

# Blood urea nitrogen-to-albumin ratio as a predictor of mortality in patients undergoing emergency surgery for obstructive colon cancer

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## ABSTRACT

**BACKGROUND:** Mortality rates are high in patients undergoing emergency surgery for obstructed colon adenocarcinoma. The etiology of mortality is multifactorial, and parameters with high predictive value are still needed. The aim of this study was to investigate the relationship between the blood urea nitrogen-to-serum albumin ratio (BAR) and short-term mortality in patients with obstructed colon cancer undergoing emergency surgery.

**METHODS:** This retrospective cohort study included patients with obstructed colon adenocarcinoma who underwent emergency surgery at two tertiary care centers between January 2015 and December 2024. Baseline characteristics, laboratory findings, operative details, and clinical data were collected. According to time-dependent receiver operating characteristics (ROC) analysis, the optimal cut-off value for pretreatment BAR was 0.68. Data from patients who died within the first 30 days and those who survived were compared. Univariate and multivariate Cox regression analyses were performed to evaluate the association between BAR and other factors with early mortality.

**RESULTS:** A total of 173 patients underwent emergency surgery, and 17 (9.8%) experienced early mortality. In multivariate logistic regression analysis, age ( $\geq 75$  years), lactate level, neutrophil count, and  $\text{BAR} \geq 0.68$  (odds ratio: 7.053; 95% confidence interval: 1.728-28.785;  $p=0.006$ ) were identified as significant risk factors for early mortality in patients undergoing emergency surgery for obstructed colon cancer.

**CONCLUSION:** Mortality in patients undergoing emergency surgery for obstructed colon cancer is high and multifactorial. BAR is a cost-effective, easily measurable, and useful predictor of early mortality.

**Keywords:** Blood urea nitrogen-to-serum albumin ratio; colon cancer; mortality; obstruction.

## INTRODUCTION

In Asia, colorectal cancer (CRC) ranks as the third most frequently diagnosed malignancy, with approximately one million new cases annually, and is as the fourth leading cause of can-

cer-related mortality.<sup>[1]</sup> Approximately 20% of colorectal cancer cases require emergency intervention due to colonic obstruction.<sup>[2]</sup> Most studies have identified emergency surgery as an independent risk factor for early mortality compared with elective surgery. Postoperative mortality and morbidity

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rates in patients with obstructed colon cancer (OCC) are reported to be 8%-15% and 40%, respectively. High morbidity and mortality rates are associated with advanced disease stage, ischemia, perforation, renal failure, advanced age, fluid-electrolyte imbalance, sepsis, and comorbidities.<sup>[3-8]</sup> Serum albumin concentration is a key marker of nutritional status. The systemic inflammatory response caused by the tumor, together with decreased oral intake due to obstruction, can lead to a progressive decline in albumin levels. Low serum albumin levels markedly prolong hospitalization and increase complication rates, particularly the risk of surgical site infections, enterocutaneous fistulas, and deep vein thrombosis.<sup>[9-11]</sup> Furthermore, a significant proportion of patients with advanced colon cancer present with malnutrition and hypoalbuminemia, which significantly increase mortality in those undergoing major emergency surgery.<sup>[12]</sup> Blood urea nitrogen (BUN), a product of protein metabolism, is an important indicator of renal function as well as metabolic and nutritional status, and has been associated with mortality.<sup>[13-15]</sup> Emerging evidence suggests that an elevated blood urea nitrogen-to-albumin ratio (BAR) is a strong prognostic marker of mortality in various clinical conditions, including upper gastrointestinal bleeding, chronic obstructive pulmonary disease, sepsis, lung cancer, pneumonia, coronavirus disease 2019 (COVID-19), and other critical illnesses.<sup>[13,16-21]</sup> However, the prognostic role of BAR in predicting early mortality among patients undergoing emergency surgery for OCC has not yet been evaluated. Therefore, the present study aimed to assess the prognostic significance of BAR in predicting mortality in patients with OCC who underwent emergency surgical intervention.

## MATERIALS AND METHODS

### Study Design and Population

This retrospective cohort study included patients who underwent emergency surgery for OCC at two tertiary care research hospitals. Patients who underwent surgery between January 2015 and December 2024 and had complete electronic medical records were included in the analysis. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of Dicle University Faculty of Medicine (Approval No: 2025-245). All patient data were anonymized to ensure confidentiality.

Adult patients who underwent surgery within 24 hours of emergency admission for colonic obstruction and had a pathological diagnosis of adenocarcinoma were included. Acute colonic obstruction was confirmed both clinically (obstipation, abdominal distension, nausea, and vomiting) and radiologically (abdominopelvic computed tomography scan with or without contrast). Patients who underwent colectomy for non-adenocarcinoma etiologies, those with rectum-localized obstruction, those treated with bridge therapy using endoscopic stenting, and those managed with medical treatment alone were excluded. In addition, patients with chronic kid-

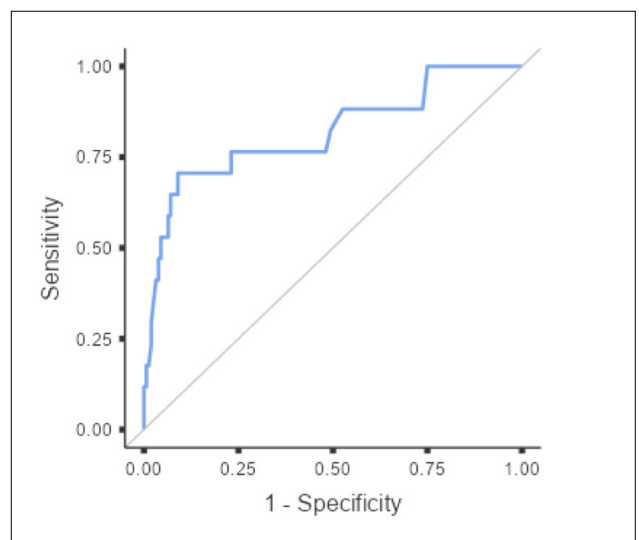
ney disease, protein-losing nephropathy, or chronic liver disease were excluded.

### Data Collection and Outcome Measurement

The following data were collected: demographic characteristics (age, sex, comorbidities, Eastern Cooperative Oncology Group Performance Status [ECOG PS]), symptom duration (days), tumor localization (tumors located in the colon from the cecum to the splenic flexure were defined as proximal, whereas tumors located from the distal splenic flexure to the proximal rectum were defined as distal), intraoperative findings (perforation, presence of metastasis), and surgical details (palliative or curative intent, duration of surgery, etc.). Laboratory parameters recorded at the time of emergency admission included white blood cell count, hemoglobin level, neutrophil count, lactate level, BUN, albumin, creatinine, lactate dehydrogenase (LDH), and C-reactive protein. Time-dependent receiver operating characteristic (ROC) curve analysis for mortality prediction identified 0.68 as the optimal pretreatment BAR threshold, corresponding to a sensitivity of 76.5% and a specificity of 76.9% (area under the curve [AUC]=0.817;  $p<0.001$ ) (Fig. 1). The predictive cut-off value for mortality for the LDH/albumin ratio was determined to be 5.27.<sup>[10]</sup> To identify factors associated with hospital mortality following emergency surgery, patients were divided into two groups: those who died and those who survived.

### Statistical Analysis

Statistical analyses were performed using jamovi version 2.6 (The jamovi Project, 2025) available at <https://www.jamovi.org>. Baseline clinical characteristics were analyzed by categorizing patients into early mortality and survival groups. Continuous variables are presented as mean  $\pm$  standard deviation (SD) or median (range), as appropriate, and categorical vari-



**Figure 1.** Determination of the optimal cutoff value of the blood urea nitrogen-to-albumin ratio (BAR). The cutoff value was 0.68, yielding a sensitivity of 76.5% and a specificity of 76.9% (area under the receiver operating characteristics curve: 0.817;  $p=0.001$ ).

ables as frequencies and percentages. The Shapiro-Wilk test was used to assess normality of numerical data. The Mann-Whitney U test was applied for comparisons of continuous variables, while categorical variables were analyzed using the chi-square test. Subsequently, univariate and multivariate Cox regression analyses were performed to evaluate the association between BAR and short-term mortality in patients with OCC. A two-tailed p value <0.05 was considered statistically significant.

## RESULTS

### Study Population and Baseline Characteristics

During the 10-year study period, 173 patients underwent emergency surgery for OCC at two tertiary hospitals. The demographic characteristics, operative findings, and clinical outcomes of the patients are presented in Table 1. The median age of the cohort was 61 years (range: 23-96), and 96 patients (55.5%) were male. Seventeen patients (9.8%) expe-

**Table 1.** Comparison of demographic, clinical, and operative variables between patient groups

Variable	Survivors (n=156)	Non-Survivors (n=17)	Total (n=173)	p-value
Age, years*	60.5 (23-96)	75 (34-89)	61 (23-96)	0.004
Age <75	121 (77.6)	7 (41.2)	128 (74.0)	
Age ≥75	35 (22.4)	10 (58.8)	45 (26.0)	0.003
Sex, n (%)				
Female	66 (42.3)	11 (64.7)	77 (45.5)	0.132
Male	90 (57.7)	6 (35.3)	96 (55.5)	
Comorbidities, n (%)				
Diabetes mellitus	36 (23.1)	3 (17.6)	39 (22.5)	0.766
Coronary artery disease	16 (10.3)	5 (29.4)	5 (29.4)	0.038
Hypertension	46 (29.5)	8 (47.1)	54 (31.2)	0.227
Pulmonary disease	10 (6.4)	2 (11.8)	12 (6.9)	0.334
Heart failure	4 (2.6)	3 (17.6)	7 (4.0)	0.022
ECOG PS, n (%)				
0-1	78 (50.0)	4 (23.5)	82 (47.4)	0.069
≥2	78 (50.0)	13 (76.5)	91 (52.6)	
Duration of symptoms, days				
<3	101 (64.7)	15 (88.2)	116 (67.1)	0.092
≥3	55 (35.3)	2 (11.8)	57 (32.9)	
Tumor location, n (%)				
Proximal colon	48 (30.8)	3 (17.6)	51 (29.5)	0.397
Distal colon	108 (69.2)	14 (82.4)	122 (70.5)	
Perforation, n (%)	15 (9.6)	5 (29.5)	20 (11.6)	0.031
Synchronous liver metastasis, n (%)	25 (16.0)	6 (35.3)	31 (17.9)	0.087
Synchronous peritoneal metastasis, n (%)	8 (5.1)	1 (5.9)	9 (5.2)	1.000
Synchronous lung metastasis, n (%)	3 (1.9)	0 (0.0)	3 (1.7)	1.000
Curative surgery, n (%)	133 (85.3)	10 (58.8)	143 (82.7)	0.013
Surgical procedures, n (%)				
Right/extended right colectomy	37 (23.7)	2 (11.8)	39 (22.5)	0.534
Left/sigmoid colectomy	80 (51.3)	10 (58.8)	90 (52.0)	
Total/subtotal colectomy	39 (25.0)	5 (29.4)	44 (25.4)	
Stoma creation, n (%)	107 (68.6)	16 (94.1)	123 (71.1)	0.026
Blood transfusion, n (%)	25 (16.0)	5 (29.4)	30 (17.3)	0.180
Operative time (minutes, mean±SD)	145.8±51.0	149.4±65.5	146.1±52.4	
Operative time, minutes*	135 (60-310)	135 (80-330)	135 (60-330)	0.868
Anastomotic leak, n (%)	2 (1.3)	1 (5.9)	3 (1.7)	0.268
Relaparotomy, n (%)	2 (1.3)	1 (5.9)	3 (1.7)	0.268

ECOG PS: Eastern Cooperative Oncology Group Performance Status; SD: Standard deviation. \*Median (range).

rienced early mortality. Patients in the non-mortality group were younger, with a median age of 61 years (range: 23-96) ( $p=0.004$ ). Synchronous liver metastasis was the most common metastatic site in both the mortality group (six patients, 35.3%) and the non-mortality group (25 patients, 16.0%). Intestinal perforation detected during surgical exploration was more frequent in the mortality group (29.5%) ( $p=0.031$ ). Curative surgery with R0 resection was performed in 10 patients (58.8%) in the mortality group and in 133 patients (85.3%) in the non-mortality group, with a statistically significant difference ( $p=0.013$ ). Sex, comorbidities, performance status, symptom duration, tumor localization, type of surgical procedure, stoma formation, and operative time were similar between the two groups (Table 1).

In the mortality (+) group, BUN, LDH, and lactate levels were higher, whereas albumin levels were significantly lower compared to the non-mortality group (Table 2). Consistent with these findings, both the BAR and LDH/albumin ratios were markedly elevated in the mortality group ( $p<0.001$ ). The proportion of patients with BAR  $\geq 0.68$  was 76.5% in the mortality group and 23.1% in the non-mortality group, and the difference was statistically significant ( $p=0.003$ ).

#### Factors Associated with Mortality

In univariate logistic regression analysis, age ( $\geq 75$  years),

ECOG PS  $\geq 2$ , perforation, elevated lactate, neutrophilia, and BAR  $\geq 0.68$  were identified as significant risk factors for early mortality. Multivariate logistic regression analysis was performed including these significant variables (Table 3). In multivariate logistic regression analysis, age ( $\geq 75$  years), lactate level, neutrophil count, and BAR  $\geq 0.68$  (odds ratio [OR]: 7.053; 95% confidence interval [CI]: 1.728-28.785;  $p=0.006$ ) were identified as significant risk factors for early mortality in patients with OCC undergoing emergency surgery.

## DISCUSSION

Despite screening colonoscopy programs, the rate for emergency surgery for OCC is still approximately 15%-20%. In this clinical setting, two major problems stand out for clinicians: i) the high morbidity and mortality associated with emergency surgery and ii) planning the optimal oncologic treatment. Adverse clinical outcomes are common in patients presenting with OCC due to advanced age, fluid-electrolyte imbalance, advanced disease stage, perforation, and frequently accompanying comorbidities.<sup>[2,4,6,22]</sup> In this study, we investigated the impact of an elevated BAR on mortality in patients with OCC undergoing emergency surgery. Our findings demonstrated that a preoperative BAR value above 0.68 is associated with increased mortality. To our knowledge, this is the first study to evaluate the association between BAR and early mortal-

**Table 2.** Comparison of initial admission laboratory parameters between survivors group and non-survivors

Variable	Survivors (n=156)	Non-Survivors (n=17)	Total (n=173)	p-value
White blood cell count ( $10^9/L$ )	10.5 $\pm$ 4.42	12.9 $\pm$ 7.28	10.8 $\pm$ 4.80	0.322
Hemoglobin (g/dL)	12.0 $\pm$ 2.50	11.4 $\pm$ 2.29	11.9 $\pm$ 2.48	0.380
Platelet count ( $10^9/L$ )	319.4 $\pm$ 116.3	351.1 $\pm$ 192.4	322.5 $\pm$ 125.4	0.984
Neutrophil count ( $10^9/L$ )	8.16 $\pm$ 4.24	10.7 $\pm$ 6.93	8.42 $\pm$ 4.62	0.214
Lymphocyte count ( $10^9/L$ )	1.58 $\pm$ 1.17	1.33 $\pm$ 0.87	1.55 $\pm$ 1.14	0.168
C-reactive protein (mg/L)	46.1 $\pm$ 64.3	71.8 $\pm$ 102.1	48.7 $\pm$ 69.0	0.949
Blood urea nitrogen (mg/dL)	17.5 $\pm$ 9.35	29.7 $\pm$ 17.0	18.7 $\pm$ 10.9	0.001
Creatinine (mg/dL)	0.91 $\pm$ 0.62	1.11 $\pm$ 0.70	0.93 $\pm$ 0.63	0.297
Albumin (g/L)	33.0 $\pm$ 7.79	23.5 $\pm$ 7.78	32.1 $\pm$ 8.27	<0.001
LDH (U/L)	231.2 $\pm$ 96.8	328.4 $\pm$ 202.5	240.7 $\pm$ 114.5	0.028
BUN-to-albumin ratio	0.55 $\pm$ 0.34	1.42 $\pm$ 0.97	0.64 $\pm$ 0.51	<0.001
LDH-to-albumin ratio	7.40 $\pm$ 4.11	15.0 $\pm$ 10.3	8.15 $\pm$ 5.52	<0.001
Lactate level (mmol/L)	1.47 $\pm$ 0.65	2.23 $\pm$ 1.11	1.54 $\pm$ 0.74	0.003
BUN-to-albumin ratio				
<0.68	120 (76.9)	4 (23.5)	124 (71.7)	0.003
$\geq 0.68$	36 (23.1)	13 (76.5)	49 (28.3)	
LDH-to-albumin ratio				
<5.27	42 (26.9)	1 (5.9)	43 (24.9)	0.075
$\geq 5.27$	114 (73.1)	16 (94.1)	130 (75.1)	

BUN: Blood urea nitrogen; LDH: Lactate dehydrogenase.

**Table 3.** Univariate and multivariate logistic regression analyses of mortality predictors

Variable	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age $\geq 75$ years	4.939 (1.752-13.925)	0.003	6.286 (1.303-30.326)	0.022
Male sex	0.400 (0.141-1.136)	0.085		
ECOG PS $\geq 2$	3.250 (1.015-10.406)	0.047		
Duration of symptoms $\geq 3$ days	0.245 (0.054-1.110)	0.068		
Perforation	3.917 (1.214-12.635)	0.022	2.892 (0.470-17.779)	0.252
Tumor location (distal colon)	2.074 (0.570-7.553)	0.269		
Operative time, minutes	1.001 (0.992-1.011)	0.787		
Blood transfusion	2.183 (0.707-6.742)	0.175		
Lactate level (mmol/L)	2.721 (1.558-4.752)	<0.001	3.999 (1.698-9.421)	0.002
White blood cell count ( $10^9/L$ )	1.097 (0.999-1.204)	0.053		
Neutrophil count ( $10^9/L$ )	1.109 (1.009-1.219)	0.032	1.141 (1.014-1.283)	0.028
C-reactive protein (mg/dL)	1.004 (0.998-1.010)	0.154		
BUN-to-albumin ratio ( $\geq 0.68$ )	10.833 (3.326-35.288)	<0.001	7.053 (1.728-28.785)	0.006
LDH-to-albumin ratio ( $\geq 5.27$ )	5.895 (0.758-45.837)	0.090		
Anastomotic leak	4.813 (0.413-56.051)	0.210		

BUN: Blood urea nitrogen; CI: Confidence interval; ECOG PS: Eastern Cooperative Oncology Group Performance Status; LDH: Lactate dehydrogenase; OR: Odds ratio.

ity in colon cancer patients undergoing emergency surgery for obstruction. Additionally, we found that age  $\geq 75$  years, elevated lactate levels, and increased neutrophil counts were associated with early mortality.

Blood urea nitrogen levels are routinely used in clinical practice because of the ease of measurement as a serum biomarker for assessing renal function. In critically ill patients, particularly those with multiple organ failure and sepsis, renal dysfunction is one of the earliest deteriorating parameters, and elevated BUN levels have been associated with poor clinical outcomes.<sup>[19,23]</sup> In patients with obstruction, vomiting, reduced oral intake, dehydration, and sepsis secondary to intestinal perforation or ischemia may impair renal function, resulting in increased BUN levels. Previous studies have demonstrated an association between BUN and prognosis or mortality in conditions such as aortic dissection, renal failure, patients undergoing hemodialysis, *Escherichia coli* bacteremia, lung cancer, and peripheral arterial disease.<sup>[13,21,24-27]</sup>

Albumin is the principal plasma protein and plays a key role in the distribution of body fluids and maintenance of acid-base balance. It also facilitates the transport of substances such as hormones, bilirubin, and lipids in the blood and helps regulate the inflammatory process.<sup>[28]</sup> Preoperative hypoalbuminemia, indicating malnutrition, is recognized as being linked to poor outcomes after gastrointestinal surgery. In colorectal surgery patients, hypoalbuminemia significantly increases complications and is considered a predictor of mortality.<sup>[12]</sup> If there is

a serious nutritional risk due to hypoalbuminemia, it is recommended to postpone surgery and administer preoperative nutritional therapy enterally for 10-14 days before surgery, if possible, or parenterally if the enteral route is not adequate.<sup>[29]</sup> Unfortunately, it is not possible to treat malnutrition in patients undergoing emergency surgery with OCC.

When analyzed in this context, an elevated BAR reflects increased BUN levels combined with reduced albumin concentrations. It has been suggested that a high BAR level may serve as a new prognostic marker for different categories of critically ill patients. Bae et al.<sup>[15]</sup> examined 914 nontraumatic patients admitted emergently and found that BAR was a predictor of mortality. In another study examining an elderly patient population that included over 1,000 patients, BAR was similarly identified as a powerful predictor of mortality.<sup>[16]</sup> In critically ill patients requiring intensive care follow-up due to gastrointestinal bleeding, BAR was found to be higher in the group that died.<sup>[18]</sup> A separate investigation involving 801 patients with sepsis reported a significant positive correlation between BAR levels and both Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores. High SOFA and APACHE II scores are recognized markers of greater disease severity and poorer prognosis.<sup>[19]</sup>

Undoubtedly, our study has some limitations. Its retrospective design and limited number of cases are the most important constraints and may have introduced selection bias.

Because BUN and albumin levels exhibit dynamic variability, supportive therapies may have influenced the results. Additionally, we did not perform external validation; therefore, caution should be exercised when generalizing these findings, and large-scale prospective studies are needed. However, we believe the study is valuable because it includes data from homogeneous patient groups across two centers.

## CONCLUSION

In conclusion, BAR at admission is an easily measurable biomarker and an independent predictor of early mortality in patients undergoing emergency surgery for obstructed colon cancer.

**Ethics Committee Approval:** This study was approved by the Clinical Research Ethics Committee of Dicle University Faculty of Medicine Ethics Committee (Date: 18.06.2025, Decision No: 2025–245).

**Peer-review:** Externally peer-reviewed.

**Authorship Contributions:** Concept: U.A., AA, H.Ö.; Design: U.A., A.A.; Supervision: E.G., E.Gü.; Resource: Ö.S.D., H.Ö.; Materials: U.A., A.A., Ö.S.D., H.Ö., E.G.; Data collection and/or processing: E.G., E.Gü., H.A.; Analysis and/or interpretation: H.A., U.A., A.A.; Literature review: U.A., A.A., H.Ö.; Writing: U.A., A.A., E.G.; Critical review: E.G., E.Gü., U.A.

**Conflict of Interest:** None declared.

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## ORIJİNAL ÇALIŞMA - ÖZ

### Tıkaçıcı kolon kanseri nedeniyle acil ameliyata alınan hastalarda mortaliteyi öngördüren bir faktör olarak kan üre azotu/albumin oranı

**AMAÇ:** Tıkalı kolon adenokarsinomunda acil cerrahiye başvuran hastalarda mortalite oranları yüksektir. Mortalitenin etiyojisi çok faktörlüdür ve yüksek prediktif değere sahip parametreler hala gereklidir. Bu çalışmanın amacı, acil cerrahiye başvuran tıkalı kolon kanseri hastalarında kan üre azotu/serum albumin oranı (BAR) ile kısa dönem mortalite arasındaki ilişkiyi araştırmaktır.

**GEREÇ VE YÖNTEM:** Bu çalışma, Ocak 2015 ile Aralık 2024 tarihleri arasında iki üçüncü basamak sağlık merkezinde acil cerrahi uygulanan tıkaçıcı kolon adenokarsinomu hastalarını kapsayan retrospektif bir kohort çalışmasıdır. Başlangıç özellikleri, laboratuvar, cerrahi ve klinik veriler elde edilmiştir. Zamana bağlı alıcı işletim karakteristikleri (ROC) analizine göre, tedavi öncesi BAR için optimal kesme değeri 0.68 olarak belirlenmiştir. İlk 30 gün içinde mortalite olan ve olmayan hastaların verileri karşılaştırılmıştır. BAR ile erken mortalite arasındaki ilişkiyi araştırmak için tek değişkenli ve çok değişkenli Cox regresyon analizi kullanılmıştır.

**BULGULAR:** Toplam 173 hasta acil cerrahiye alınmış ve 17'si (%9.8) erken mortaliteye gelişmiştir. Çok değişkenli lojistik regresyon analizinde, yaş ( $\geq 75$  yıl), laktat düzeyi, nötrofil sayısı ve  $BAR \geq 0.68$  (odds oranı, 7.053; %95 güven aralığı, 1,728-28,785;  $p=0.006$ ) tıkaçıcı kolon kanseri nedeniyle acil cerrahi geçiren hastalarda erken mortalite için önemli risk faktörleri olarak belirlendi.

**SONUÇ:** Acil cerrahi gerektiren tıkanmış kolon kanserinde mortalite yüksektir ve çok faktörlüdür. BAR, maliyet etkin, kolayca ölçülebilir ve erken mortalitenin öngörücüsü olarak yararlıdır.

**Anahtar sözcükler:** Kolon kanseri; tıkanma; kan üre azotu/serum albumin oranı; mortalite.

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