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Evaluation of Clinical and Laboratory Parameters for Hospitalization in Acute Parotitis: A ROC-Based Analysis

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Abstract

Introduction: Acute parotitis (AP) ranges from mild local inflammation to systemic complications. While some patients can be treated as outpatients, others require hospitalization and intravenous therapy. This study aimed to identify clinical and laboratory predictors of hospitalization and determine optimal cut-off values using receiver operating characteristic (ROC) curve analysis in patients presenting to the emergency department with AP.

Materials and Methods: This retrospective study included 62 patients diagnosed with AP between 2019 and 2025. Demographic characteristics, clinical findings (oral feeding intolerance, purulent discharge from Stensen's duct, and comorbidities), and laboratory parameters were evaluated. Logistic regression analysis was used to identify independent predictors of hospitalization, and ROC analysis was performed to determine discriminatory performance and optimal cut-off values.

Results: The mean age was 49.90±20.44 years, and 59.6% were female. Hospitalized patients were older and had higher WBC, neutrophil counts, CRP levels, and BUN/creatinine ratios, while lymphocyte counts were lower. Oral feeding intolerance and purulent discharge from Stensen's duct were more frequent among hospitalized patients. Multivariate analysis identified age (OR: 1.065, 95% CI: 1.018–1.114, p=0.006) and CRP (OR: 1.038, 95% CI: 1.006–1.071, p=0.021) as independent predictors of hospitalization. ROC analysis identified cut-off values of ≥61.5 years for age (AUC=0.843) and ≥22.95 mg/L for CRP (AUC=0.832). The combined model incorporating age and CRP showed good discriminatory performance (AUC=0.887).

Conclusion: Older age and elevated CRP levels were independently associated with hospitalization in patients with AP. ROC-derived cut-off values and the combined predictive model may support clinical decision-making in the emergency management of AP.

Key words: Parotitis; hospitalization; risk factors.

Introduction

The parotid gland is the largest of the major salivary glands and plays a crucial role in digestion, taste perception, and maintenance of oral hygiene through serous secretion production. Parotitis, defined as inflammation of the parotid gland, represents a clinical entity with diverse etiology that may arise from bacterial, viral, obstructive (sialolithiasis), autoimmune (Sjögren's syndrome), and metabolic causes (1). Reduced salivary flow, dehydration, malnutrition, and poor oral hygiene are recognized predisposing factors in the development of parotitis (2,3). Clinically, patients typically present with unilateral facial swelling exacerbated by eating, pain, erythema, trismus, and fever. Purulent discharge from the Stensen's duct orifice represents a valuable finding suggestive of infection (1). Parotitis cases presenting to emergency departments may exhibit a variable clinical spectrum ranging from mild local symptoms to airway compromise and systemic infection (4). While some cases of acute parotitis (AP) can be managed on an outpatient basis, certain patients may require intravenous therapy, fluid replacement, and close monitoring. Laboratory parameters such as BUN/creatinine ratio and CRP (C-Reactive Protein) have been reported to correlate with clinical course and length of hospital stay (5). Although several studies have investigated the clinical characteristics and outcomes of acute parotitis, objective parameters that may guide hospitalization decisions in the emergency department remain poorly defined (5–8). Currently, there are no universally accepted or standardized criteria for hospitalization in patients with acute parotitis. As a result, admission

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decisions are largely based on clinician judgment, taking into account clinical presentation, laboratory findings, and patient-related factors. In particular, no previous study has systematically evaluated the discriminatory performance of clinical and laboratory parameters using receiver operating characteristic (ROC) curve analysis to establish clinically applicable cut-off values for hospitalization risk stratification. This study aimed to identify independent clinical and laboratory predictors of hospitalization in patients presenting to the emergency department with acute parotitis and to determine clinically relevant cut-off values using ROC curve analysis.

Materials and Methods

In this retrospective study, patients diagnosed with acute parotitis between 2019 and 2025 at our institution were evaluated. A total of 62 adult patients were included. Individuals aged ≥18 years with clinically and/or radiologically confirmed acute parotitis were eligible for inclusion. Patients with chronic parotitis, tumoral lesions, sialolithiasis, autoimmune parotitis (Sjögren's syndrome), or incomplete medical records were excluded. Patients' demographic data (age, gender), clinical characteristics (oral feeding intolerance, presence of purulent discharge from Stensen's duct, comorbidity status, presence of diabetes mellitus), and hospitalization status were obtained from medical records. Laboratory parameters at the time of presentation were recorded for all patients. Hospitalization decisions were made based on clinical evaluation by an otolaryngology specialist in the emergency setting. As there are no standardized criteria for hospital admission in acute parotitis, decisions were individualized and based on a combination of clinical severity (e.g., pain, oral feeding intolerance), laboratory findings, signs of systemic infection, and patient comorbidities. Although predefined criteria were not formally standardized, commonly considered factors included elevated inflammatory markers, impaired oral intake, and clinical signs of systemic infection. Laboratory parameters included complete blood count (white blood cell count, neutrophils, lymphocytes, monocytes, platelets, and hematocrit) and biochemical measurements (amylase, lactate dehydrogenase, creatinine, aspartate aminotransferase, alanine aminotransferase, albumin, blood urea nitrogen, glucose, sodium, and CRP). In addition, the BUN/creatinine ratio and calculated serum osmolality ((2 × Na) + (glucose/18) + (BUN/2.8)) were determined for each patient. Based on treatment course, patients were categorized into two groups: outpatient management (n=43) and hospitalized patients (n=19).

Ethical approval: This study received approval from the Ethics Committee of Ankara City Hospital (Date: 19.11.2025, Decision No:1-25-1888) and was conducted in accordance with the Declaration of Helsinki.

Statistical analysis: SPSS version 31.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. The Shapiro-Wilk test was used to assess the variables' distribution. The Student's t-test was used to compare continuous variables having a normal distribution between groups. These variables were reported as mean ± standard deviation (SD). The Mann-Whitney U test was used for variables that did not have a normal distribution. Numbers and percentages were used to summarize categorical variables, and where necessary, the Chi-square test or Fisher's exact test were used to compare groups. Variables that were considered clinically relevant and those showing statistical significance in univariate analysis ($p < 0.05$) were selected as candidate predictors for multivariate logistic regression. Given the relatively small sample size and limited number of hospitalization events, the multivariate model included only a limited number of variables to avoid overfitting. Therefore, only a limited number of key variables representing different clinical domains (age, inflammatory markers, and dehydration parameters) were included in the final model. Odds ratios (OR) with 95% confidence intervals (CI) were presented as the outcomes of the logistic regression analysis. The discriminatory ability of significant predictors was evaluated using ROC curve analysis. ROC analyses were performed for age, CRP, BUN/creatinine ratio, and the combined predictive model (Age + CRP) derived from logistic regression. For every parameter, the area under the curve (AUC) and associated 95% confidence intervals were computed. The Youden Index (sensitivity + specificity − 1), which finds the threshold offering the optimal balance between sensitivity and specificity, was used to identify the ideal cut-off values. Statistical significance was defined as a p-value of less than 0.05.

Results

Sixty-two patients diagnosed with acute parotitis were evaluated. The cohort had a mean age of 49.90 ± 20.44 years, and females accounted for 59.6% (n=37) of the study population. Nineteen

Table 1: Demographic and Clinical Characteristics of Patients

		n (%)	Mean ± SD
Age, *year*		62 (100)	49.90 ± 20.44
Sex			
	Female	37 (59.6)	-
	Male	25 (40.4)	-
Hospitalization Status			
	Absent	43 (69.4)	-
	Present	19 (30.6)	-
Length of hospital stay, *day*		19 (30.6)	5.95 ± 2.36
Presence of diabetes mellitus			
	Absent	53 (85.4)	-
	Present	9 (14.6)	-
Oral feeding intolerance			
	Absent	49 (79)	-
	Present	13 (21)	-
Stensen's duct pus			
	Absent	54 (87.1)	-
	Present	8 (12.9)	-
Ultrasonography			
	Absent	5 (8)	-
	Present	57 (92)	-
Computed Tomography			
	Absent	50 (80.6)	-
	Present	12 (19.4)	-
Comorbidity			
	Absent	39 (62.9)	-
	Present	23 (37.1)	-

Table 2: Comparison of Laboratory Parameters According to Hospitalization Status

	Non-hospitalization Group (n=43)	Hospitalization Group (n=19)	
	Mean ± SD	Mean ± SD	p value
WBC, $\times 10^3/\mu L$	10.60 ± 3.86	13.25 ± 3.75	0.015
Neutrophil, $\times 10^3/\mu L$	7.67 ± 3.77	10.76 ± 3.93	0.005
Lymphocyte, $\times 10^3/\mu L$	2.05 ± 0.75	1.45 ± 0.56	0.003
Monocyte, $\times 10^3/\mu L$	0.55 ± 0.21	0.58 ± 0.15	0.524
Platelet, $\times 10^3/\mu L$	295.47 ± 86.14	287.79 ± 78.83	0.741
Amylase, *U/L*	376.72 ± 465.81	420.95 ± 316.26	0.072*
LDH, *U/L*	238.79 ± 38.62	253.42 ± 36.57	0.168
Creatinine, *mg/dL*	0.69 ± 0.17	0.72 ± 0.14	0.514
AST, *U/L*	22.21 ± 6.97	25.05 ± 7.32	0.150
ALT, *U/L*	21.60 ± 7.16	21.53 ± 7.94	0.969
Albumin, *g/L*	41.98 ± 3.17	40.00 ± 5.58	0.082
CRP, *mg/L*	12.07 ± 16.81	69.18 ± 64.58	< 0.001*
Serum Osmolality, *mOsm/kg*	287.43 ± 5.12	294.53 ± 12.76	0.056*
Hematocrit, *%*	41.12 ± 4.11	40.05 ± 7.03	0.454
Hemoglobin, g/dL	14.11 ± 1.71	13.85 ± 1.77	0.587
Sodium, *mmol/L*	138.55 ± 2.49	140.15 ± 4.95	0.095
BUN, *mg/dL*	14.13 ± 3.26	22.40 ± 17.13	0.004*
BUN/Creatinine Ratio	19.91 ± 9.14	30.92 ± 21.78	< 0.001*
Glucose, *mg/dL*	95.79 ± 23.32	115.57 ± 47.12	0.136*

Abbreviations: WBC, White Blood Cell Count; LDH, Lactate Dehydrogenase; AST, Aspartate Aminotransferase; ALT, Alanine Aminotransferase; CRP, C-Reactive Protein; BUN, Blood Urea Nitrogen. Data are presented as Mean ± SD. *Mann-Whitney U test was used for non-normally distributed variables; Student's t-test was used for normally distributed variables. A p-value <0.05 was considered statistically significant

patients (30.6%) required hospitalization, with a mean length of hospital stay of 5.95 ± 2.36 days. The baseline demographic and clinical characteristics of the study population are

presented (Table 1). When laboratory parameters were compared according to hospitalization status, hospitalized patients demonstrated significantly higher white blood cell count, neutrophil count, CRP levels, BUN levels, and BUN/creatinine ratio, whereas lymphocyte counts were significantly lower. Serum osmolality was also higher in hospitalized patients; however, the difference did not reach statistical significance. Other laboratory parameters did not differ significantly between the two groups (Table 2).

Analysis of clinical characteristics revealed that oral feeding intolerance and purulent discharge from Stensen's duct were significantly more common among hospitalized patients. In contrast, sex distribution and the presence of comorbidities were not significantly associated with hospitalization (Table 3).

Table 3: Comparison of Clinical Characteristics of Patients According to Hospitalization Status

	Hospitalization Status		
	Absent n=43 (%)	**Present n=19 (%)**	**p value**
Age, *year*	42.09 ± 15.91	67.58 ± 18.68	< 0.001*
Sex			
Female	23 (53.5)	14 (73.7)	0.135
Male	20 (46.5)	5 (26.3)	
Presence of diabetes mellitus			
Absent	39 (90.7)	14 (73.7)	0.117
Present	4 (9.3)	5 (26.3)	
Oral feeding intolerance			
Absent	41 (95.3)	8 (42.1)	< 0.001
Present	2 (4.7)	11 (57.9)	
Stensen's duct pus			
Absent	42 (97.7)	12 (63.2)	< 0.001
Present	1 (2.3)	7 (36.8)	
Comorbidity			
Absent	30 (69.8)	9 (47.4)	0.092
Present	13 (30.2)	10 (52.6)	

Categorical variables were compared using the Chi-square test or Fisher's exact test where appropriate. A p-value <0.05 was considered statistically significant.

Table 4: Multivariate logistic regression analysis of age, CRP and BUN/creatinin ratio for the presence of hospitalization patients with acute parotitis

			95% CI For Odds Ratio		
	B	**Odds Ratio**	**Lower**	**Upper**	**p**
Age	0.063	1.065	1.018	1.114	0.006
CRP	0.037	1.038	1.006	1.071	0.021
BUN/Creatinine Ratio	0.047	1.048	0.983	1.117	0.153

Abbreviations: CRP, C-Reactive Protein; BUN, Blood Urea Nitrogen.

Multivariate logistic regression was used to assess factors that were shown to be significant in the univariate study. The analysis identified age and CRP as independent predictors of hospitalization, whereas the BUN/creatinine ratio did not retain statistical significance (Table 4). ROC curve analysis was applied to determine the predictive performance of the significant parameters. Age and CRP demonstrated good discriminatory ability for predicting hospitalization. The BUN/creatinine ratio showed moderate discriminatory performance. The combined model derived from the multivariate logistic regression model including age and CRP yielded the highest predictive performance, with an AUC of 0.887, sensitivity of 73.8%, and specificity of 93.0% (Table 5, Figure 1).

Discussion

Acute parotitis is an infectious condition that may lead to significant morbidity, particularly in elderly and comorbid patients. In this study, the demographic, clinical, and laboratory characteristics of 62 patients diagnosed with AP were evaluated, and factors associated with hospitalization were investigated.

Table 5: ROC Curve Analysis for Predictors of Hospitalization in Acute Parotitis

Variable	AUC	95% CI	Cut-off	Sensitivity (%)	Specificity (%)	Youden Index
Age	0.843	0.733–0.953	≥61.5 years	68.4	90.7	0.591
CRP	0.832	0.711–0.953	≥22.95 mg/L	73.7	86.0	0.597
BUN/Cr ratio	0.767	0.644–0.890	≥19.47	78.9	62.8	0.417
Age + CRP	0.887	0.791–0.984	≥0.365	73.8	93.0	0.667

The combined model was derived from the multivariate logistic regression model incorporating age and CRP.

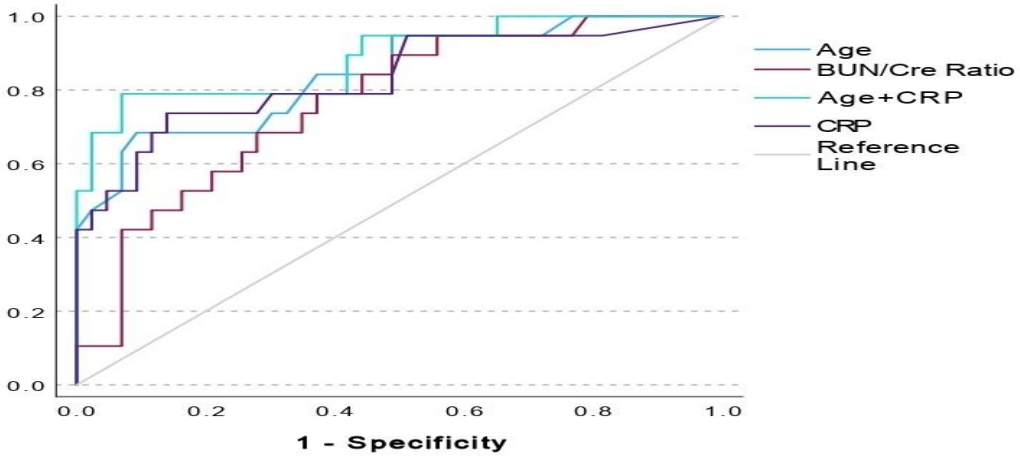

Figure 1. ROC curves for the prediction of hospitalization in patients with acute parotitis.

Our findings demonstrated that increasing age and elevated CRP levels at presentation were independent predictors of hospitalization. ROC curve analysis further showed that age ≥61.5 years and CRP ≥22.95 mg/L had good discriminatory performance for identifying patients requiring hospitalization. The BUN/creatinine ratio also demonstrated moderate discriminatory ability. The combined predictive model derived from age and CRP yielded the highest predictive performance, with an AUC of 0.887, indicating good overall accuracy in distinguishing patients who required hospitalization. In addition to laboratory findings, clinical features such as oral feeding intolerance and purulent discharge from Stensen's duct were significantly more frequent among hospitalized patients. The etiology and clinical course of parotitis may vary with age. In our study, the mean age of hospitalized patients (67.58 years) was significantly higher than that of outpatients (42.09 years). Older age is a well-established risk factor for poor prognosis in AP (5,9). In multivariate analysis, age was also identified as an independent risk factor for hospitalization. This finding is consistent with the study by Markovich et al., which reported that age is an important factor affecting length of hospital stay in patients with AP (5). In older patients, decreased salivary flow rate, increased comorbidities, and weakened immune response may lead to more severe infection and increased risk of systemic complications (10–13). ROC curve analysis identified an optimal cut-off of ≥61.5 years for predicting hospitalization, with a sensitivity of 68.4% and a specificity of 90.7% (AUC=0.843). The high specificity of this threshold suggests that patients below this age are unlikely to require hospitalization, which may support outpatient management decisions in younger patients. This finding suggests that acute parotitis requires more aggressive management in the elderly population. Although comorbidity is generally known to increase with age, we did not observe a statistically significant association between comorbidity status

and hospitalization in our cohort. Furthermore, in multivariate analysis, age remained an independent predictor of hospitalization, suggesting that the effect of age may not be solely explained by the presence of comorbidities. However, the relatively small sample size may have limited the ability to detect a significant relationship between comorbidity and hospitalization. Therefore, the interplay between age and comorbidities should be further investigated in larger prospective studies.

When evaluated in terms of laboratory parameters, hospitalized patients demonstrated significantly higher WBC, neutrophil, and CRP values, while lymphocyte counts were lower. These findings indicate the presence of a more severe inflammatory response in hospitalized patients. Notably, CRP was identified as an independent risk factor for hospitalization in multivariate analysis. Each 1 mg/L increase in CRP was associated with a 3.8% increase in the odds of hospitalization. CRP is a reliable biomarker used to predict disease severity and prognosis in numerous infectious and inflammatory conditions (14,15). Our study demonstrates that CRP can also be utilized to predict disease severity and the need for hospitalization in AP. ROC curve analysis identified an optimal cut-off of ≥22.95 mg/L, with a sensitivity of 73.7% and a specificity of 86.0% (AUC=0.832, Youden Index: 0.597), suggesting that this threshold may serve as a practical reference point for hospitalization decisions in the emergency setting (15). Dehydration plays a central role in the pathogenesis of AP, leading to salivary stasis and facilitating bacterial colonization (2,3). In our study, the BUN/creatinine ratio, used as an indicator of dehydration, was significantly higher in hospitalized patients. Markovich et al. reported that the BUN-to-creatinine ratio was the only independent factor associated with length of hospital stay in patients with AP (5). In our analysis, the BUN-to-creatinine ratio was not statistically significant in the multivariate model. This discrepancy may be explained by differences in study design and outcome measures: the previous study evaluated predictors of hospital length of stay, whereas our study focused on factors associated with the decision to hospitalize. Nevertheless, ROC curve analysis revealed that a BUN/creatinine ratio ≥19.47 had an AUC of 0.767 and a sensitivity of 78.9%, suggesting that, despite its non-significance in multivariate analysis, this parameter may still have moderate discriminative value for identifying patients at risk of hospitalization. Therefore, the BUN/creatinine ratio should be considered a supportive clinical parameter rather than an independent predictor of hospitalization. Regarding clinical findings, oral feeding intolerance and presence of purulent discharge from Stensen's duct were significantly more frequent in hospitalized patients. Purulent discharge from Stensen's duct is one of the pathognomonic findings of AP, and its presence may indicate more severe infection and consequently the need for hospitalization (2,16). Oral feeding intolerance can be both a consequence and a cause of dehydration, and this vicious cycle may contribute to disease exacerbation. In our study, the prevalence of diabetes mellitus was 14.6%, and all diabetic patients had type 2 diabetes. Although diabetes is a well-recognized risk factor for acute parotitis and may contribute to a more severe clinical course, we did not observe a statistically significant association between diabetes status and hospitalization. Notably, a higher proportion of diabetes was observed among hospitalized patients compared to outpatients; however, this difference did not reach statistical significance. This finding may be explained by the relatively small number of diabetic patients in our cohort, which may have limited the statistical power to detect a significant association. Furthermore, due to the retrospective design of the study, detailed data regarding the duration of diabetes and glycemic control were not consistently available, precluding a more comprehensive evaluation of the impact of diabetes severity on clinical outcomes. Given the known role of diabetes in impairing immune response and prolonging infection, further prospective studies with larger sample sizes and detailed metabolic data are needed to better clarify its role in hospitalization risk in acute parotitis.

Regarding imaging modalities, ultrasonography was performed in 92% of patients and computed tomography in 19.4%. Ultrasonography is the preferred initial imaging method in the diagnosis of AP, offering the advantages of being noninvasive, cost-effective, and applicable at the bedside (17,18). Computed tomography is preferred particularly when abscess formation, deep tissue involvement, or complications are suspected. The low rate of CT utilization in our study suggests that most patients presented with uncomplicated AP. An important consideration is the absence of standardized or widely accepted criteria for hospitalization in patients with acute parotitis. In routine clinical practice, admission decisions are largely based on physician judgment, incorporating both clinical and laboratory findings. This variability may lead to differences in management approaches across clinicians and

institutions. Therefore, the identification of objective and reproducible parameters is of particular importance. In this context, our findings suggest that age and CRP levels may serve as clinically useful supportive markers for identifying patients who may require hospitalization. However, these parameters should be interpreted as adjunctive tools rather than definitive criteria, and prospective validation is required before clinical implementation. These findings may be particularly useful in emergency settings where rapid triage decisions are required. Based on our findings, a simple risk stratification approach incorporating age, CRP levels, and key clinical findings such as oral feeding intolerance and purulent discharge may be considered. Patients with low-risk profiles may be suitable for outpatient management, whereas those with higher-risk features may benefit from closer monitoring or hospitalization. However, such an approach requires prospective validation before routine clinical implementation. Based on our findings, a simple risk stratification approach may be proposed to support clinical decision-making in patients with acute parotitis. Patients presenting with age ≥61.5 years and CRP ≥22.95 mg/L may be considered at higher risk for hospitalization. In addition, clinical findings such as oral feeding intolerance and purulent discharge from Stensen's duct may further indicate disease severity. Accordingly, younger patients with low CRP levels and absence of significant clinical findings may be considered low risk and suitable for outpatient management, whereas patients with either elevated CRP or concerning clinical findings may represent an intermediate-risk group requiring closer monitoring. Patients with both advanced age and elevated CRP, particularly in the presence of oral intake intolerance or purulent discharge, may be classified as high risk and may benefit from hospitalization. This proposed approach should be considered a supportive clinical framework rather than a definitive decision tool and requires prospective validation before routine clinical implementation.

Study limitations: The first limitation is the restricted generalizability of findings due to its retrospective and single-center design. Additionally, hospitalization decisions were not based on standardized criteria but rather on clinician judgment, which may have introduced selection bias and incorporation bias. This may have reduced the objectivity of the study, as clinical and laboratory parameters may have influenced the decision to hospitalize. Second, culture data could not be included in the study due to very limited microbiological agent identification, precluding commentary on causative microorganisms. Additionally, the ROC-derived cut-off values and the combined predictive model were not externally validated, and prospective studies with larger cohorts are needed to confirm their clinical applicability. The model was also not internally validated due to the limited sample size. Finally, the relatively small sample size prevented certain subgroup analyses from being performed.

Conclusion

This study demonstrated that increasing age and elevated CRP levels are independent predictors of hospitalization in patients with acute parotitis. In addition, clinical findings such as oral feeding intolerance and the presence of purulent discharge from Stensen's duct were significantly associated with hospitalization. These findings may assist clinicians in risk stratification and clinical decision-making in the emergency management of acute parotitis. Patients presenting with age ≥61.5 years and CRP ≥22.95 mg/L may represent a higher-risk subgroup that could benefit from closer clinical monitoring and consideration for hospitalization. The combined predictive model derived from age and CRP showed good discriminatory performance (AUC=0.887) and may provide supportive information for identifying patients at higher risk of hospitalization. Further prospective studies with larger patient cohorts are needed to externally validate these findings.

Ethics approval: Ethics Committee permission was obtained from Ankara City Hospital Clinical Research Ethics Committee with the decision number 1-25-1888 on 19.11.2025.

Informed consent: In accordance with the ethics committee approval, written informed consent was waived considering the retrospective nature of the study and the anonymity of the data.

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Conflict of interest: The authors declare no conflict of interest.

Artificial intelligence disclosure: An artificial intelligence language model (ChatGPT, OpenAI)

was used only for language editing and grammatical improvements.

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