ORIGINAL ARTICLE
Medycyna Paliatywna 2022; 14(1): 36–40
DOI: https://doi.org/10.5114/pm.2022.118005

The effect of blood urea nitrogen/creatinine and blood urea nitrogen/albumin ratios on the prognosis and mortality of patients in the palliative care service

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Abstract

Introduction: In this study we aimed to evaluate the effects of the blood urea nitrogen/creatinine ratio (BUN/BCR) and the BUN/albumin ratio (BAR) on the prognosis and mortality in patients in the palliative care service.

Material and methods: Patients in the palliative service were included in the study. Sociodemographic data of the patients such as age, gender, chronic diseases, discharge from the service, length of stay in the service, BUN, creatinine, albumin, C-reactive protein (CRP), and haemogram parameters were recorded retrospectively from patient files and the hospital automation system. BCR and BAR values were calculated.

Results: A total of 209 patients were included in the study. 57.4% of them were male, and 44.9% were ≥ 81 years of age. While 78.0% of the patients were discharged alive, 22.0% of them died. When the blood test results of the patients who were discharged from the palliative service alive and those who died were compared, it was seen that the CRP, BUN, BCR, and BAR levels were high, and the albumin levels were low in the patients who died. A positive correlation was observed between BCR and BAR levels in patients in the palliative service. It was observed that as BAR and BCR levels increased, the length of stay in the service, BUN, creatinine, and CRP levels increased, while albumin levels decreased.

Conclusions: In our study, a positive correlation was found between BCR and BAR parameters, hospitalization time, and mortality status of patients in the palliative service with various systemic diseases. In this case, it can be said that the BCR and BAR ratios have value in predicting the outcomes and mortality in patients.

Key words: prognosis, mortality, palliative care, BUN/creatinine ratio, BUN/albumin ratio.

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INTRODUCTION

Serum creatinine, blood urea nitrogen (BUN), and electrolyte levels are the most used tests to evaluate kidney functions, and the BUN level is also used to evaluate hypovolaemia as well as kidney functions [1–3]. Causes such as excessive protein intake, amino acid infusion, accelerated catabolism, acute illness, some antibiotics such as tetracycline, or steroid use can increase BUN without kidney disease [1]. Apart from these, BUN level has been shown to be higher in patients with pneumonia, chronic obstructive pulmonary disease, pancreatitis, acute myocardial infarction, heart failure, sepsis, and geriatric mortality [3–9].

The ratio of BUN to creatinine (BCR) is frequently used to determine the level of dehydration [3]. The BCR is normally 10/1, and greater than 10 may be a sign of decreased extracellular fluid volume. Its proportional increase indicates renal failure [1]. BCR is also used for the prognosis of many diseases such as stroke, gastrointestinal bleeding, heart failure, and hip fracture [10–14].

Albumin is a protein and a negative acute phase reactant, and it directly or indirectly reflects conditions such as nutrition and dehydration [15–19]. Albumin levels in patients with pneumonia, acute coronary syndrome, and pancreatitis are low; severe acute malnutrition and hypoalbuminaemia are associated with high mortality in patients with various diseases [20–23] . Studies have been conducted to estimate the mortality rate with the BUN/albumin ratio (BAR) in geriatric patients and patients with pneumonia, and it has been reported that the pre-

dictive power of BAR for mortality is higher than that of BUN and albumin in these studies [3, 24]. BCR and BAR parameters, which are used frequently in routine blood tests, have recently been associated with the severity and prognosis of chronic diseases [3, 10–14, 24–26].

In our study, we aimed to evaluate the effect of BCR and BAR rates on prognosis and mortality in patients hospitalized in the palliative service with a variety of comorbid diseases.

MATERIAL AND METHODS

Patients hospitalized in the palliative service of the local University Training and Research Hospital Family Medicine Department between May 2019 and May 2021 were included in the cross-sectional study. Sociodemographic data such as age, gender, chronic diseases, discharge status, length of stay, blood parameters such as BUN, creatinine, albumin, C-reactive protein (CRP), and haemogram parameters of the patients in the palliative service were recorded retrospectively from the patients' files and the hospital automation system. BCR was calculated by dividing the serum BUN value by the serum creatinine value, and BAR was calculated by dividing the serum BUN value by the serum albumin value.

Statistical analysis

SPSS package program version 22.0 was used in the statistical analysis of the obtained data. Descriptive statistics were expressed as numbers, percentages, and mean ± standard deviation. In the comparisons between groups, the t-test was used for normally distributed data, and the Wilcoxon signed rank test was used for non-parametric data by looking at the distribution of the data. Categorical data were compared with the χ^2 test. Pearson correlation test was used for correlation analysis. The significance level was accepted as $p < 0.05$.

Ethics committee approval

Ethical approval was taken from the University Clinical Research Ethics Committee for this study (Approval letter number: 2021/578, Date of approval: 02/06/2021).

RESULTS

In total, 209 patients who were hospitalized in the palliative care service between May 2019 and May 2021 were included in the study. 57.4% of the patients were male, 44.9% were ≥ 81 years old, and 89.0% were married. Concomitant chronic neurological disease was present in 71.3% of the patients, and oral intake disorder was the reason for hospitalization in the palliative care service in 61.7%. Hospitalization of 53.6% of the patients was done in the family medicine clinic. The average length of stay in the service was 22.4 ±22.1 days. While 78.0% of the patients in the palliative service were discharged alive, 22.0% died (Table 1).

When the blood parameters of the patients who were discharged alive from the palliative service and those who died were compared, there was no differ-

Table 1. Demographic characteristics of the patients

Parameters	Participants, *n* (%)
Gender	
Female	88 (41.6)
Male	121 (57.4)
Age groups [year], mean ±SD (min–max)	75.8 ±12.0
≤ 50	11 (5.3)
51–60	13 (6.3)
61–70	32 (15.5)
71–80	59 (28.0)
≥ 81	94 (44.9)
Marital status	
Single	23 (11.0)
Married	186 (89.0)
Units that admit patients to the palliative service	
Emergency	56 (26.7)
Other services	14 (6.7)
Intensive care	25 (12.0)
Policlinic	114 (53.6)
Length of stay in the service [days]	22.4 ±22.1
Chronic disease	
Chronic lung disease	88 (42.1)
Diabetes mellitus	54 (25.8)
Cardiovascular diseases	103 (49.3)
Chronic renal disease	138 (66.0)
Chronic neurological disease	149 (71.3)
Reason for hospitalization	
Malignancy	52 (24.9)
Decubitus ulcer	97 (46.4)
Oral intake disorder	129 (61.7)
Mortality status of patients	
Discharged alive	165 (78.0)
Died	44 (22.0)
Total	209 (100)

Table 2. Comparison of blood test values of patients discharged alive and those who died

Parameters	Total	Discharged alive mean ±SD	Died mean ±SD	p
Haemoglobin [g/dl]	13.10 ±14.67	12.57 ±11.75	15.15 ±22.88	0.311
WBC [10^3/mm^3]	10.53 ±6.62	10.38 ±6.53	11.11 ±7.05	0.525
Lymphocytes [10^3/mm^3]	1.76 ±3.94	1.91 ±4.97	1.16 ±0.90	0.275
Platelets [10^3/mm^3]	268.82 ±126.19	273.76 ±122.55	249.40 ±139.50	0.265
MPV [fl]	10.08 ±1.27	10.04 ±1.23	10.23 ±1.44	0.370
CRP	64.23 ±50.92	59.91 ±50.92	81.18 ±47.84	0.015
BUN	91.36 ±61.22	80.39 ±55.73	134.49 ±63.38	< 0.001
Creatinine	1.15 ±0.77	1.12 ±0.75	1.30 ±0.85	0.177
Albumin	3.42 ±2.46	3.65 ±2.70	2.53 ±0.49	0.008
BCR	45.52 ±31.34	40.93 ±29.28	63.55 ±32.97	< 0.001
BAR	24.50 ±34.49	20.41 ±31.26	40.59 ±41.64	0.001

BAR – albumin ratio, BCR – creatinine ratio, BUN – blood urea nitrogen, CRP – C-reactive protein, p-value – t-test, paired samples test, MPV – mean platelet volume, SD – standard deviation, WBC – white blood cells

ence between the haemoglobin, leukocyte, lymphocyte, platelet, mean platelet volume, or creatinine values, whereas CRP ($p = 0.015$), BUN ($p < 0.001$), BCR ($p < 0.001$), and BAR ($p = 0.001$) values were high and albumin ($p = 0.008$) values were low in the patients who died (Table 2).

When the BCR and BAR values of the patients were compared according to their chronic diseases and hospitalization indications, it was observed that the BCR values were statistically significantly higher in those with diabetes mellitus (DM) compared to those without. BCR ($p = 0.013$) and BAR ($p = 0.035$) values were found to be statistically significantly higher in patients with cardiovascular system (CVS) disease compared to those without CVS disease (Table 3).

A positive correlation was found between BCR and BAR levels in patients in the palliative service ($r = 0.316$, $p \leq 0.001$). It was determined that as the BAR and BCR levels increased, the length of stay in the service, BUN, creatinine, and CRP levels also increased, and the albumin levels decreased as the BAR and BCR levels increased (Table 4).

DISCUSSION

In our study we found a positive correlation between BCR and BAR levels in patients in the palliative service. As their BAR and BCR levels increased, the length of stay in the service, BUN, creatinine, and CRP levels increased but albumin levels decreased, and the BUN, BCR, and BAR levels of patients who died in the palliative service were higher and the albumin levels were lower compared to those who were discharged alive.

BCR and BAR parameters have been associated with the severity and prognosis of chronic diseases in many recent studies [27–30].

It has been reported that the combined use of the BUN/creatinine ratio is more beneficial than the use of both tests alone in differentiating renal azotaemia from prerenal and postrenal azotaemia [31]. BCR increases in prerenal azotaemia such as heart failure, dehydration, blood loss, and shock, and obstructive uropathies such as kidney stones, benign prostatic hypertrophy, and postrenal azotaemia. It decreases in chronic renal failure, long-term dialysis applications, low protein intake, insufficient urea synthesis due to severe liver failure, in cases where urea levels decrease, in conditions that increase muscle breakdown and therefore creatinine synthesis occurs, such as rhabdomyolysis, and in the syndrome of inappropriate antidiuretic hormone secretion that increases urea secretion [31, 32].

Matsue *et al*. found in their study, comparing BCR levels in patients with acute heart failure to those in the general population, that higher than normal range of BCR is associated with poor prognosis and high mortality, independently of both BUN and creatinine, and that this provides additional prognostic information on pre-existing prognostic factors including BCR, creatinine, and BUN [30].

In the study by Rachoin *et al*., it was reported that the prevalence of DM, CV disease, and chronic obstructive pulmonary disease is higher in critically ill patients in the intensive care unit, and that there is a correlation between various underlying chronic conditions and high levels of BCR (> 20). It was found that the use of vasopressors and mechanical ventilation was more common in patients with BCR > 20, and these patients had higher mean

BUN when admitted to the intensive care unit. In the same study, a significant correlation was shown between BUN and APACHE II score [27]. Similarly, in our study, when the BCR and BAR values of the patients in the palliative service were compared according to their chronic disease, it was found that the BCR value was significantly higher in all patients with a BCR > 20 than in those with DM, those with CVS disease, and those without CVS.

In a study by Feinfeld *et al*. evaluating BCR in intensive care patients, the mortality rate was found to be 58% in the critically ill group with very high BUN (mean BCR 36) values, high protein catabolism, and low muscle mass [33]. In the study of Rachoin *et al*., BCR > 20 in critically ill patients in the intensive care unit was associated with increased mortality rates [27]. In our study, the mean BCR values of the entire study group were high (BCR: 45.52), and the mean BCR was found to be significantly higher in the deceased (BCR: 63.55) than in the survivors (BCR: 40.93).

In our study, a positive correlation was found between BAR, length of hospital stay, and mortality. In a retrospective multicentre study by Akyil *et al*., conducted by P.P. in Turkey with patients diagnosed with community-acquired pneumonia, short-term mortality was found to be 9.2% in 785 patients, and it was reported that high BAR rates were associated with 30-day mortality [28].

In the study of Dundar *et al*., the risk of in-hospital mortality was found to be higher in elderly patients with a BUN level > 23 mg/dl, albumin level < 3.5 g/dl, and BAR > 6.25 mg/g in the emergency department. In addition, it was reported that BAR is a superior and independent predictor of in-hospital mortality compared to BUN, albumin, creatinine levels, and eGFR in elderly patients [3].

Again, Bae *et al*. reported that BAR is an important predictor of in-hospital mortality and intensive care unit admission in their study comparing inferior vena cava diameter ratio, BCR, and BAR for risk estimation in emergency room patients [10].

Küçükceran *et al*. studied the role of BAR in predicting mortality in COVID-19 patients in the emer-

Table 3. Creatinine ratio and albumin ratio values according to chronic diseases and hospitalization diagnosis

Parameters	BCR, mean ±SD	BAR, mean ±SD
Diabetes mellitus		
Yes	52.78 ±40.73	26.75 ±40.61
No	42.96 ±26.97	23.71 ±32.16
p	0.048	0.579
Chronic renal disease		
Yes	46.38 ±33.27	27.17 ±40.91
No	43.81 ±27.20	19.16 ±13.66
p	0.580	0.115
Cardiovascular disease		
Yes	50.96 ±36.57	29.57 ±43.06
No	40.13 ±24.10	19.48 ±22.17
p	0.013	0.035
Neurological disease		
Yes	44.24 ±30.71	24.40 ±34.93
No	48.80 ±32.95	24.75 ±33.63
p	0.349	0.949
Malignancy		
Yes	46.54 ±29.17	25.54 ±28.00
No	45.18 ±32.11	24.15 ±36.48
p	0.787	0.802
Pulmonary disease		
Yes	45.63 ±31.25	23.00 ±32.31
No	45.44 ±31.53	25.61 ±36.10
p	0.965	0.592
Decubitus ulcer		
Yes	46.94 ±30.28	23.53 ±31.31
No	44.27 ±32.33	25.36 ±37.18
p	0.541	0.705
Oral intake disorder		
Yes	47.77 ±32.65	25.84 ±34.51
No	41.81 ±28.85	22.29 ±34.55
p	0.186	0.474
Total	45.52 ±31.34	24.50 ±34.49

BAR – albumin ratio, BCR – creatinine ratio, p-value – t-test, paired samples test, SD – standard deviation

Table 4. Correlation analysis of the change in blood parameters of patients

Parameters	BCR		BAR	
	r^1	p^1	r^2	p^2
Age	0.097	0.165	–0.039	0.578
Length of stay	0.419	< 0.001	0.157	0.024
BUN	0.208	0.003	0.603	< 0.001
Albumin	–0.253	< 0.001	–0.225	0.001
Creatinine	–0.358	< 0.001	0.379	< 0.001
CRP	0.229	0.001	0.359	< 0.001
BCR	–	–	0.316	< 0.001
BAR	0.316	< 0.001	–	–

BAR – albumin ratio, BCR – creatinine ratio, BUN – blood urea nitrogen, CRP – C-reactive protein, p-value – Pearson partial correlation test, r – correlation coefficient

gency department and reported that BAR levels have a reliable predictive value of in-hospital mortality, and that BAR is a more reliable predictor than BUN and albumin levels [29]. Similarly, in recent studies, it has been reported that BAR is an important indicator in the evaluation of mortality in many diseases such as pneumonia and gastrointestinal bleeding [24–26].

The strength of our study is that no study examining BAR or BCR rates in palliative care patients was found in the current literature. The limitation of our study is that it is retrospective.

CONCLUSIONS

In this study, which aimed to evaluate the effect of BCR and BAR ratios on prognosis and mortality in patients in the palliative service, it was determined that there was a positive and significant correlation between BCR, and BAR and length of hospital stay and mortality. BCR and BAR, which are thought to be associated with dehydration and malnutrition, are useful and simple parameters that can also be used to predict hospital stay and mortality.

The authors declare no conflict of interest.

REFERENCES

1. Set T, Şahin EM. Birinci basamak hekimi için böbrek fonksiyon testleri. Sürekli Tıp Eğitimi Dergisi 2003; 12: 344.
2. Dalcomune DM, Terrão J, Porto ML, Vasquez EC, Baldo MP, Pereira TM. Predictive value of cystatin C for the identification of illness severity in adult patients in a mixed intensive care unit. Clin Biochem 2016; 49: 762-767.
3. Dundar ZD, Küçükceran K, Ayranci MK. Blood urea nitrogen to albumin ratio is a predictor of in-hospital mortality in older emergency department patients. Am J Emerg Med 2020; 46: 349-354.
4. Metersky ML, Waterer G, Nsa W, Bratzler DW. Predictors of in-hospital vs. postdischarge mortality in pneumonia. Chest 2012; 142: 476-481.
5. Shorr AF, Sun X, Johannes RS, Yaitanes A, Tabak YP. Validation of a novel risk score for severity of illness in acute exacerbations of COPD. Chest 2011; 140: 1177-1183.
6. Faisst M, Wellner UF, Utzolino S, Hopt UT, Keck T. Elevated blood urea nitrogen is an independent risk factor of prolonged intensive care unit stay due to acute necrotizing pancreatitis. J Crit Care 2010; 25: 105-111.
7. Aronson D, Hammerman H, Beyar R, et al. Serum blood urea nitrogen and long-term mortality in acute ST-elevation myocardial infarction. Int J Cardiol 2008; 127: 380-385.
8. Aronson D, Mittleman MA, Burger AJ. Elevated blood urea nitrogen level as a predictor of mortality in patients admitted for decompensated heart failure. Am J Med 2004; 116: 466-473.
9. Liu Z, Meng Z, Li Y, et al. Prognostic accuracy of the serum lactate level, the SOFA score and the qSOFA score for mortality among adults with Sepsis. Scand J Trauma Resusc Emerg Med 2019; 27: 1-10.
10. Bae SJ, Lee SH, Yun SJ, Kim K. Comparison of IVC diameter ratio, BUN/creatinine ratio and BUN/albumin ratio for risk prediction in emergency department patients. American J Emerg Med 2021; 47: 198-204.
11. Deng L, Wang C, Qiu S, et al. Association between blood urea nitrogen-to-creatinine ratio and three-month outcome in patients with acute ischemic stroke. Curr Neurovasc Res 2019; 16: 166-172.
12. Wu KH, Shih HA, Hung MS, Hsiao CT, Chen YC. The association between blood urea nitrogen to creatinine ratio and mortality in patients with upper gastrointestinal bleeding. Arab J Gastroenterol 2018; 19: 143-147.
13. Qian H, Tang C, Yan G. Predictive value of blood urea nitrogen/creatinine ratio in the long-term prognosis of patients with acute myocardial infarction complicated with acute heart failure. Medicine 2019; 98: e14845.
14. Li CY, Zhang XC, Zheng X, et al. Effect of admission blood urea and creatinine levels on mortality in elderly patients with hip fracture. Zhongguo Gu Shang 2017; 30: 901-905.
15. Nicholson J, Wolmarans M, Park G. The role of albumin in critical illness. Br J Anaesth 2000; 85: 599-610.
16. Vincent JL, Russell JA, Jacob M, et al. Albumin administration in the acutely ill: what is new and where next? Crit Care 2014; 18: 1-10.
17. Ronit A, Kirkegaard-Klitbo DM, Dohlmann TL, et al. Plasma albumin and incident cardiovascular disease: results from the CGPS and an updated meta-analysis. Arterioscler Thromb Vasc Biol 2020; 40: 473-482.
18. Abdelhafiz AH, Sinclair AJ. Tailor treatment in the older patient with type 2 diabetes. Practitioner 2013; 257: 21-26.
19. Zhang Z, Pereira SL, Luo M, Matheson EM. Evaluation of blood biomarkers associated with risk of malnutrition in older adults: a systematic review and meta-analysis. Nutrients 2017; 9: 829.
20. Wu CY, Hu HY, Huang N, Chou YC, Li CP, Chou YJ. Albumin levels and cause-specific mortality in community-dwelling older adults. Preven Med 2018; 112: 145-151.
21. Kim H, Jo S, Lee JB, et al. Diagnostic performance of initial serum albumin level for predicting in-hospital mortality among aspiration pneumonia patients. Am J Emerg Med 2018; 36: 5-11.
22. González-Pacheco H, Amezcua-Guerra LM, Sandoval J, et al. Prognostic implications of serum albumin levels in patients with acute coronary syndromes. Am J Cardiol 2017; 119: 951-958.
23. Jellinge ME, Henriksen DP, Hallas P, Brabrand M. Hypoalbuminemia is a strong predictor of 30-day all-cause mortality in acutely admitted medical patients: a prospective, observational, cohort study. PloS One 2014; 9: e105983.
24. Ryu S, Kwang Oh S, Cho SU, et al. Utility of the blood urea nitrogen to serum albumin ratio as a prognostic factor of mortality in aspiration pneumonia patients. Am J Emerg Med 2021; 43: 175-179.
25. Feng DY, Zhou YQ, Zou XL, et al. Elevated blood urea nitrogen-to--serum albumin ratio as a factor that negatively affects the mortality of patients with hospital-acquired pneumonia. Can J Infect Dis Med Microbiol 2019; 2019: 1547405.
26. Bae SJ, Kim K, Yun SJ, Lee SH. Predictive performance of blood urea nitrogen to serum albumin ratio in elderly patients with gastrointestinal bleeding. Am J Emerg Med 2021; 41: 152-157.
27. Rachoin JS, Daher R, Moussallem C, et al. The fallacy of the BUN: creatinine ratio in critically ill patients. Nephrol Dial Transplant 2012; 27: 2248-2254.
28. Akyil FT, Yalcinsoy M, Hazar A, et al. Prognosis of hospitalized patients with community-acquired pneumonia. Pulmonology 2018; 24: 164-169.
29. Küçükceran K, Ayrancı MK, Girişgin AS, Koçak S, Dündar ZD. The role of the BUN/albumin ratio in predicting mortality in COVID-19 patients in the emergency department. Am J Emerg Med 2021; 48: 33-37.
30. Matsue Y, van der Meer P, Damman K, et al. Blood urea nitrogen--to-creatinine ratio in the general population and in patients with acute heart failure. Heart 2017; 103: 407-413.
31. Duman C, Erden F. Birinci basamak sağlık hizmetlerine yönelik biyokimyasal laboratuvar verilerinin kısa yorumu. Sürekli Tıp Eğitimi Dergisi 2004; 13: 256-262.
32. Wallach JB. Interpretation of diagnostic tests. Lippincott Williams & Wilkins, Filadelphia 2007.
33. Feinfeld DA, Bargouthi H, Niaz Q, Carvounis CP. Massive and disproportionate elevation of blood urea nitrogen in acute azotemia. Int Urol Nephrol 2002; 34: 143-145.