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Clinical Characteristics and Short-Term Outcomes of Adult Patients Presenting to the Emergency Department with Hemoptysis: A Retrospective Cohort Study

Halil E. Koyuncuoğlu[1], Nur D. Özkan Koyuncuoğlu[2], Yalçın Gölcük[3], Fulden Cantaş Türkiş[4]

[1]*Muğla Training and Research Hospital, Department of Emergency Medicine, Muğla, Türkiye*
[2]*Milas State Hospital, Department of Thoracic Surgery, Muğla, Türkiye*
[3]*Muğla Sıtkı Kocman University, Faculty of Medicine, Department of Emergency Medicine, Muğla, Türkiye*
[4]*Muğla Sıtkı Koçman University, Faculty of Medicine, Department of Biostatistics, Muğla, Türkiye*

Abstract

Objective: This study aimed to characterize the clinical profile of adults presenting with hemoptysis to the emergency department (ED), describe short-term clinical outcomes and their distribution across predefined FLHASc risk strata, and explore patterns of healthcare resource utilization within this cohort.

Materials and Methods: This retrospective cohort study included consecutive adults presenting with hemoptysis to the ED of (blinded for review), Türkiye, between June 1, 2019, and December 31, 2024. Patients were categorized as low risk (FLHASc=0) or moderate-to-high risk (FLHASc≥1). Primary outcomes were 28-day mortality, intensive care unit (ICU) admission, and invasive mechanical ventilation (IMV).

Results: Of 322 screened patients, 258 were analyzed (mean age 62.1±17.8 years; 74% male): 63 (24.4%) were low risk and 195 (75.6%) were moderate-to-high risk. Pure bright-red hemoptysis and active malignancy occurred only in the higher-risk group (62.6% vs. 0%; 23.6% vs. 0%; both p<0.001). Lobar consolidation predominated in low-risk patients (52.4% vs. 25.1%; p<0.001). Overall 28-day all-cause mortality was 9.3%, with a numerically higher rate in the moderate-to-high-risk group (11.3% vs. 3.2%; p=0.094). ICU admission (11.3% vs. 9.5%) and IMV (13.3% vs. 7.9%) rates were numerically higher in the moderate-to-high-risk group without reaching statistical significance.

Conclusion: In this retrospective cohort, predefined FLHASc risk categories were associated with differences in clinical presentation, imaging findings, and short-term outcome distribution. These findings provide descriptive insight into risk patterns within a mixed-etiology emergency department population. Prospective multicenter studies are required before conclusions can be drawn regarding predictive performance or clinical implementation.

Keywords: Computed tomography; emergency department; hemoptysis; mortality; risk stratification

Introduction

Hemoptysis is a time-critical cardiorespiratory emergency in which the immediate threat to life is hypoxemic asphyxiation from airway flooding rather than exsanguination. This pathophysiology places a premium on early risk stratification at emergency department (ED) arrival to avert decompensation and prioritize definitive hemostasis [1,2]. Current management combines rapid stabilization with contrast-enhanced computed tomography (CT) for localization, reserving bronchoscopy for persistent bleeding or tissue sampling when CT is nondiagnostic [3,4].

In Türkiye, lung cancer, pneumonia, bronchiectasis, and tuberculosis are the leading causes, reflecting both malignant and infectious contributors to the national burden [2]. Etiological patterns vary, with lung cancer, bronchiectasis, and tuberculosis being common causes, resulting in wide variation in resource utilization. This highlights the need for standardized early risk tools to guide imaging, intervention, and disposition [5,6].

Address for Correspondence: Yalcin Golcuk, Muğla Sıtkı Kocman University, Faculty of Medicine, Department of Emergency Medicine, Muğla, Türkiye
E-mail: dryalcingolcuk@gmail.com, yalcingolcuk@mu.edu.tr **ORCID-ID:** 0000-0002-8530-8607

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Although several risk tools have been proposed, their application across diverse epidemiological settings remains variable [4]. The Florence Hemoptysis Score (FLHASc) stratifies short-term risk but lacks validation in mixed etiologies, and its links to practical outcomes remain limited [7]. This study aimed to describe the clinical characteristics, etiological spectrum, and short-term outcomes of adult patients presenting to a tertiary ED with hemoptysis. Additionally, we explored how predefined FLHASc risk categories were distributed within this cohort and how these categories were associated with clinical outcomes and resource utilization.

Therefore, the primary aim of this study was to characterize the demographic, clinical, and etiological features of adults presenting with hemoptysis to a tertiary ED. A secondary objective was to describe short-term outcomes and explore their distribution across predefined FLHASc risk categories.

Materials and Methods

Study Design and Setting

We conducted a retrospective observational cohort study of consecutive adult patients presenting with hemoptysis to the ED of a tertiary care center (blinded for review). The study period extended from June 1, 2019, to December 31, 2024. Ethical approval was obtained from the Muğla Sıtkı Kocman University Institutional Review Board (Approval No.: 250104/141; Approval Date: 16/07/2025), and informed consent was waived due to the retrospective design. The study complied with the Declaration of Helsinki and adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines. The index time was the first ED assessment, and 28-day outcomes were determined from hospital records and national death registries. The study flow diagram is presented in Figure 1 in accordance with STROBE recommendations.

Study Population

The study included all patients aged 18 years or older whose primary ED admission diagnosis was hemoptysis, identified using the International Classification of Diseases, Tenth Revision (ICD-10) code R04.2. Hemoptysis was defined as the expectoration of blood originating from the lower respiratory tract. We excluded patients with trauma-related airway bleeding, pseudohemoptysis (e.g., from epistaxis or hematemesis), those under 18 years of age, and encounters with insufficient data in the electronic health record (EHR) to confirm the diagnosis or calculate the FLHASc score. Pseudohemoptysis exclusions were confirmed independently by two reviewers using clinical notes, thoracic imaging, and available endoscopy; discordances were adjudicated by a senior emergency physician.

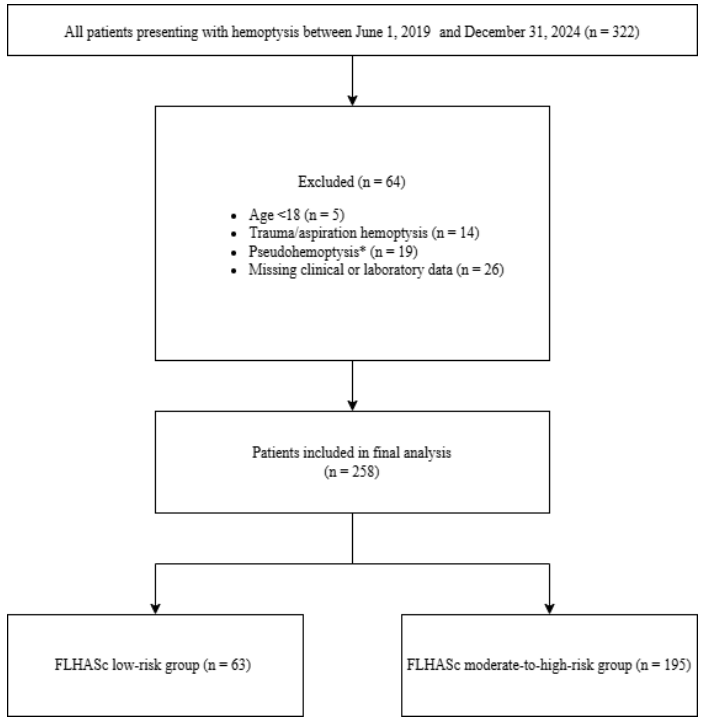

Figure 1. Flowchart of patient selection and FLHASc-based risk stratification *Pseudohemoptysis refers to bleeding from extrapulmonary sources such as epistaxis or hematemesis. Abbreviations: FLHASc: Florence Hemoptysis Score

Data Sources and Collection

Data were retrospectively extracted from the hospital's electronic health records using a standardized form. Two investigators independently collected and verified all data; discrepancies were resolved by a senior reviewer. Variables included demographics, smoking status, comorbidities (malignancy, bronchiectasis, tuberculosis, chronic obstructive pulmonary disease [COPD]), and prior oncologic therapies. Clinical data included vital signs and Glasgow Coma Scale scores. Laboratory results included hematologic, coagulation, renal, hepatic, inflammatory, and cardiac markers. Imaging findings from chest radiography and CT were categorized as normal or abnormal, and bronchoscopy findings were incorporated to determine final etiologies.

Risk Stratification and Variables

Patients were risk-stratified using the FLHASc, calculated from data available at the initial ED presentation. The FLHASc assigns points as follows: systolic blood pressure <100 mmHg (3 points), pure-blood hemoptysis (1 point), history of pulmonary malignancy (1 point), and ≥2 hemoptysis episodes within 24 hours (1 point), yielding a total score from 0 to 6 [7]. For standardization, "pure-blood hemoptysis" was defined as the expectoration of undiluted blood without visible sputum admixture at the index visit, as reported by the patient and documented in clinician notes,

and "≥2 hemoptysis episodes within 24 hours" was defined as at least two discrete expectorations in the preceding 24 hours, confirmed by patient history and corroborated by nursing or physician documentation. Consistent with its derivation study, we dichotomized the score for analysis: low risk (score=0) and moderate-to-high risk (score≥1). [7] Patients with any missing component required for FLHASc calculation were excluded from the primary analysis.

Outcomes

The primary outcomes were 28-day all-cause mortality, need for invasive mechanical ventilation (IMV), and ICU admission. Secondary outcomes included hospital admission, transfusion of blood products, and performance of definitive hemostatic procedures. Resource utilization was assessed during the index ED encounter and ensuing hospitalization, including thoracic CT and bronchoscopy. All outcome data were obtained from the hospital EHR and verified through national death registry records where applicable.

Statistical Analysis

Continuous variables were assessed for normality using the Shapiro–Wilk test. Group comparisons between the low-risk and moderate-to-high-risk strata were performed using the independent samples t-test or Mann–Whitney U test for continuous variables and the chi-square test for categorical variables. Fisher's exact test was used when expected cell counts were <5. Continuous variables compared using the Mann–Whitney U test are presented as median (minimum–maximum), and those compared using the independent samples t-test are presented as mean±standard deviation. Categorical variables were summarized as counts and percentages. All statistical tests were two-tailed, with a p-value<0.05 considered statistically significant. Analyses were conducted using IBM SPSS Statistics Version 27.0 (IBM Corp., Armonk, NY, USA) and RStudio Version 2024.12.0 (RStudio, PBC, Boston, MA, USA). No formal sample size calculation was performed; all eligible patients during the study period were included in the analysis. Patients with missing key variables were excluded, and no imputation or sensitivity analyses were performed.

Results

During the five-and-a-half-year study period, 322 consecutive patients presented to the ED with hemoptysis; after exclusions, 258 comprised the analytic cohort (Fig. 1), with 63 (24.4%) classified as FLHASc low risk and 195 (75.6%) as moderate-to-high risk. The cohort had a mean age of 62.1±17.8 years and was predominantly male (74.0%). Baseline characteristics by risk stratum are summarized in Table 1.

The analysis revealed significant disparities in comorbidities that reflected the underlying structure of the FLHASc. The moderate-to-high-risk group had markedly higher rates of both extrapulmonary malignancy (10.3% vs. 0%; p=0.005) and primary lung cancer (23.6% vs. 0%; p<0.001), whereas chronic kidney failure was more prevalent in the low-risk stratum (9.5% vs. 2.6%; p=0.028). This pattern extended to anticancer therapies, with ongoing chemotherapy (27.7% vs. 0%; p<0.001) and radiotherapy (20.0% vs. 0%; p<0.001) documented exclusively in the higher-risk group, whereas antiplatelet/anticoagulant use and smoking history distribution remained comparable between groups.

Beyond comorbidities, the presentation characteristics of hemoptysis itself further distinguished the risk strata. Pure bright-red hemoptysis occurred exclusively in the moderate-to-high-risk group (62.6% vs. 0%; p<0.001), accompanied by significantly higher bleeding volumes and more frequent recurrent episodes. The moderate-to-high-risk group demonstrated not only a greater proportion of patients with recurrent bleeding (23.1% vs. 9.5%; p=0.030) but also a wider distribution in episode frequency despite identical medians (2 [1–6] vs. 2 [1–2]; p<0.001).

Laboratory parameters, including hematologic, biochemical, and blood gas analyses, showed no significant differences between FLHASc risk groups. However, imaging findings closely reflected risk stratification: pulmonary masses (30.8% vs. 12.7%; p=0.008), atelectasis, and pulmonary embolism (6.2% vs. 0%; p=0.043) were more frequent in higher-risk patients, whereas consolidation predominated in low-risk cases (52.4% vs. 25.1%; p<0.001). Bronchoscopic findings showed no intergroup differences; complete radiological and bronchoscopic results are detailed in Table 2.

The etiological distribution, derived from this comprehensive diagnostic workup, revealed distinct and expected patterns across risk strata. Infectious etiologies, particularly bacterial pneumonia, were common in both groups but represented a greater proportion of causes in the low-risk stratum. Malignancy-related hemoptysis predominated in the moderate-to-high-risk group, whereas cardiogenic causes, such as congestive heart failure, were more frequent in low-risk patients, and pulmonary embolism occurred exclusively in the higher-risk stratum (p=0.026). The complete etiological spectrum is presented in Table 3, and its distribution by sex and risk category is illustrated in Figure 2, which highlights the predominance of malignancy among high-risk males and infectious or cardiovascular causes among low-risk females.

With respect to clinical management and outcomes, tranexamic acid was administered to over 85% of patients in both groups.

Table 1. Comparison of Demographic, Clinical, and Hemoptysis Characteristics Between Low and Moderate to High-Risk Patients Based on the FLHASc

Characteristics		Low risk (n=63)	Moderate to high risk (n=195)	X^2 / Z / t	p
Age, years		63.9±17.2	61.54±17.9	-0.845	0.398
Sex, n (Men/Women)		44/19	147/48	0.500	0.479
Physiological parameters on admission					
SBP (mm Hg)		129 (103-210)	130 (65-208)	-0.424	0.672
DBP (mm Hg)		79 (45-135)	80 (30-126)	0.882	0.378
HR (beats/min)		100 (58-141)	100 (62-155)	-0.124	0.901
RR (breaths/min)		14 (10-25)	13 (10-36)	-2.988	0.003
Oxygen saturation (SaO2%)		94(74-100)	94 (73-100)	-0.326	0.744
Temperature (°C)		36.9 (35.9-39.2)	36.5 (35.3-39.8)	-1.552	0.121
GCS Score		15 (6-15)	15 (3-15)	-0.018	0.985
Previous medical history, n (%)					
Extrapulmonary malignancy	No	63 (100)	175 (89.7)	0.005	0.005
	Yes	0 (0)	20 (10.3)		
Coronary artery disease	No	43 (68.3)	153 (78.5)	2.187	0.139
	Yes	20 (31.7)	42 (21.5)		
Diabetes mellitus	No	52 (82.5)	158 (81)	0.007	0.934
	Yes	11 (17.5)	37 (19)		
Hypertension	No	46 (73)	152 (77.9)	0.402	0.526
	Yes	17 (27)	43 (22.1)		
Chronic Kidney Failure	No	57 (90.5)	190 (97.4)	0.028	0.028
	Yes	6 (9.5)	5 (2.6)		
Cerebrovascular disease	No	62 (98.4)	187 (95.9)	0.693	0.693
	Yes	1 (1.6)	8 (4.1)		
Pulmonary comorbidities, n (%)					
Primary lung cancer	No	63 (100)	149 (76.4)	16.512	< 0.001
	Yes	0 (0)	46 (23.6)		
Lung metastases	No	63 (100)	186 (95.4)	0.118	0.118
	Yes	0 (0)	9 (4.6)		
COPD	No	48 (76.2)	170 (87.2)	3.591	0.058
	Yes	15 (23.8)	25 (12.8)		
Asthma	No	60 (95.2)	185 (94.9)	1.000	>0.999
	Yes	3 (4.8)	10 (5.1)		
Tuberculosis	No	61 (96.8)	192 (98.5)	0.598	0.598
	Yes	2 (3.2)	3 (1.5)		
Pulmonary hypertension	No	62 (98.4)	192 (98.5)	1.000	>0.999
	Yes	1 (1.6)	3 (1.5)		
Aspergilloma	No	62 (98.4)	193 (99)	0.570	0.570
	Yes	1 (1.6)	2 (1)		

Table 1. Continue

Characteristics		Low risk (n=63)	Moderate to high risk (n=195)	X^2 / Z / t	p
Current medication use, n (%)					
Antiplatelet	No	39 (61.9)	136 (69.7)	1.006	0.316
	Yes	24 (38.1)	59 (30.3)		
Anticoagulant	No	55 (87.3)	166 (85.1)	0.049	0.825
	Yes	8 (12.7)	29 (14.9)		
Others	No	43 (68.3)	118 (60.5)	0.909	0.340
	Yes	20 (31.7)	77 (39.5)		
Ongoing chemotherapy, n (%)	No	63 (100)	141 (72.3)	22.064	< 0.001
	Yes	0 (0)	54 (27.7)		
Ongoing radiotherapy, n (%)	No	63 (100)	156 (80)	13.326	< 0.001
	Yes	0 (0)	39 (20)		
Smoking history, n (%)					
Current smoker		15 (23.8)	44 (22.6)	1.208	0.547
Former smoker		25 (39.7)	92 (47.2)		
Never smoker		23 (36.5)	59 (30.3)		
Characteristics of hemoptysis, n (%)					
Type of expectoration	Pure bright blood	0 (0)	122 (62.6)	74.773	< 0.001
	Blood-streaked sputum	63 (100)	73 (37.4)		
Amount of expectoration	More than a glass of water (>200 ml)	2 (3.2)	33 (16.9)	18.778	< 0.001
	A glass of water (200 ml)	6 (9.5)	47 (24.1)		
	Half a tea glass (100 ml)	20 (31.7)	52 (26.7)		
	A tablespoon (15 ml)	21 (33.3)	38 (19.5)		
	A teaspoon (5 ml)	14 (22.2)	25 (12.8)		
Type of presentation	First episode of hemoptysis	57 (90.5)	150 (76.9)	4.693	0.030
	Recurrent hemoptysis	6 (9.5)	45 (23.1)		
Number of episodes		2 (1-2)	2 (1-6)	-4.347	< 0.001

Data were presented as median (minimum-maximum), mean±standard deviation or n (%). Statistically significant p values are in bold. Z, t, are the test statistics for Mann Whitney U, independent samples-t and Chi-Square test; respectively. Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; DBP: Diastolic Blood Pressure; FLHASc: Florence Hemoptysis Score; GCS: Glasgow Coma Scale; HR: Heart Rate (beats/min); RR: Respiratory Rate (breaths/min); SBP: Systolic Blood Pressure

No significant differences were observed in rates of IMV (13.3% vs. 7.9%; p=0.356) or blood transfusion (9.2% vs. 11.1%; p=0.846). The overall 28-day all-cause mortality rate was 9.3% (n=24), with a numerically higher rate in the moderate-to-high-risk group (11.3% vs. 3.2%; p=0.094), representing a greater than threefold difference. The moderate-to-high-risk group accounted for all four ED deaths and had higher ICU admission rates (11.3% vs. 9.5%). Comprehensive management and outcome data are summarized in Table 4. No additional subgroup or sensitivity analyses were performed beyond the predefined FLHASc risk stratification.

Discussion

In this single-center cohort of ED patients with hemoptysis, predefined FLHASc risk categories were associated with distinct clinical and radiological patterns. Patients in the moderate-to-high-risk group more frequently demonstrated features such as pure bright-red hemoptysis, recurrent bleeding episodes, and malignancy-related findings, whereas infectious patterns and lobar consolidation were more common among low-risk patients. These differences likely reflect the structural components of the FLHASc within this cohort rather than independent predictive

Table 2. Comparison of Laboratory, Radiological, and Bronchoscopic Findings Between FLHASc Risk Groups					
Characteristics		**Low risk (n=63)**	**Moderate to high risk (n=195)**	**X^2 / Z / t**	**p**
Laboratory findings					
Hemoglobin (g/dL)		12.7±2.9	12.2±2.41	-1.036	0.300
Hematocrit (%)		39.4±8.8	37.7±6.8	-0.669	0.503
White blood cell count (x10^3/µL)		9.23±4.2	8.77±6	-0.810	0.418
Platelet count (x10^3/µL)		243±106	254±95.2	-0.729	0.467
PT (s)		12.6 (9.2-35.1)	12.8 (8.9-262.1)	-1.216	0.224
aPTT (s)		26.3 (18.3-65)	25.7(18.2-129.3)	-0.793	0.428
INR		1.12 (0.9-3.11)	1.13 (0.8-23.72)	-0.997	0.319
Troponin T (pg/mL)		8.1 (2.32-1657)	7.6 (2-238)	-0.078	0.938
D-dimer (ng/mL)		531 (20-7189)	711 (10-9782)	-1.064	0.287
Urea (mg/dL)		32.7±40.3	31±18.3	-1.019	0.308
Creatinine (mg/dL)		0.88±0.2	0.84±0.55	-1.630	0.103
Sodium (mEq/L)		137±3.6	137±3.7	-0.734	0.463
Potassium (mEq/L)		4.35±0.53	4.24±0.47	-1.309	0.191
Calcium (mg/dL)		8.83±0.88	8.98±0.62	-0.729	0.144
Aspartate transaminase (IU/L)		18±31.8	16±30.3	-0.720	0.471
Alanine transaminase (IU/L)		14±12.7	13±30.7	-0.619	0.536
Total bilirubin (mg/dL)		0.36±0.35	0.39±0.12	-0.146	0.884
Direct bilirubin (mg/dL)		0.14±0.14	0.16±1.03	-0.787	0.431
Indirect bilirubin (mg/dL)		0.19±0.17	0.23±0.19	-0.116	0.908
C-reactive protein (mg/L)		13.7 (0.39-324)	20.3 (0.42-270)	-0.033	0.974
pH		7.40±0.05	7.41±0.06	-1.204	0.229
pCO_2 (mmHg)		42±7.1	42±8.4	-0.479	0.632
pO_2 (mmHg)		34±24.8	37±19.6	-0.145	0.885
HCO_3^- (mmol/L)		25.3±4.3	25.6±3.7	-0.309	0.757
Lactate (mmol/L)		1.4±0.9	1.4±1.6	-1.147	0.251
sO_2 (%)		65±21.8	67.6±25.2	-0.031	0.975
Chest X-ray findings, n (%)					
Chest X-ray performed	No	1 (1.6)	15 (7.7)	0.129	0.129
	Yes	62 (98.4)	180 (92.3)		
Chest X-ray results, n (%)	No abnormal findings	26 (41.3)	107 (54.9)	27.757	<0.001
	Tumor	4 (6.3)	36 (13.3)		
	Pleural effusion	4 (6.3)	8 (4.1)		
	Atelectasis	1 (1.6)	24 (12.3)		
	Consolidation	28 (44.4)	30 (15.4)		

Table 2. Continue

Characteristics		Low risk (n=63)	Moderate to high risk (n=195)	X^2 / Z / t	p
Chest CT findings, n (%)					
Chest CT performed	No	4 (6.3)	10 (5.1)	0.751	0.751
	Yes	59 (93.7)	185 (94.9)		
Cavitation	No	61 (96.8)	187 (95.9)	1.000	>0.999
	Yes	2 (3.2)	8 (4.1)		
Bronchiectasis	No	60 (95.2)	187 (95.9)	0.733	0.733
	Yes	3 (4.8)	8 (4.1)		
Segmental or lobar consolidation	No	30 (47.6)	146 (74.9)	16.311	<0.001
	Yes	33 (52.4)	49 (25.1)		
Ground-glass opacity	No	59 (93.7)	166 (85.1)	2.384	0.123
	Yes	4 (6.3)	29 (14.9)		
Pleural effusion	No	55 (87.3)	160 (82.1)	0.605	0.437
	Yes	8 (12.7)	35 (17.9)		
Solid pulmonary mass	No	55 (87.3)	135 (69.2)	7.107	0.008
	Yes	8 (12.7)	60 (30.8)		
Thoracic aortic rupture	No	63 (100)	194 (99.5)	1.000	>0.999
	Yes	0 (0)	1 (0.5)		
PTE	No	63 (100)	183 (93.8)	0.043	0.043
	Yes	0 (0)	12 (6.2)		
Bronchoscopic findings, n (%)					
Bronchoscopy performed	No	46 (73)	136 (69.7)	0.113	0.737
	Yes	17 (27)	59 (30.3)		
Bronchoscopy results, n (%)	Hemorrhage	7 (11.1)	27 (13.8)	2.853	0.848
	Endobronchial tumor	6 (9.5)	20 (10.3)		
	Tuberculosis	1 (1.6)	8 (4.1)		
	Vasculitis	0 (0)	4 (2.1)		
	Pneumonia	1 (1.6)	2 (1)		
	Aspergilloma	0 (0)	1 (0.5)		
	No abnormal findings	48 (76.2)	133 (68.2)		

Data were presented as median (minimum-maximum), mean±standard deviation or n (%). Statistically significant p values are in bold. Z, t, are the test statistics for Mann Whitney U, independent samples-t and Chi-Square test; respectively. Abbreviations: aPTT: Activated Partial Thromboplastin Time; HCO_3^-: Bicarbonate; CT: Computed Tomography; FLHASc: Florence Hemoptysis Score; INR: International Normalized Ratio; pCO_2: Partial Pressure of Carbon Dioxide (mmHg); pH: Potential of Hydrogen; pO_2: Partial Pressure of Oxygen (mmHg); PT: Prothrombin Time (seconds); PTE: Pulmonary Thromboembolism; SD: Standard Deviation; sO_2: Oxygen Saturation (%).

effects. Although numerically higher rates of short-term adverse outcomes and greater resource utilization were observed in the moderate-to-high-risk group, this study was not designed to evaluate predictive performance. Therefore, these findings should be interpreted as descriptive and hypothesis-generating rather than confirmatory.

This phenotypic separation should be interpreted cautiously, as part of the observed differences across FLHASc risk strata arises from the score's inherent structure. Key variables, such as pure-blood hemoptysis and pulmonary malignancy, are integral components of the score rather than independent outcomes; therefore, the higher prevalence of malignancy-related etiologies and mass lesions in higher-risk groups likely reflects score-driven

Table 3. Etiological distribution of hemoptysis according to FLHASc risk groups

Characteristics		Low risk (n=63)	Moderate to high risk (n=195)	X^2	p
Etiological causes of hemoptysis, n (%)					
Infectious causes	Bacterial Pneumonia	32 (91.4)	48 (81.4)	1.984	0.347
	Fungal Infection	1 (2.9)	2 (3.4)		
	Tuberculosis	2 (5.7)	9 (15.3)		
Malignancy	Primary lung cancer	10 (100)	49 (81.7)	0.980	0.642
	Endobronchial metastasis	0 (0)	5 (8.3)		
	Parenchymal metastasis	0 (0)	6 (10)		
Pulmonary	Bronchiectasis	4 (44.4)	5 (20.8)	2.722	0.445
	Diffuse alveolar hemorrhage	3 (33.3)	7 (29.2)		
	Chronic bronchitis	2 (22.2)	8 (33.3)		
	Autoimmune disease	0 (0)	4 (16.7)		
Cardiovascular	Congestive heart failure	6 (100)	9 (40.9)	6.669	0.026
	Pulmonary embolism	0 (0)	12 (54.5)		
	Ruptured thoracic aortic aneurysm	0 (0)	1 (4.5)		
Unknown		3 (9.1)	30 (90.9)	—	—

Data were reported as number (%) as appropriate. is the Chi-Square test statistic. Abbreviations: FLHASc: Florence Hemoptysis Score

enrichment rather than true independent prediction. Accordingly, the FLHASc should be interpreted primarily as a clinical triage tool, not a diagnostic classifier [7].

The phenotypic separation reflects core hemoptysis mechanisms, with high-risk cases characterized by pure bleeding, recurrence, and malignancy linked to vascular invasion and thromboembolism [8,9]. The low-risk pattern with consolidation reflects the slower course of inflammatory or infectious causes. This distinction emphasizes that, in ED hemoptysis, airway flooding and hypoxemia, rather than blood loss, pose the main threat, requiring early localization and airway protection [10,11]. This mechanistic interpretation provides the physiological basis for our observed clinical stratification and supports the risk-based differentiation embedded within the FLHASc.

Our cohort's etiological spectrum, featuring substantial burdens of infection, bronchiectasis, and malignancy, reflects the transitional epidemiology of Türkiye and similar regions [2,12]. This contrasts sharply with malignancy-predominant Western cohorts and has important implications for risk tool application [8,13]. Prognostic scores derived from malignancy-weighted populations may demonstrate spectrum bias when applied to mixed-etiology settings [7]. Our findings suggest that FLHASc-based categorization reflects observable clinical differences within this mixed-etiology cohort.

The lack of laboratory differences suggests that hemoptysis risk stratification depends mainly on clinical and radiological findings, as routine laboratory tests offer limited prognostic value for early assessment [14]. Similarly, a tertiary university hospital-based cohort including 391 patients reported no significant laboratory differences except for hemoglobin, supporting the

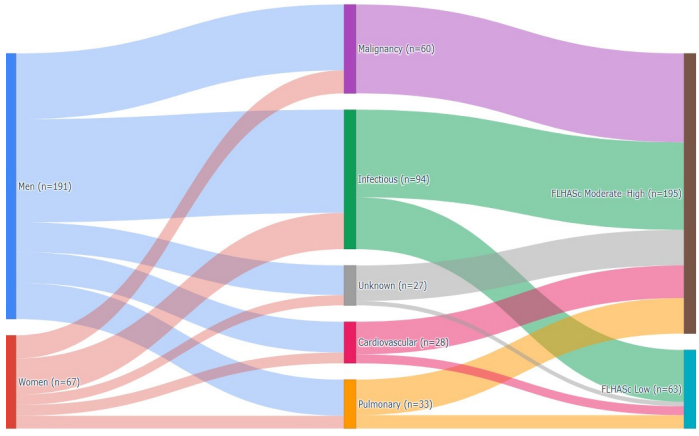

Figure 2. Sankey diagram showing the relationships among sex, etiologic category, and FLHASc risk strata in an emergency department hemoptysis cohort Flow thickness represents patient volume; malignancy and infectious etiologies predominate in moderate-to-high-risk cases, whereas pulmonary and cardiovascular causes are predominant in low-risk groups. Abbreviations: FLHASc: Florence Hemoptysis Score

Table 4. In-Hospital Management, Clinical Outcomes, and Disposition of Patients According to FLHASc Risk Groups

Characteristics		Low risk (n=63)	Moderate to high risk (n=195)	X^2 / Z	p
In-hospital management and interventions, n (%)					
Tranexamic acid treatment	No	8 (12.7)	26 (13.3)	1.000	>0.999
	Yes	55 (87.3)	169 (86.7)		
Mechanical ventilation	No	58 (92.1)	169 (86.7)	0.851	0.356
	Yes	5 (7.9)	26 (13.3)		
Blood transfusion	No	56 (88.9)	177 (90.8)	0.038	0.846
	Yes	7 (11.1)	18 (9.2)		
Blood transfusion products	No	56 (88.9)	177 (90.8)	3.451	0.285
	Packed red blood cells	7 (11.1)	11 (5.6)		
	Fresh frozen plasma	0 (0)	5 (2.6)		
	Platelet concentrate	0 (0)	2 (1)		
Clinical outcomes and disposition					
Emergency department disposition	Discharged	16 (25.4)	35 (17.9)	2.278	0.501
	Hospitalized (ward)	41 (65.1)	134 (68.7)		
	Transferred to ICU	6 (9.5)	22 (11.3)		
	Exitus in ED	0 (0)	4 (2.1)		
Short-term outcomes (28-day mortality) (Time to Death/Median days)		2.5 (2-3)	4 (1-24)	-0.798	0.464
Overall mortality	Survived	61 (96.8)	173 (88.7)	2.811	0.094
	Death	2 (3.2)	22 (11.3)		

Data were presented as median (minimum-maximum) or n (%). Statistically significant p values are in bold. Z, are the test statistics for Mann Whitney U and Chi-Square test; respectively. Abbreviations: ED: Emergency Department; FLHASc: Florence Hemoptysis Score; ICU: Intensive Care Unit.

concordance of our findings with previous evidence [15]. This consistency across cohorts reinforces the robustness of the clinical-radiological framework as the primary determinant of early risk differentiation.

Our imaging findings were consistent with current evidence-based practice, as higher-risk patients more frequently underwent CT angiography in routine clinical care [16,17]. The concordance between risk strata and imaging patterns observed in routine clinical practice aligns with current evidence-based imaging strategies and illustrates how predefined risk categories may correspond to differences in diagnostic resource utilization.

Although this study was not designed to establish management algorithms, the observed differences across FLHASc risk categories may offer preliminary insights for future research exploring structured care pathways. In our cohort, low-risk patients were more frequently associated with infectious patterns and lower intervention rates, whereas moderate-to-high-risk patients more commonly underwent advanced imaging and specialist evaluation. These findings describe current practice patterns rather than prescriptive recommendations and should be interpreted within the descriptive scope of the study.

Although differences in 28-day mortality, ICU admission, and invasive mechanical ventilation did not reach statistical significance, the consistent direction and magnitude of effects across outcomes suggest a clinically meaningful risk gradient. The lack of significance likely reflects limited event numbers rather than the absence of a true association, rendering these findings hypothesis-generating and supportive of further adequately powered prospective studies.

Future studies may explore the integration of risk-based tools into electronic health systems and assess their potential impact in prospective multicenter settings. Multicenter prospective validation using decision-curve analysis is essential to quantify clinical benefits. Further studies should refine score thresholds,

assess treatment–risk interactions, and include equity measures to ensure broader applicability in emergency care.

This study did not assess FLHASc discrimination via ROC analyses but evaluated the score in its intended real-world role as a first-line clinical stratification tool. Accordingly, emphasis was placed on outcome distribution and resource utilization across predefined risk strata rather than on predictive modeling or threshold optimization.

Limitations Study

This study has several limitations that should be considered when interpreting the findings. The single-center retrospective design limits generalizability and precludes causal inference. The FLHASc's dependency on historical elements introduces potential information bias, whereas the exclusion of patients with missing data may have created selection bias. Our inability to analyze time-to-intervention metrics prevented the assessment of care delays, and our dichotomized approach leaves ordinal threshold analysis for future investigation. Recognizing these limitations provides context for interpretation and defines clear directions for methodological improvement in subsequent studies. As this was a descriptive observational study, no formal predictive modeling or discrimination analysis was performed.

Conclusion

In this consecutive emergency department cohort, predefined FLHASc risk categories were associated with differences in clinical presentation and short-term outcomes. Although these findings provide descriptive insight into risk distribution in a mixed-etiology population, further prospective and multicenter studies are required before definitive conclusions can be drawn regarding predictive performance or implementation in routine practice.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Muğla Sıtkı Kocman University Institutional Review Board (Approval No.: 250104/141; Approval Date: 16/07/2025). The study complied with the Declaration of Helsinki and adhered to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Informed Consent: Informed consent was not obtained as this is a retrospective study.

Use of AI for Writing Assistance: Not declared.

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