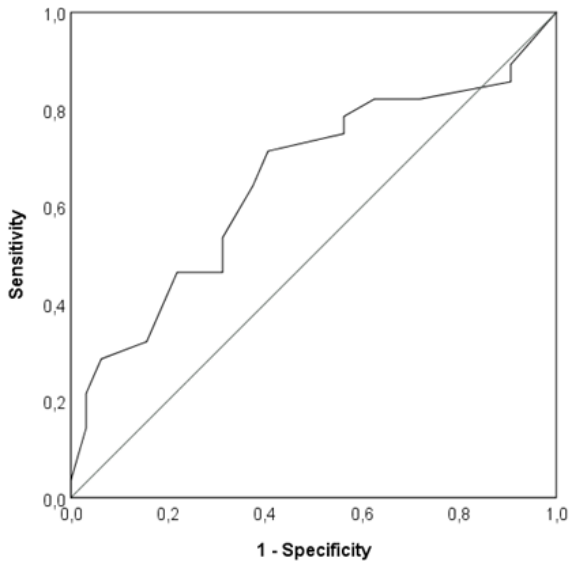

Figure 2. ROC curve for albumin according to the exitus status

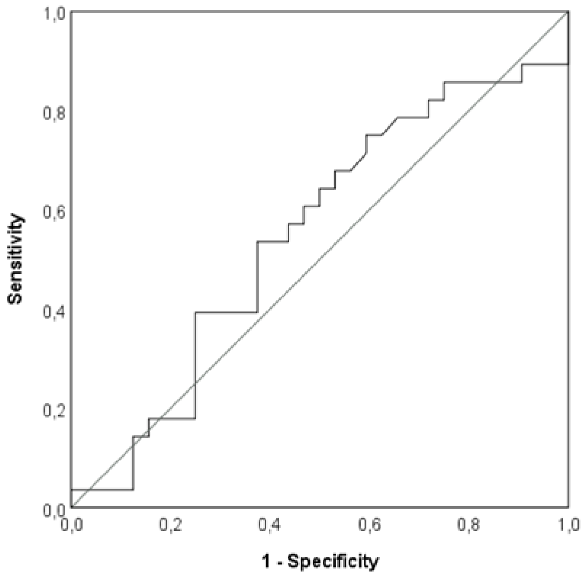

Figure 3. ROC curve for Uric acid according to the exitus status

Table 6. Comparison of the albumin cut-off value according to groups and exitus status

	≤2.75	>2.75	Total	Test statistics	P
Group					
AKI	170 [56.7]	130 [43.3]	300 [100]	χ^2=1.067	0.302
NON-AKI	130 [43.3]	170 [56.7]	300 [100]		
Last condition					
Discharged	120 [37.5]	200 [62.5]	320 [100]	χ^2=4.286	**0.038**
Exitus	180 [64.3]	100 [35.7]	280 [100]		

x^2: Chi-square test statistics

There was a meaningful difference between the distributions of the albumin cut-off value according to the last condition of the patients (p=0.038). While the albumin value of 64.3% of exitus cases was obtained as 2.75 and below, the albumin value of 62.5% of discharged cases was found above 2.75. No meaningful difference between the distributions of the albumin cut-off value according to the groups (when AKI and Non-AKI groups are compared) (p>0.050).

Discussion

When uric acid values were confronted among the AKI and Non-AKI groups, a meaningful difference was detected; the uric acid values were found to be higher in the AKI group. When the uric acid/albumin values were compared between the AKI and Non-AKI groups, a meaningful difference was found. The uric acid/albumin ratio was found to be considerably higher in the AKI group. When uric acid/creatinine values were compared between the AKI and Non-AKI groups, a meaningful difference was found. The uric acid/creatinine ratio was found to be considerably low in the AKI group. When compared in terms of mortality, no relationships were found among uric acid, uric acid/creatinine proportion and mortality. However, meantime the relationship between albumin, uric acid/albumin proportion and mean blood pressure and mortality were compared, a significant relationship was found. As the uric acid/albumin ratio increases, mortality increases. It is possible to say that mortality increases as albumin and mean blood pressure decrease.

Recently, a sum of 1112 subjects approved to the intensive care unit were evaluated with a retrospective study conducted by Chen et al., and the uric acid values of these patients at the time of admission were collected. The relationship between ICU and 90-day mortality and plasma uric acid values of patients were examined. No difference was reported between uric acid level and mortality, as in our study [4]. In addition to this study, in a prospective study by Aminiahidashti et al., 120 subjects received to the intensive care unit in 2014 were examined, and no significant relationship was detected between the uric acid level of the patients and intensive care mortality whereas the high uric acid level prolonged the span of mechanical ventilation [10].

In a prospective research conducted in the United States of America in 2015, the relationship between plasma uric acid values and intensive care mortality of patients received to the intensive care unit due to sepsis was reviewed, and it was concluded that the intensive care mortality increased as the uric acid value increased [3].

In a study conducted by Yeter et al, the relationship between uric acid/albumin proportion and mortality in intensive care patients was examined. The authors found a strong correlation between hypoalbuminemia and early mortality. They determined the cut-off value for albumin as 2.86. They observed that mortality increased at albumin values below 2.86. They asserted that the uric acid/albumin ratio was a valuable biomarker in predicting acute kidney injury, and it was a valuable biomarker in predicting intensive care mortality [11]. Our study consequences are in full compatibility with the study results of Yeter et al. The study of Yeter et al. is the first study in the literature searching the relationship between uric/acid albumin ratio and mortality. Our research is the second study in the literature. There are no other studies researching the relationship between acid/albumin ratio and mortality.

Guler et al. examined the relationship of albumin and hemoglobin values with hospitalization time and mortality in geriatric patients operated for thigh fractures. They discovered that there was no relationship between albumin and hemoglobin values and mortality [12]. In our study, we observed that mortality increased as albumin values decreased. Meanwhile, as our albumin values decreased, our APACHE-II and SOFA scores, which were our intensive care mortality scores, increased. The relationship between hypoalbuminemia and intensive care mortality was proven many times in our study with different analysis methods.

Likewise, in pediatric intensive care units and mortality studies, a significant relationship was detected between the low albumin level and mortality, and it was found out that albumin had a predictive value on mortality [13,14]. Even though our study was carried out with adult intensive care patients, our results fully coincide with the literature.

Msaad et al. investigated the factors causing mortality in hemodialysis patients. In their study, the researchers reported that albumin and prealbumin were the indicators of malnutrition and mortality in 126 hemodialysis patients. They expressed that mortality increased as the albumin and preaalbumin levels decreased [15]. Our study populations are different; however, our results are similar. Msaad et al. researched the albumin relationship in end-stage chronic kidney patients. In our study, that is to say, the relationship among hypoalbuminemia and deadness was investigated in critically care subjects with acute kidney injury.

Uric acid/creatinine ratio obtained when correction is made by proportioning to creatinine to neutralize the effect of possible serum uric acid level changes resulting from kidney functions is more sensitive than the uric acid level to show anaerobic changes caused by hypoxia. There are various studies indicating that the uric acid/creatinine is increased in cardiovascular and pulmonary and neuropsychiatric diseases which cause hypoxemia, such as chronic obstructive pulmonary disease, heart failure, cyanotic heart disease, pulmonary thromboembolism and pulmonary hypertension [16-18]. In our study, however, it was attributed that the uric acid/creatinine proportion was not correlated with deadness. Besides, the uric acid/creatinine proportion was detected to be lower in patients with acute kidney injury and patients who passed out. From this aspect the uric acid/creatinine ratio, our results are not compatible with the literature. The patient groups studied in the literature and our patient groups are quite different. Our difference from the literature in terms of the uric acid/creatine ratio may be related to the fact that our patient group is a completely different group.

Our research has some limitations. The retrospective style of the study is the first limiting factor. Moreover, examining the 90-day mortality of patients after drainage from the critically care service would have been useful in investigating the long-term effects of serum uric acid, uric acid/albumin and albumin levels.

Conclusion

Consequently, the uric acid/albumin ratio is a simple, inexpensive, useful biomarker which can be calculated practically. As albumin is a marker of mortality, the uric acid/albumin ratio can also be utilised as an identifier of mortality in intensive care patients. The uric acid/albumin ratio may be a useful biomarker in predicting prognosis in cases of acute kidney injury. We believe that our study will shed light on future studies on the uric acid/albumin ratio in larger populations and different patient groups.

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Ethical considerations: The study has obtained the approval of the ethical board with the ethical board decision number 10.10.2019/139 from Ordu University Clinical Research Ethics Committee.

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References:

1. Aminiahidashti H, Bozorgi F, Mousavi SJ, Sedighi O, Gorji AM, Rashidian H. Serum Uric Acid Level in Relation to Severity of the Disease and Mortality of Critically Ill Patients. *J Lab Physicians*. 2017;9(1):42-46.

2. Lee HW, Choi SM, Lee J, et al. Serum Uric Acid Level as a Prognostic Marker in Patients With Acute Respiratory Distress Syndrome. *J Intensive Care Med.* 2019 ;34(5):404-410.

3. Akbar SR, Long DM, Hussain K, et al. Hyperuricemia: An Early Marker for Severity of Illness in Sepsis. *Int J Nephrol.* 2015;2015:301021.

4. Chen Q, Huang K, Li L, et al. Serum uric acid on admission cannot predict long-term outcome of critically ill patients: a retrospective cohort study. *Ther Clin Risk Manag.* 2018;14:1347-1359.

5. Pesquera JIM, Rubio AH, Ruiz IG, et al. La hiperuricemiacomo factor de riesgo cardiovascular y renal. *Diálisis y Trasplante*. 2011;32(2):57-61.

6. Ioachimescu AG, Brennan DM, Hoar BM, Hazen SL, Hoogwerf BJ. Serum uric acid is an independent predictor of all-cause mortality in patients at high risk of cardiovascular disease: a preventive cardiology information system (PreCIS) database cohort study. *Arthritis Rheum.* 2008;58(2):623-630.

7. Dawson J, Jeemon P, Hetherington L, et al. Serum uric acid level, longitudinal blood pressure, renal function, and long-term mortality in treated hypertensive patients. *Hypertension.* 2013;62(1):105-111.

8. Andrassy KM. Comments on 'KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease'. *Kidney Int.* 2013;84(3):622-623.

9. KDIGO Clinical Practice Guideline for Acute Kidney Injury. AKI definition. *Kidney International Supplements* 2012;2(1):19-22.

10. Aminiahidashti H, Bozorgi F, Mousavi SJ, Sedighi O, Gorji AM, Rashidian H. Serum Uric Acid Level in Relation to Severity of the Disease and Mortality of Critically Ill Patients. *J Lab Physicians.* 2017;9(1):42-46.

11. Yeter HH, Eyupoglu D, Pasayev T, Cetik S, Akçay OF, Yıldırım T. Role of Uric Acid Albumin Ratio in Predicting Development of Acute Kidney Injury and Mortality in Intensive Care Unit Patients. *Turk J Nephrol.* 2019; 28(3): 160-167.

12. Guler A, Dogukan M, Kaya R, Uludag O, Duran M, Tutak A. Retrospective Evaluation of the Effects of Albumin and Hemoglobin Values on the Duration of Hospital Stay and Mortality in Elderly Patients Operated for Hip Fracture. *ADYU Journal of Health Sciences.* 2018; 4(1):637-647.

13. Horowitz IN, Tai K. Hypoalbuminemia in critically ill children. *Arch Pediatr Adolesc Med*. 2007;161(11):1048-1052

14. Leite HP, Rodrigues da Silva AV, de Oliveira Iglesias SB, Koch Nogueira PC. Serum albumin is an independent predictor of clinical outcomes in critically ill children. *Critic Care Med.* 2016;17(2):e50-e57

15. Msaad R, Essadik R, Mohtadi K, et al. Predictors of mortality in hemodialysis patients. *Pan Afr Med J.* 2019; 33:61.

16. Garcia-Pachon E, Padilla-Navas I, Shum C. Serum uric acid to creatinine ratio in patients with chronic obstructive pulmonary disease. *Lung.* 2007;185(1):21-24.

17. Zhong LL, Song YQ, Tian XY, Can H, Ju KJ. Level of uric acid and uric acid/creatinine ratios in correlation with stage of Parkinson disease. *Medicine [Baltimore]*. 2018;97(26):e10967.

18. Albay VB, Tutuncu M. Are Uric Acid Level and Uric Acid/Creatinine Ratio Reliable Biomarkers for Idiopathic Parkinson's Disease Severity? *Med Bull Haseki.* 2020;58:315- 319.