

Predicting ICU Admission and Length of Stay in Geriatric ED Patients: Comparison of Clinical Scores, Frailty and Comorbidity

✉ Ezgi Cesur¹, ✉ Ali Halıcı^{2*}, ✉ Beyazıt Cesur³, ✉ Uğur Kahveci⁴

¹ Kütahya City Hospital, Department of Emergency Medicine, Kütahya, Türkiye

² Kütahya Health Sciences University, Medical Faculty, Department of Emergency Medicine, Kütahya, Türkiye

³ Kütahya Evliya Çelebi Training and Research Hospital

⁴ Eskişehir City Hospital, Department of Emergency Medicine, Eskişehir, Türkiye

*Correspondence: Ali Halıcı; ali.halici@ksbu.edu.tr

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Abstract

Objective: To evaluate the association of commonly used clinical scores, frailty and comorbidity burden with intensive care unit(ICU) admission and ICU length of stay(LOS) in geriatric patients presenting to the emergency department(ED). **Methods:** This retrospective single-center study included 294 patients aged ≥ 65 years presenting to the ED. The Clinical Frailty Scale(CFS), Charlson Comorbidity Index(CCI), quick Sequential Organ Failure Assessment(qSOFA) and National Early Warning Score 2(NEWS2) were evaluated. ROC analysis was performed for ICU admission. Multivariable logistic regression was used to identify factors associated with ICU admission, while linear regression of log-transformed ICU LOS was performed among ICU admitted patients. **Results:** 34 patients(11.6%) were admitted to the ICU. qSOFA had the numerically highest AUC for ICU admission (0.702, 95% CI 0.594-0.809), followed by CCI(0.653), NEWS2(0.633) and CFS(0.625). In multivariable analysis, qSOFA was independently associated with ICU admission (OR 3.82, 95% CI 2.14-6.80; $p < 0.001$), whereas CFS and CCI were not. Among ICU admitted patients, higher CCI was associated with longer ICU LOS($B = 0.142$, 95% CI 0.017-0.267; $p = 0.027$). **Conclusion:** qSOFA was independently associated with ICU admission, highlighting the importance of acute physiological status in early risk assessment of geriatric ED patients. In contrast, among ICU admitted patients, higher comorbidity burden was associated with longer ICU stay, although this finding should be interpreted cautiously given the limited ICU sample. These findings suggest that acute physiological status and underlying health burden may provide complementary information at different stages of care, supporting an integrated rather than score based approach to clinical decision making in geriatric emergency patients.

Keywords: Geriatric Patients, Emergency Medicine, Intensive Care Unit, Frailty, Comorbidity

1. Introduction

The global aging of the population has led to a marked increase in the number of geriatric patients presenting to emergency departments. Older adults represent a particularly complex patient group due to the presence of multiple chronic conditions, increased frailty, polypharmacy and reduced physiological reserve. In these patients, the burden of chronic disease and frailty may contribute to a more severe course of acute illnesses and make clinical stabilization more difficult. In addition, drug interactions related to polypharmacy and the complexity of treatment management may render the clinical course more unpredictable and less consistent. Collectively, these factors lead to increased care needs, prolonged hospital and intensive care stays and greater social support requirements in the geriatric population^{1,2}.

Early and accurate assessment and risk stratification of geriatric patients in the emergency department are therefore of critical importance for clinical management. However, clinical evaluation in this population is often challenging. Older patients frequently present with atypical or subtle symptoms, and vital signs may not reliably reflect the severity of the underlying condition. Previous studies have shown that, for these reasons, serious conditions in geriatric patients may be overlooked in the early stages, resulting in delayed diagnosis and treatment due to inappropriate triage³. This situation makes it particularly difficult to identify patients at risk of early clinical deterioration and may lead to delays in timely intervention.

These challenges have increased the need for rapid, objective and easily applicable risk assessment tools in the emergency department. Various clinical scoring systems have been developed for this purpose. The qSOFA score is a simple bedside tool designed to predict poor clinical outcomes, particularly in the presence of infection⁴. The NEWS2 score is a more comprehensive system incorporating multiple physiological parameters to detect early clinical deterioration⁵. In addition, geriatric-specific assessment tools, such as the CFS, which measures frailty, and the CCI, which quantifies the burden of chronic disease, provide valuable information. These scoring systems reflect different yet complementary dimensions of patient status, including acute physiological condition, functional reserve and comorbidity burden⁶.

However, data on the comparative performance of these scoring systems in predicting ICU admission in the general geriatric emergency population remain limited. Most existing studies have focused on specific patient groups, particularly those with suspected infection or sepsis, while data encompassing the broader geriatric emergency population are relatively scarce. Furthermore, the literature has predominantly evaluated these scores in terms of mortality outcomes, whereas parameters such as ICU length of stay, an important indicator of healthcare resource utilization, have been insufficiently explored. Yet, the ability to predict not only ICU admission but also ICU length of stay may provide important contributions to patient management, early clinical decision-making, and efficient use of healthcare resources.

In this study, we aimed to comparatively evaluate the performance of qSOFA, NEWS2, the Clinical Frailty Scale and the Charlson Comorbidity Index in predicting ICU admission among patients aged 65 years and older presenting to the emergency department. In addition, we sought to identify clinical factors associated with ICU length of stay in this population. Through this approach, we aimed to contribute to the development of a more integrated assessment strategy that may support early risk stratification in geriatric emergency patients.

2. Methods

2.1. Study Design

This study was designed as a retrospective, single-center, observational cohort study and was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

2.2. Study Setting and Population

The study was conducted in the Emergency Department of Kütahya City Hospital, a tertiary-care referral center. The data were obtained retrospectively from the hospital information management system. Patients aged ≥ 65 years who presented to the emergency department between 1 October 2025 and 1 January 2026 were assessed for eligibility.

Patients were eligible if sufficient clinical information was available to obtain the study variables and calculate the evaluated clinical scores. Patients presenting with trauma, those with insufficient clinical documentation for score calculation or outcome assessment and those with a documented palliative care plan that included limitation of escalation to intensive care were excluded. For patients with multiple emergency department presentations during the study period, only the first eligible presentation was included. The study protocol was approved by the institutional ethics committee. All procedures were conducted in accordance with institutional and national research regulations.

2.3. Data Collection and Assessment of Clinical Scores

Data were retrospectively extracted from the hospital electronic medical records. No additional laboratory testing, imaging studies or interventions were performed for study purposes. Demographic characteristics, vital signs at ED presentation, clinical scores, ICU admission status and ICU length of stay were recorded.

The clinical parameters used for score calculation were based on information documented during the initial clinical assessment in the ED. qSOFA was calculated using respiratory rate, systolic blood pressure and level of consciousness at ED presentation. NEWS2 was calculated using respiratory rate, oxygen saturation, supplemental oxygen use, body temperature, systolic blood pressure, heart rate and level of consciousness assessed using the AVPU scale.

CFS was assessed using the 9-point Clinical Frailty Scale based on the patient's baseline functional status before the acute illness. Functional impairment attributable to the acute presenting condition was not considered when assigning the CFS score. Baseline mobility, independence in activities of daily living and care needs were assessed from the history obtained from the patient and, when necessary, from relatives or caregivers. The standard CCI, without age adjustment, was used to quantify comorbidity burden. CCI was calculated based on the weighted comorbid conditions documented in the medical records.

2.4. Outcomes

The primary outcome was ICU admission during the index hospitalization. The secondary outcome was ICU length of stay, defined as the total number of days spent in the ICU.

2.5. Sample Size and Power Analysis

A priori sample size estimation was performed using the logistic regression based Hsieh method for binary outcomes. Published studies evaluating older adults presenting to emergency departments report ICU admission rates generally ranging between approximately 8% and 12%. Based on these data, an expected ICU admission rate of 10% was used for sample size calculation.

Assuming a clinically meaningful effect size corresponding to an odds ratio of 2.5 for qSOFA, with a two-sided alpha level of 0.05 and a statistical power of 80%, the minimum required sample size was calculated to be 270 patients. The final study cohort consisted of 294 patients, exceeding the estimated minimum sample size requirement for adequate statistical power.

2.6. Statistical Analysis

Statistical analyses were conducted using SPSS software (IBM Corp., Armonk, NY, USA) and Python (Python Software Foundation, Wilmington, DE, USA). Continuous variables were expressed as mean $\pm$ standard deviation or median (interquartile range) according to distribution. Categorical variables were presented as counts and percentages. Group comparisons were conducted using independent samples t-tests or non-parametric equivalents for continuous variables and chi-square or Fisher's exact tests for categorical variables, as appropriate.

ROC curve analysis was performed to evaluate the discriminative performance of qSOFA, NEWS2, CFS and CCI for predicting ICU admission. The area under the curve (AUC) was calculated and optimal cut-off values were determined using the Youden index. Given the limited number of ICU admission events, parsimonious multivariable models were constructed using three variables representing clinically distinct domains: qSOFA for acute physiological derangement, CFS for baseline frailty and CCI for chronic comorbidity burden. Age was not included simultaneously with CFS because of the strong correlation observed between these variables (Spearman's $\rho=0.857$), although variance inflation factors did not indicate severe multicollinearity. Multivariable logistic regression was used to evaluate factors associated with ICU admission and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test. For the secondary outcome, multivariable linear regression was performed using log-transformed ICU length of stay as the dependent variable and the same three clinical domains as independent variables. Regression coefficients (B) with 95% CIs and p-values were reported. Regression assumptions were assessed using residual diagnostic plots.

3. Results

A total of 294 patients were included in the study, of whom 34 (11.6%) required ICU admission. Demographic and clinical factors associated with ICU admission were analyzed (Table 1).

The mean age of patients admitted to the ICU (77.3 ± 7.4 years) did not differ significantly from that of patients who were not admitted (76.6 ± 7.2 years). Similarly, sex distribution was comparable between groups. Among vital parameters recorded at emergency department presentation, diastolic blood pressure, oxygen saturation and respiratory rate were significantly associated with ICU admission ($p = 0.010$, $p = 0.035$, and $p = 0.002$, respectively). Patients with lower diastolic blood pressure and oxygen saturation, as well as those presenting with tachypnea, were more likely to require ICU care.

Regarding clinical scores, higher NEWS2 scores, greater frailty as measured by the Clinical Frailty Scale and higher Charlson Comorbidity Index values were significantly associated with ICU admission ($p = 0.008$, $p = 0.011$, and $p = 0.006$, respectively). In addition, qSOFA scores were significantly higher among ICU patients, with a clear shift toward higher qSOFA categories in the ICU group ($p < 0.001$).

Table 1. Baseline characteristics according to ICU admission

Variable	No ICU (n=260)	ICU (n=34)	p-value
Demographic Characteristics			
Age (years)	76.6 ± 7.2	77.3 ± 7.4	0.587
Female sex, n (%)	133 (51.2%)	19 (55.9%)	0.604
Vital Signs at ED Admission			
Systolic BP (mmHg)	134.7 ± 26.0	128.5 ± 36.1	0.346
Diastolic BP (mmHg)	77.9 ± 12.9	71.5 ± 17.9	0.010
Heart rate (bpm)	90.7 ± 22.4	87.3 ± 21.8	0.411
Oxygen saturation (%)	94.8 ± 2.9	92.6 ± 5.7	0.035
Temperature (°C)	36.62 ± 0.42	36.66 ± 0.41	0.589
Respiratory rate (breaths/min)	16.3 ± 4.1	20.0 ± 6.2	0.002
Comorbidities			
Diabetes mellitus, n (%)	107 (41.2%)	17 (50.0%)	0.326
Cardiovascular disease, n (%)	100 (38.5%)	14 (41.2%)	0.760
Cerebrovascular disease, n (%)	28 (10.8%)	6 (17.6%)	0.253
Chronic kidney disease, n (%)	31 (11.9%)	5 (14.7%)	0.315
COPD / Asthma, n (%)	37 (14.2%)	8 (23.5%)	0.157
Malignancy, n (%)	17 (6.5%)	3 (8.8%)	0.714
Clinical Scores			
NEWS2 score	7.27 ± 2.02	8.26 ± 2.30	0.008
Clinical Frailty Scale	3.73 ± 1.66	4.50 ± 1.62	0.011
Charlson Comorbidity Index	5.40 ± 1.95	6.41 ± 2.27	0.006
qSOFA score (0/1/2)			
0	222 (85.4%)	16 (47.1%)	<0.001
1	33 (12.7%)	11 (32.4%)	
2	5 (1.9%)	7 (20.6%)	

Receiver operating characteristic (ROC) analysis was performed to evaluate the discriminative ability of clinical scores for predicting ICU admission (Figure 1). Among the evaluated scores, qSOFA had the numerically highest AUC (0.702, 95% CI 0.594-0.809), followed by CCI (AUC 0.653, 95% CI 0.567-0.738), NEWS2 (AUC 0.633, 95% CI 0.525-0.741) and CFS (AUC 0.625, 95% CI 0.527-0.724).

The optimal cut-off value for qSOFA was ≥1, yielding a sensitivity of 52.9% and a specificity of 85.4%. For CCI, a cut-off of ≥6 provided a sensitivity of 67.6% and a specificity of 60.0%. NEWS2 at a threshold of ≥9 achieved a sensitivity of 50.0% and a specificity of 78.1%, whereas CFS at ≥5 yielded a sensitivity of 52.9% and a specificity of 65.8%. Sensitivity and specificity values corresponding to these thresholds are presented in detail in Table 2.

Table 2. Diagnostic performance of clinical scores for predicting ICU admission

Predictor	AUC (95%CI)	Cut-off	Sensitivity	Specificity
qSOFA score	0.702 (0.594–0.809)	≥1	52.9%	85.4%
NEWS2 score	0.633 (0.525–0.741)	≥9	50.0%	78.1%
Clinical Frailty Scale (CFS)	0.625 (0.527–0.724)	≥5	52.9%	65.8%

Predictor	AUC (95%CI)	Cut-off	Sensitivity	Specificity
Charlson Comorbidity Index (CCI)	0.653 (0.567–0.738)	≥ 6	67.6%	60.0%

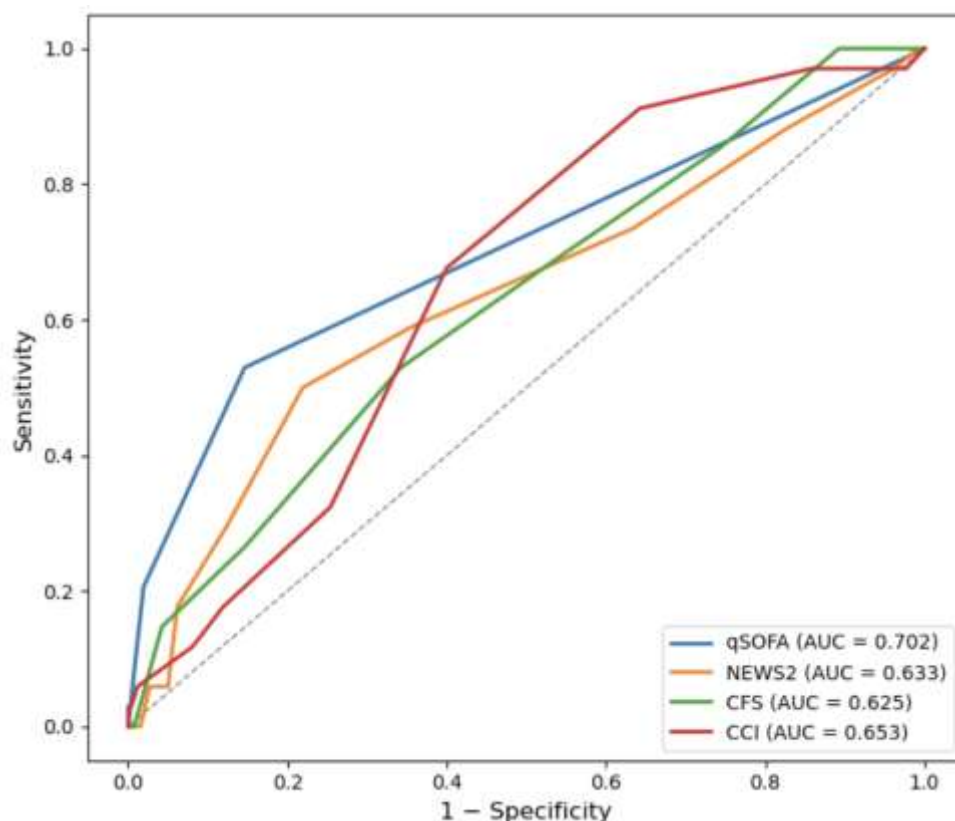


Figure 1. ROC curves of clinical scores for ICU admission

A parsimonious multivariable logistic regression model including qSOFA, CFS, and CCI was used to evaluate factors independently associated with ICU admission (Table 3).

qSOFA was independently associated with ICU admission (OR 3.82, 95% CI 2.14-6.80; $p < 0.001$), indicating that each one-point increase in qSOFA was associated with higher odds of ICU admission. CFS (OR 1.21, 95% CI 0.96-1.54; $p = 0.115$) and CCI (OR 1.18, 95% CI 0.98-1.42; $p = 0.084$) were not independently associated with ICU admission. The overall model was statistically significant ($\chi^2 = 33.23$, $p < 0.001$).

Table 3. Multivariable logistic regression analysis for predictors of ICU admission

Variable	β (SE)	Adjusted OR	95% CI	p value
qSOFA score	1.340 (0.294)	3.82	2.14-6.80	<0.001
Clinical Frailty Scale	0.191 (0.121)	1.21	0.96-1.54	0.115
Charlson Comorbidity Index	0.164 (0.095)	1.18	0.98-1.42	0.084

*OR: Odds Ratio; CI: Confidence Interval; qSOFA: Quick Sequential Organ Failure Assessment;

CFS: Clinical Frailty Scale; CCI: Charlson Comorbidity Index.

A multivariable linear regression model including qSOFA, CFS and CCI was used to evaluate factors associated with log-transformed ICU length of stay among patients admitted to the ICU (Table 4).

Among the evaluated variables, only the CCI was independently associated with longer ICU length of stay ($B = 0.142$, 95% CI 0.017–0.267; $p = 0.027$). As ICU length of stay was natural log-transformed, this coefficient corresponds to an approximately 15% increase in ICU length of stay for each one-point increase in CCI, after adjustment for qSOFA and CFS. This finding indicates that increasing comorbidity burden was significantly related to longer ICU duration. In contrast, qSOFA ($B = 0.132$, 95% CI –0.252 to 0.516; $p = 0.488$) and CFS ($B = 0.041$, 95% CI –0.144 to 0.225; $p = 0.655$) were not significantly associated with ICU length of stay.

Table 4. Multivariable linear regression analysis for predictors of ICU length of stay

Variable	B (SE)	Standardized β	95% CI for B	p value
qSOFA score	0.132 (0.188)	0.130	–0.252 to 0.516	0.488
Clinical Frailty Scale	0.041 (0.090)	0.082	–0.144 to 0.225	0.655
Charlson Comorbidity Index	0.142 (0.061)	0.402	0.017 to 0.267	0.027

4. Discussion

The accurate triage and early prediction of clinical outcomes in geriatric patients presenting to the emergency department remain one of the most challenging aspects of modern emergency medicine, largely due to the atypical symptom presentation and diminished physiological reserves frequently observed in this population. With the progressive aging of the population, the number of elderly patients presenting to emergency departments is steadily increasing, which in turn leads to a growing demand for advanced healthcare services such as intensive care and a substantial rise in healthcare resource utilization. In this study evaluating elderly patients admitted to the emergency department, various clinical scoring systems were assessed in terms of their ability to predict both ICU admission and ICU length of stay. Our findings demonstrated that 11.6% of the geriatric cohort required ICU admission, a rate consistent with the increasing demand for critical care resources reported in aging populations^{7,8}. In the multivariable analysis, qSOFA remained independently associated with ICU admission. Patients admitted to the ICU had significantly higher qSOFA scores, with a clear shift toward higher score categories observed in the ICU group. Notably, each one-point increase in qSOFA was associated with approximately 3.8-fold higher odds of ICU admission. These findings are in line with previous studies indicating that qSOFA reflects early organ dysfunction and serves as a practical bedside tool for identifying patients at high risk of clinical deterioration⁹.

Physiological parameters recorded at emergency department presentation also provided important clinical insights. Lower diastolic blood pressure, reduced oxygen saturation and increased respiratory rate were all significantly associated with ICU admission. These findings underscore the importance of careful evaluation and continuous monitoring of vital signs in the geriatric population, in whom early physiological derangements may be subtle but clinically significant^{10–13}. Although NEWS2 scores were significantly higher among patients requiring ICU admission in the unadjusted analysis, their discriminative performance was modest. This finding suggests that NEWS2 may provide useful physiological information but may have limited ability to distinguish patients requiring ICU admission when used alone.

Although higher CFS and CCI scores were associated with ICU admission in the unadjusted analyses, neither remained independently associated with ICU admission after accounting for the other clinical domains. In contrast, qSOFA remained independently associated with ICU admission. Frailty remains clinically relevant in geriatric emergency care because it reflects baseline physiological and functional reserve and vulnerability to

acute stressors¹⁴⁻¹⁷. However, CFS was not independently associated with ICU admission after accounting for acute physiological status and comorbidity burden. Similarly, CCI was not independently associated with ICU admission after adjustment for qSOFA and CFS. Nevertheless, comorbidity burden remains an important component of geriatric assessment, as multiple chronic conditions may reduce physiological reserve, increase the complexity of clinical management, and complicate recovery from acute illness¹⁸⁻²¹.

The discriminative performance of clinical scores for predicting ICU admission was evaluated using ROC analysis, which showed that qSOFA had the highest discriminative ability among the assessed scores. Although qSOFA is primarily used in patients with suspected sepsis, our findings suggest that it may also serve as a rapid risk stratification tool in the broader geriatric emergency population. The identified cut-off value of ≥ 1 yielded a sensitivity of 52.9% and a specificity of 85.4%, indicating that, despite moderate sensitivity, its relatively high specificity may make it particularly useful in identifying patients who are more likely to require ICU care. In addition, the simplicity and rapid applicability of qSOFA provide a practical advantage in the often time-pressured environment of emergency departments. The CCI demonstrated the second highest discriminative performance, whereas NEWS2 and the CFS showed comparatively lower performance. Overall, these findings suggest that while clinical scoring systems alone may have limited discriminative capacity in predicting ICU admission, they can still contribute meaningfully to risk stratification when used in conjunction with comprehensive clinical evaluation²².

Among patients admitted to the ICU, higher CCI scores were associated with longer ICU stays, whereas qSOFA and CFS were not significantly associated with ICU length of stay. This finding suggests a possible relationship between chronic comorbidity burden and subsequent ICU course; however, it should be interpreted cautiously given the limited number of patients admitted to the ICU. The CCI, which quantitatively reflects comorbidity burden, has been widely used as a prognostic tool for predicting mortality, complications, and hospital length of stay. Previous studies have similarly demonstrated that a higher comorbidity burden is associated with increased healthcare utilization and prolonged ICU and hospital stays²³⁻²⁵. This relationship may be explained by the increased complexity of clinical management, higher risk of complications, and delayed stabilization observed in patients with multiple chronic conditions.

In this study, we found that simple bedside clinical tools may offer meaningful support in the early risk assessment of elderly patients presenting to the emergency department. Among the evaluated clinical measures, qSOFA was independently associated with ICU admission, whereas CFS and CCI were not independently associated with this outcome. Nevertheless, the overall discriminatory performance of these scores was limited, suggesting that they are best used alongside clinical judgment rather than as standalone decision making tools. Among patients admitted to the ICU, higher comorbidity burden was associated with longer ICU stay, although this finding should be interpreted cautiously given the limited number of patients included in this analysis. Taken together, these findings suggest that acute physiological status and underlying comorbidity burden may provide complementary information at different stages of clinical assessment, supporting an integrated approach to decision-making in older emergency department patients.

4.1. Limitations

This study has several limitations. Its retrospective, single-center design and relatively limited sample size may restrict the generalizability of the findings. Clinical scores were evaluated at ED presentation, and subsequent changes were not assessed. Primary ED diagnoses and specific reasons for ICU admission were not systematically recorded,

limiting diagnosis specific analyses. Moreover, ICU admission may be influenced by clinical judgment and local admission practices. ICU length of stay analysis was limited by the small number of ICU admitted patients and events during the ICU course, including early mortality, may have influenced the observed length of stay. Finally, the ROC derived cut-off values were not internally or externally validated and should therefore be considered exploratory.

Ethics approval and consent to participate: The study was approved by the Kütahya Health Sciences University Non-Interventional Clinical Research Ethics Committee (decision no. 2026/03-56; March 9, 2026) and was conducted in accordance with the Declaration of Helsinki.

Informed Consent: The requirement for informed consent was waived by the ethics committee due to the retrospective nature of the study and the use of anonymized patient data.

Data Availability Statement: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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