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Risk Factors and Clinical Follow-up in Patients with Upper Gastrointestinal Bleeding

THESIS SUMMARY

of a PhD Thesis

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Research Supervisor:

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List of Abbreviations.

ACLD – Advanced chronic liver disease

ASA – American Society of Anaesthesiologists

COX-1 – cyclooxygenase-1

CSMCPI – Cedars Sinai Medical Centre Predictive Index

ESGE – European Society of Gastrointestinal Endoscopy

GAVE – Gastric Antral Vascular Ectasia

GBS – Glasgow-Blatchford Score

H.p. – *Helicobacter pylori*

HVPG – hepatic venous pressure gradient

INR – International normalised ratio

NSBBs – Non-Selective Beta-Blockers

NVUGIB – Non-variceal upper gastrointestinal bleeding

OTSC – Over-The-Scope Clips

PNED – Progretto Nazional Emoragia Digestiva

SSRIs – selective serotonin reuptake inhibitors

TIPS – Transjugular intrahepatic portosystemic shunt

I Introduction

Acute bleeding from the gastrointestinal tract is a potentially life-threatening emergency in medical practice, which remains a frequent cause of hospital admission. The annual hospitalization rate in the United States for gastrointestinal hemorrhage is 350/100,000 persons, which equals more than 1,000,000 hospitalizations per year at a cost of 3.3 billion dollars. The social significance of the problem stems from the fact that, despite advances in the development of therapeutic endoscopic modalities and the widespread use of acid-suppressing medications, the rate of in-hospital mortality remains relatively constant at 2–10%.

Upper gastrointestinal bleeding is defined as bleeding originating proximal to the ligament of Treitz, specifically from the esophagus, stomach, or duodenum. It can be acute or chronic, occult or overt, depending on the underlying lesion and its location. Although the etiology is often uncertain until esophagogastroduodenoscopy is performed, in clinical practice upper gastrointestinal bleeding is classified as variceal or non-variceal. This is due to the different management algorithms and prognostic factors associated with the two conditions. In addition, with the advancement of interventional gastroenterology and therapeutic endoscopy, post-procedural bleeding can be classified as a separate subcategory.

An adequate assessment of risk factors, proper prioritization of patients with bleeding, early resuscitation, and accurate endoscopic diagnosis are the key factors determining the patient's prognosis and outcome. Emergency esophagogastroduodenoscopy aims to identify the source of bleeding and to stop it using one of the therapeutic modalities for endoscopic hemostasis. Endoscopic hemostasis can be achieved using injection, mechanical, and thermal methods, as well as a combination of these techniques. In recent years, new techniques such as over-the-scope clips and topical agents have also been introduced.

Numerous topics, such as risk factor stratification, the strategy regarding blood transfusion in emergency settings, and the optimal timing for emergency endoscopy, continue to be the subject of debate. In addition, of particular importance is the management of patients undergoing treatment with anticoagulants and antiplatelet agents, including the indications and associated risk factors.

Upper gastrointestinal bleeding is a clinical syndrome encompassing various pathological conditions, with rapid dynamics and potential risk to the patient's life. Therefore, it requires timely diagnostic and therapeutic intervention carried out within a multidisciplinary team consisting of a gastroenterologist, internist, intensivist, surgeon, and radiologist.

II Aim and Objectives

1. Aim.

The aim of this study is to analyze the clinical, laboratory, endoscopic, and therapeutic characteristics of patients with acute upper gastrointestinal bleeding, with a view to identifying risk factors for severe disease, recurrence, and poor outcomes, as well as to optimize the diagnostic and therapeutic approach and clinical follow-up.

2. Objectives.

To achieve the above aim, we set the following objectives:

1. To perform a retrospective analysis of the demographic, clinical, laboratory, and endoscopic characteristics of patients with acute upper gastrointestinal bleeding who underwent emergency fibrogastroduodenoscopy between February 2021 – March 2024.

2. To identify risk factors for a severe non-variceal bleeding.

3. To investigate the risk factors for variceal bleeding in patients with chronic liver disease.

4. To evaluate the predictive value of established scoring systems (GBS, AIMS65, Rockall, etc.) with regard to major clinical events and outcomes in patients with variceal and non-variceal bleeding.

5. Conduct a direct comparison of established risk scoring systems (GBS, AIMS-65, Rockall, CANUKA, etc.) in terms of their predictive value for the risk of rebleeding, mortality, and the need for intervention.

6. To assess the time to rebleeding and to identify independent risk factors for the occurrence of recurrent bleeding.

7. To analyze the incidence, causes, and risk factors for in-hospital mortality in patients with acute upper gastrointestinal bleeding.

III Materials and Methods

1. Materials and Study Design.

The present paper describes a retrospective, observational, cohort, single-center study. The subjects of the study are all consecutive patients hospitalized at UMHAT “Sveta Marina”, Varna, who underwent emergency fibrogastroduodenoscopy at the endoscopy unit of the Gastroenterology Clinic due to suspected or confirmed acute upper gastrointestinal bleeding between February 2021 and March 2024. The study was approved by Decision No. 10/02/27/2025 of the Research Ethics Committee (REC) at Medical University “Prof. Dr. Paraskov Stoyanov” – Varna.

1.1. Inclusion Criteria.

The following criteria were selected for inclusion of patients in the study:

1) Age ≥ 18 years.

2) Clinical signs of upper gastrointestinal bleeding, including at least one symptom:

- Melena
- Hematemesis
- Hematochezia in the setting of hemodynamic instability

3) Emergency fibrogastroduodenoscopy performed during the hospitalization.

4) Endoscopically verified source of bleeding.

1.2. Exclusion Criteria.

Patients were excluded if they met any of the following criteria:

1) Age <18 years

2) Pregnancy

3) Patient refusal to undergo fibrogastroduodenoscopy

4) Lack of endoscopic evidence of a bleeding source

5) Incomplete medical records.

1.3. Data Sources.

Data for the included patients were collected retrospectively from several complementary hospital sources in order to ensure completeness and reliability. The primary information was extracted from electronic hospital records and medical histories, while endoscopic characteristics were obtained from the endoscopic information system. Laboratory parameters were collected from the electronic registers of the clinical laboratory; data on hemodynamic status and complications were obtained from the documentation of the emergency and intensive care units, and information on blood transfusions was obtained from transfusion documentation. This approach allowed the construction of a detailed and reliable clinical profile for each patient.

2. Methods.

2.1. Main Diagnostic Methods.

All patients included in the study were assessed according to standard clinical practice by means of a detailed medical history and physical examination.

2.1.1. Medical History

Upon admission, a detailed medical history was taken regarding the nature, onset, and progression of symptoms of acute gastrointestinal bleeding, previous episodes and treatment received, concomitant medical conditions, use of medications associated with an increased risk of bleeding, harmful habits, and episodes of previous hepatic decompensation. All data were

entered into a standardized electronic form to ensure the homogeneity and reproducibility of the information.

2.1.2. Physical Examination

Upon admission, a current status assessment was performed, focusing on vital signs, changes in mental status, signs of hypovolemia and liver dysfunction, abdominal status, and digital rectal examination. Based on hemodynamic stability, patients at high risk of shock requiring urgent resuscitation and intensive monitoring were identified. Admission parameters were also used to calculate prognostic scores and risk stratification, with all data systematically recorded in a database for subsequent analysis.

2.2. Laboratory tests.

All laboratory tests were performed in the accredited clinical laboratory of UMHAT "Sv. Marina" – Varna using standardized methods with assured quality control. Blood samples were collected upon admission or immediately prior to emergency fibrogastroduodenoscopy. In all patients, hematological, coagulation, and biochemical parameters were analyzed, including markers of hepatic and renal function, inflammation, and electrolyte balance. Laboratory results were used in the comprehensive assessment of the patient's clinical condition, encompassing the severity of blood loss, coagulation status disorders, hepatic and renal function, as well as the degree of organ involvement in acute bleeding.

2.3. Assessment of Hepatic Function and Portal Hypertension.

All patients with acute bleeding and evidence of chronic liver disease underwent a standardized assessment of liver function and the likelihood of clinically significant portal hypertension. The analysis included both laboratory parameters and the calculation of established non-invasive indices, as well as the use of imaging methods when available.

2.3.1. Etiology of Hepatic Injury.

The etiology of hepatic injury was investigated retrospectively, based on available medical documentation of the patients. Results of serological tests for chronic viral hepatitis B and C (HBsAg, anti-HBc Total, anti-HCV) were analyzed; when markers were positive, PCR data for HBV DNA or HCV RNA were reviewed. Available immunological tests (ANA, SMA, LKM, AMA, IgG) were evaluated in cases of suspected autoimmune liver disease, as well as metabolic markers — ferritin, transferrin saturation, ceruloplasmin. Information on alcohol consumption was derived from the medical history, noting the presence of harmful use or dependence. In patients with metabolic syndrome (diabetes mellitus, arterial hypertension, dyslipidemia, obesity), the likelihood of metabolic-associated steatotic liver disease (MASLD) was assessed. This retrospective approach allowed determination of the probable cause of hepatic injury and its comparison with clinical and endoscopic characteristics.

2.3.2. Hepatic Function.

Assessment of the hepatic functional reserve was determined by:

- *Child–Pugh Score*, calculated using five parameters: serum bilirubin, serum albumin, INR/prothrombin time, presence and degree of ascites, and degree of hepatic

encephalopathy. Patients were staged into classes A–C, with the classification serving to determine the severity of hepatic dysfunction and prognosis.

- *MELD Score*, calculated using the standard formula incorporating serum creatinine, bilirubin, and INR. MELD was used for objective staging of liver decompensation and identification of patients at high risk of adverse outcomes.

2.3.3. Non-Invasive Indices for Assessment of Fibrosis.

For indirect assessment of the degree of fibrosis, the following indices were calculated:

- *FIB-4 index*, based on age, AST, ALT, and platelet count;
- *APRI* (AST to Platelet Ratio Index).
- *AST/ALT ratio*

Elevated levels of these indices were considered indirect markers of advanced fibrosis.

2.3.4. Imaging Studies

When available, imaging studies (abdominal ultrasound and computed tomography) were used for additional assessment of morphological and hemodynamic changes associated with portal hypertension, including liver size and structure, portal vein diameter, splenomegaly, ascites, and collateral circulation.

2.4. Risk Stratification.

For the purpose of objective assessment of clinical severity, prediction of adverse outcomes, and support of therapeutic decisions in patients with acute upper gastrointestinal bleeding, validated prognostic scoring systems were applied to all participants in the study. These instruments allow early identification of high-risk patients, as well as a comparable and standardized evaluation of clinical results. Score calculation was performed based on data from medical documentation at admission and/or immediately after endoscopy. All obtained values were entered into an electronic database and used in subsequent statistical analysis.

2.4.1. Pre-Endoscopic Scoring Systems for Risk Stratification.

In the present study, established pre-endoscopic scoring systems based on clinical and laboratory parameters were applied for risk stratification prior to upper endoscopy.

Glasgow-Blatchford Score (GBS) assesses the likelihood of requiring intervention by incorporating hemodynamic parameters (systolic blood pressure, pulse), laboratory parameters (hemoglobin, urea), and clinical signs such as melena, syncope, liver disease, and cardiac failure.

AIMS65 serves to predict in-hospital mortality, incorporating five variables: serum albumin < 3.0 g/dL, INR > 1.5, altered mental status, systolic blood pressure ≤ 90 mmHg, and age ≥ 65 years.

ABC-score (Age, Blood tests, Comorbidities) combines age categories, key laboratory parameters (urea, creatinine, albumin), and severe comorbidities (liver cirrhosis, disseminated oncological disease, ASA class).

CANUKA-score integrates age, symptoms at admission (hematemesis, melena, syncope), hemodynamic stability (systolic blood pressure, pulse), laboratory results (hemoglobin, urea), and comorbidities (chronic liver disease, malignancy).

MAP(ASH)-score combines clinical parameters such as altered mental status, ASA class, pulse, and systolic blood pressure with laboratory results — urea, albumin, and hemoglobin, reflecting the severity of hemodynamic and metabolic disturbances.

Pre-endoscopic Rockall score assesses the risk of death through three clinical components: age, hemodynamic stability (pulse and blood pressure), and comorbidities.

These scoring systems were calculated for all patients at admission and used for systematic risk assessment, prediction of bleeding severity, and support of diagnostic and therapeutic decisions prior to endoscopy.

2.4.2. Post-Endoscopic Scoring Systems for Risk Stratification.

Post-endoscopic prognostic scoring systems were also applied in the present study; these integrate endoscopic findings with clinical and laboratory parameters for a more precise assessment of the risk of rebleeding, need for intervention, and mortality.

Complete Rockall score includes five components: age, hemodynamic stability at admission, severity of comorbidities, endoscopic diagnosis, and presence of high-risk endoscopic stigmata of bleeding, providing a comprehensive prognostic assessment following endoscopy.

PNED (Progetto Nazionale Emorragia Digestiva) represents an expanded post-endoscopic prognostic system encompassing the following variables: age > 80 years, time from symptom onset to hospitalization < 8 hours, hemoglobin < 70 g/l, assessment of comorbidities (chronic kidney disease, cirrhosis, neoplasm), ASA class, rebleeding, and failure of endoscopic hemostasis.

Cedars-Sinai Medical Center Predictive Index (CSMCPI) uses a combination of endoscopic findings (active bleeding, visible vessel, clot), clinical characteristics (time to symptom onset, comorbidities), and hemodynamic stability, predicting the probability of therapeutic failure and rebleeding.

Post-endoscopic scores were calculated immediately after primary endoscopy and integrated into the analysis to assess their contribution to predicting bleeding severity and clinical outcome.

2.5. Emergency Fibrogastroduodenoscopy.

In all patients of the study cohort, emergency fibrogastroduodenoscopy (FGD) was performed due to clinical evidence of acute upper gastrointestinal bleeding. The procedure was carried out following initial hemodynamic stabilization of the patient and in compliance with established standards. Endoscopic examinations were performed in the endoscopy unit of the Clinic of Gastroenterology at UMHAT “Sveta Marina” – Varna, by qualified gastroenterologists, using modern video-endoscopic equipment (Olympus CF-H 180 AL Exera II, Fujifilm EG-760R). All patients signed informed consent for upper endoscopy in accordance with the requirements of good clinical practice.

2.5.1. Timing of Endoscopy.

The time from admission to performance of FGD was recorded for each patient and classified into the following categories, in accordance with the consensus of the European Society of Gastrointestinal Endoscopy (ESGE):

- *emergent endoscopy* — within 6 hours,
- *urgent endoscopy* — within 12 hours,
- *early endoscopy* — within 24 hours,
- *delayed endoscopy* — beyond 24 hours.

2.5.2. Standard Examination Protocol.

During the endoscopic examination, the following were systematically performed:

- inspection of the esophagus, stomach, and duodenum;
- identification of the source of hemorrhage;
- assessment of bleeding activity;
- evaluation of the need for endoscopic hemostasis.

Endoscopic findings were thoroughly documented in the electronic endoscopic system and in the medical history, recording the type of bleeding (variceal or non-variceal), the localization of the lesion, the activity of the hemorrhage, and the therapeutic methods applied.

In patients with non-variceal bleeding of ulcer origin, bleeding activity was assessed according to the *Forrest* classification, as follows:

- Forrest Ia — active arterial bleeding (spurting);
- Forrest Ib — oozing;
- Forrest IIa — visible, non-bleeding vessel;
- Forrest IIb — adherent clot;
- Forrest IIc — dark spots on the base;
- Forrest III — clean base covered with fibrin deposit.

Lesions classified as Forrest Ia, Ib, IIa, and IIb were defined as high-risk for early rebleeding and represented an indication for immediate endoscopic hemostasis.

In patients with evidence of portal hypertension, esophageal and gastric varices were assessed according to:

- size of esophageal varices (*Baveno VII*) — small, moderate, and large;

- presence of high-risk stigmata — “red wale marks”, “cherry red spots”, hematocystic spots;
- presence of active variceal bleeding.

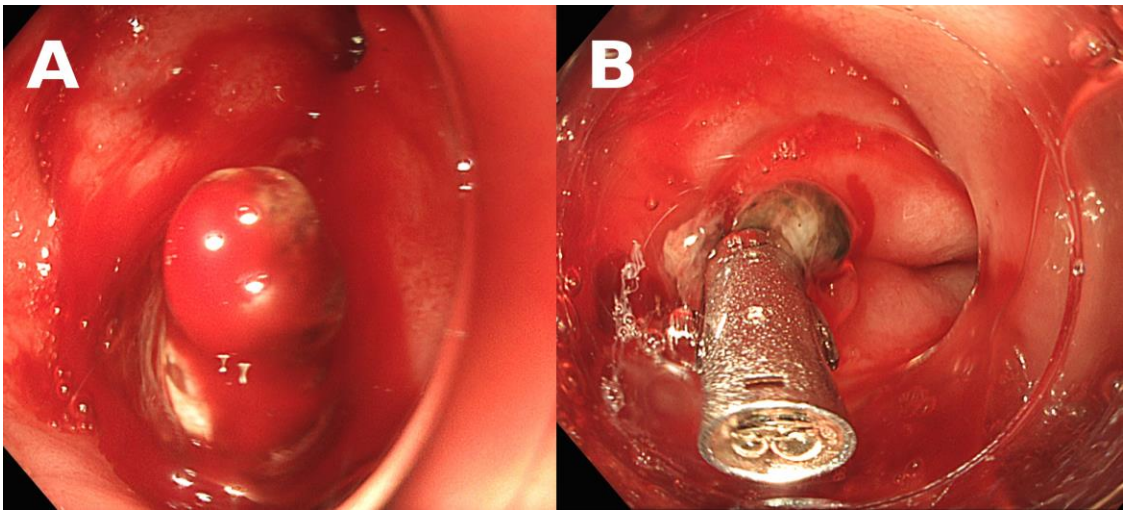
Gastric varices were classified according to the *Sarin* classification, as follows:

- GOV1 — gastroesophageal varices along the lesser curvature;
- GOV2 — gastroesophageal varices extending to the fundus;
- IGV1 — isolated fundal varices;
- IGV2 — isolated varices in other parts of the stomach (antrum, body).

2.5.3. Endoscopic Hemostasis.

During emergency fibrogastroduodenoscopy, endoscopic hemostasis was performed in all patients with confirmed active bleeding or high-risk stigmata of recent hemorrhage, tailored to the etiology and localization of the hemorrhage. For variceal bleeding from the esophagus, the primary therapeutic method was emergency or elective endoscopic band ligation following adequate resuscitation. For non-variceal bleeding, injection (adrenaline, ethoxysklerol), mechanical (hemoclips), and thermal methods were applied, either alone or in combination, depending on the endoscopic findings and lesion classification. In our center, injection therapy with cyanoacrylate for gastric variceal bleeding is not available; therefore, treatment was limited to the available alternative methods. In patients with massive variceal bleeding, balloon tamponade with the Sengstaken–Blakemore tube was used as a temporary, life-saving measure. In the presence of persistent or recurrent bleeding despite two consecutive unsuccessful attempts at endoscopic hemostasis, patients were referred for interventional or surgical treatment, in accordance with the clinical condition and multidisciplinary assessment.

Figure 1. Ulcer with a visible vessel — Forrest IIa (A). The lesion after successful placement of a hemostatic clip (B) (own archive)



2.6. Statistical Methods.

Statistical processing of the data in the present study was performed using IBM SPSS Statistics, version 26.0. All variables were coded and analyzed after verification of the completeness and logical correctness of the data. Continuous variables were described as mean ± standard deviation (SD) for normally distributed data, or as median and interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as absolute and relative frequencies (number and percentage). Normality of distribution was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests, as well as graphical methods. For comparisons between two independent groups, the independent samples t-test or the Mann–Whitney U test was used, depending on the distribution of the data. Analysis of categorical variables was performed using the χ^2 test, and in the case of small expected frequencies — using Fisher's exact test. Associations between continuous variables were assessed using correlation analysis (Pearson or Spearman, according to the type and distribution of the data). Analysis of time to rebleeding was performed using the Kaplan–Meier method, with the log-rank test used for comparison between groups; when required, the Cox proportional regression model was applied, and results are presented as hazard ratio (HR) with 95% CI. The prognostic value of various clinical and scoring parameters was analyzed by ROC analysis with calculation of the area under the curve (AUC), 95% CI, and p-value. Optimal cut-off values were determined using the Youden index (J), with sensitivity and specificity reported. For identification of independent predictors, logistic regression analysis was used (univariate and multivariate where applicable), and results are presented as odds ratio (OR) with 95% confidence intervals (95% CI). Statistical significance was accepted at $p \leq 0.05$.

IV Results and Discussion.

1. Characteristics of the studied population.

1.1. Demographic characteristics of the studied patients.

The studied population is characterized by a predominance of males (66.0%; n=138) over females (34.0%; n=71). The mean age of the patients is 66.0 ± 14.6 years, with a median of 68 years (19–93). The largest proportion consists of patients aged 61–80 years (53.1%), followed by the group aged 41–60 years (27.8%), while patients under 40 years account for only 6.3%.

Table 1. Demographic characteristics of the studied population (n=209)

Parameter	Value
Number of patients	209
Age – mean ± SD (years)	66.0 ± 14.6
Age – median (min–max)	68 (19–93)
Males, n (%)	138 (66.0%)
Females, n (%)	71 (34.0%)

Figure 2. Distribution of patients by age group.

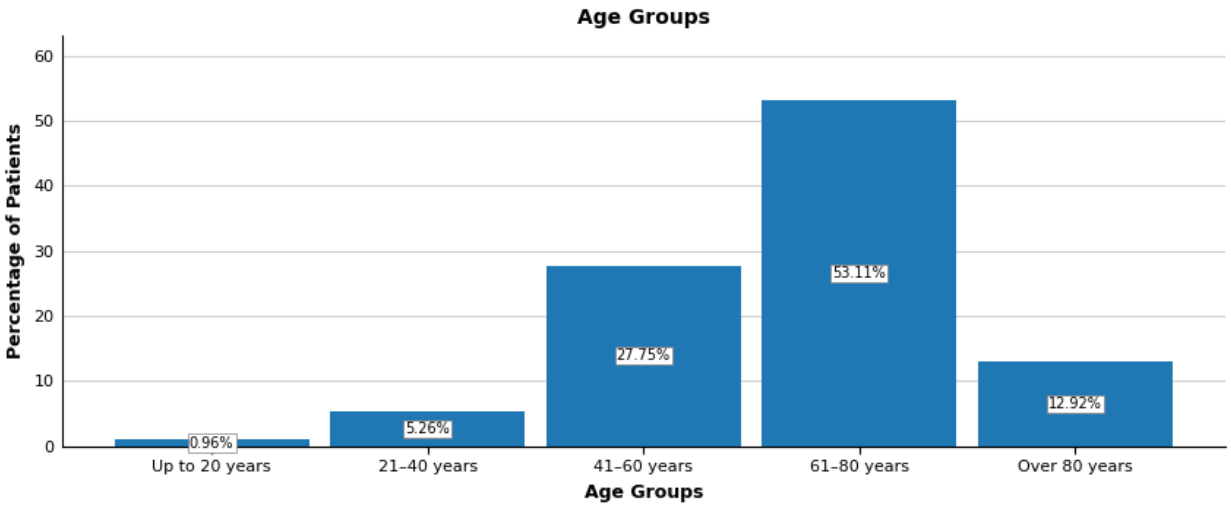
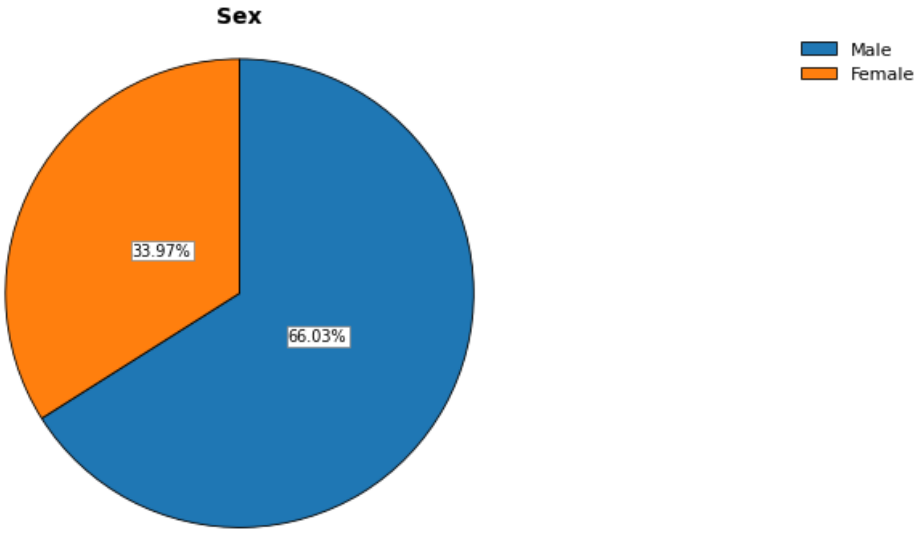


Figure 3. Distribution of patients by sex.



1.2. Clinical presentation on admission.

1.2.1. Symptoms of acute upper gastrointestinal bleeding.

The clinical presentation at admission was heterogeneous, with the most common manifestation being *melena*, identified in 86.1% (n=180) of patients. *Hematemesis* was observed in 42.1% (n=88), and *hematochezia and/or rectorrhagia* – in 20.1% (n=42). Although these symptoms are traditionally associated with lower gastrointestinal bleeding, their presence in the current cohort reflects cases of massive upper GI bleeding combined with rapid intestinal transit.

Table 2. Distribution of clinical symptoms in patients with acute upper GI bleeding

Symptom	Number (n)	Percentage (%)
Melena	180	86.1
Hematemesis	88	42.1
Hematochezia / rectorrhagia	42	20.1

1.2.2. Hemodynamic status at admission.

The hemodynamic status of patients at admission was assessed by measuring systolic blood pressure, heart rate, and calculating the shock index. The mean systolic blood pressure in the studied cohort was 101.7 ± 21.5 mmHg, with a median of 100 mmHg, and hypotension (SBP ≤ 90 mmHg) was identified in 41.6% of patients. Heart rate at admission showed a tendency toward tachycardia, with a mean of 98.6 ± 17.9 bpm, a median of 100 bpm and a maximum of 160 bpm, while tachycardia (HR ≥ 100 bpm) was found in 63.2% of patients. The shock index had a mean value of 1.03 ± 0.35, with a median of 1.0 and a maximum of 3.0, and elevated values ≥ 1.0 were recorded in 37.8% of patients.

Table 3. Hemodynamic parameters at admission

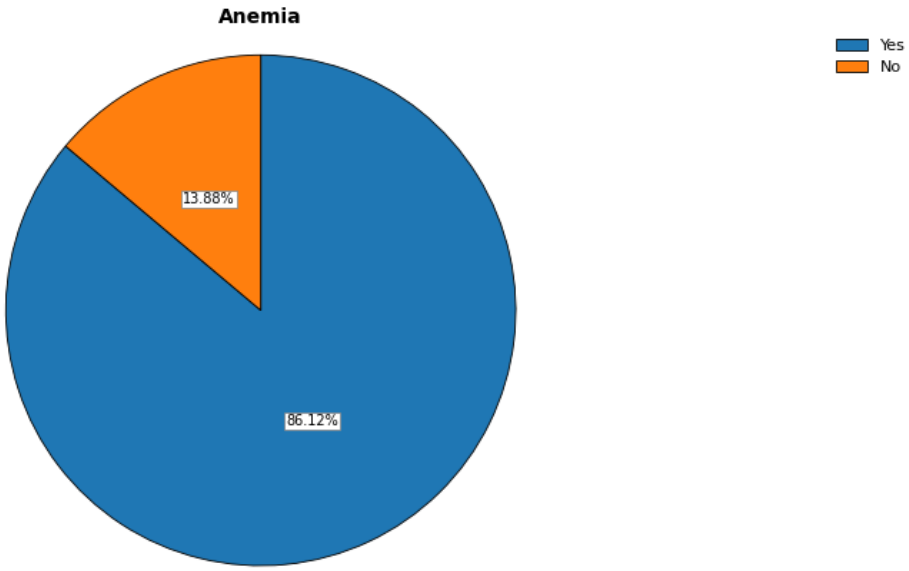
Parameter	Mean value ± SD	Median (min–max)	Pathological values* n (%)
Systolic blood pressure (mmHg)	101.7 ± 21.5	100 (40–170)	SBP ≤ 90 mmHg: n =87 (41.6%)
Heart rate (bpm)	98.6 ± 17.9	100 (45–160)	HR ≥ 100 bpm: n = 132 (63.2%)
Shock index	1.03 ± 0.35	1.0 (0.3–3.0)	SI ≥ 1.0: n = 79 (37.8%)

1.3. Laboratory parameters at admission.

1.3.1. Hematological parameters.

The hematological parameters at admission indicate significant blood loss in a large proportion of the patients. The mean hemoglobin level was 87.3 ± 33.3 g/L (median 82.5; 31–190 g/L), with anemia identified in 86.1% of patients. Hematocrit and red blood cell count were also reduced, while MCV and MCH were within the normocytic-normochromic range. The mean white blood cell count was 12.4 ± 7.8 ×10⁹/L, and platelets showed wide variability – from thrombocytopenia to reactive thrombocytosis.

Figure 4. Frequency of anemia in patients with acute upper GI bleeding.



1.3.2. Coagulation status.

Coagulation status at admission shows significant abnormalities, particularly in patients with underlying liver damage. The mean INR is 1.56 ± 1.02, with a median of 1.20 and a range of 0.78–7.81, while the prothrombin index is reduced to 64.8 ± 24.0%. The mean aPTT value is 31.7 ± 9.6 s, and the mean fibrinogen level is 3.30 ± 1.31 g/L. Clinically significant coagulopathy (INR > 1.5) was found in 40.8% of patients, prothrombin index < 50% in 30.3%, aPTT > 35 s in 22.8%, and fibrinogen < 2.0 g/L in 17.0%.

1.3.3. Biochemical parameters at admission.

Assessment of renal function revealed considerable variability in serum creatinine and urea values. The mean creatinine was 149.6 ± 148.3 μmol/L (median 100.5; 26–1098 μmol/L), and urea – 16.3 ± 12.2 mmol/L (median 13.25 mmol/L). Serum electrolytes in most patients were within relatively preserved limits. The estimated glomerular filtration rate (eGFR) was calculated for all patients. The mean eGFR at admission was 64.31 ± 33.06 ml/min/1.73 m² (median 63.5; 3–147 ml/min/1.73 m²), with a considerable proportion of patients having values below 60 ml/min/1.73 m², corresponding to moderate to severe renal impairment. Liver function parameters also varied widely, reflecting the heterogeneity of the studied population and the inclusion of patients with underlying liver disease. The mean values of ASAT and ALAT were 61.5 ± 231.0 U/L and 40.5 ± 117.8 U/L respectively, and of GGT and ALP – 126.8 ± 264.4 U/L and 124.9 ± 140.4 U/L. Total bilirubin had a mean value of 22.6 ± 57.2 μmol/L, and direct bilirubin – 15.1 ± 48.5 μmol/L, with the high maximum values in some patients suggesting more advanced liver damage. The mean albumin was 33.4 ± 7.3 g/L and total protein – 62.0 ± 10.6 g/L, indicating impaired synthetic capacity in a proportion of patients.

Table 4. Laboratory parameters at admission.

Parameter	Mean ± SD	Median	Min–Max	N (%)
Hematological parameters				
Hemoglobin (g/L)	87.3 ± 33.3	82.5	31–190	208 (99.5%)
Hematocrit	0.264 ± 0.097	0.25	0.10–0.66	209 (100%)
Red blood cells ($\times 10^{12}$/L)	3.00 ± 1.14	2.79	0.96–6.55	208 (99.5%)
MCV (fL)	90.6 ± 10.3	92.0	59–129	209 (100%)
MCH (pg)	28.9 ± 3.9	29.0	17–42	209 (100%)
Leukocytes ($\times 10^9$/L)	12.4 ± 7.8	11.0	1.08–72.9	209 (100%)
Platelets ($\times 10^9$/L)	247.5 ± 124.9	234.0	2–728	209 (100%)
Coagulation parameters				
INR	1.56 ± 1.02	1.20	0.78–7.81	201 (96.2%)
Prothrombin index (%)	64.84 ± 24.03	68.0	9–119	201 (96.2%)
aPTT (s)	31.71 ± 9.58	29.0	18.0–75.6	193 (92.3%)
Fibrinogen (g/L)	3.30 ± 1.31	3.21	0.60–8.70	165 (78.9%)
Renal parameters and electrolytes				
Creatinine (µmol/L)	149.6 ± 148.3	100.5	26–1098	208 (99.5%)
Urea (mmol/L)	16.3 ± 12.2	13.25	2.1–84.0	204 (97.6%)
Sodium (mmol/L)	137.6 ± 5.7	138.0	118–159	208 (99.5%)
Potassium (mmol/L)	4.34 ± 0.74	4.26	2.65–7.80	208 (99.5%)
Chloride (mmol/L)	102.1 ± 7.1	103.0	76–120	208 (99.5%)
eGFR (ml/min/1.73 m²)	64.3 ± 33.1	63.5	3–147	208 (99.5%)
Liver parameters and protein status				
ASAT (U/L)	61.5 ± 231.0	23.0	5–3157	204 (97.6%)
ALAT (U/L)	40.5 ± 117.8	16.5	5–1348	204 (97.6%)
GGT (U/L)	126.8 ± 264.4	42.0	4–2080	139 (66.5%)
ALP (U/L)	124.9 ± 140.4	88.0	31–1186	108 (51.7%)
Total bilirubin (µmol/L)	22.6 ± 57.2	9.0	2–646	173 (82.8%)
Direct bilirubin (µmol/L)	15.1 ± 48.5	4.0	1–549	163 (78.8%)
Albumin (g/L)	33.4 ± 7.3	34.0	16–49	166 (79.4%)

Parameter	Mean ± SD	Median	Min–Max	N (%)
Total protein (g/L)	62.0 ± 10.6	61.0	41–108	171 (81.8%)
Inflammatory markers				
CRP (mg/L)	46.6 ± 70.4	13.7	0–323	183 (87.6%)
ESR (mm/h)	37.6 ± 31.6	31.0	2–120	142 (67.9%)
LDH (U/L)	641.3 ± 818.7	355.0	197–4011	61 (29.2%)

1.3.4. Comparison of laboratory results in patients with variceal and non-variceal bleeding.

In variceal bleeding, more pronounced anemia and thrombocytopenia are observed (Hb 83.1 vs. 87.7 g/L; platelets 120.9 vs. 260.2 $\times 10^9$/L), characteristic of hypersplenism in portal hypertension, while leukocytes are higher in patients with non-variceal bleeding, likely due to more frequent concomitant inflammation. As expected, the group with variceal bleeding showed more pronounced liver damage—higher total and direct bilirubin, GGT, and ALP, and lower albumin (28.9 vs. 34.0 g/L). Patients with non-variceal bleeding have higher creatinine and urea levels, lower eGFR, and significantly higher CRP, suggesting more frequent acute renal injury, hypovolemia, and a more pronounced inflammatory response. Coagulation disturbances are more severe in variceal bleeding, with a reduced prothrombin index (54.3% vs. 65.9%) and lower fibrinogen levels (2.40 vs. 3.40 g/L) at a similar INR, corresponding to coagulopathy characteristic of advanced hepatic dysfunction.

Table 5. Comparison of laboratory parameters in variceal and non-variceal bleeding.

Parameter	Variceal bleeding	Non-variceal bleeding
Hemoglobin (g/L)	83.1 ± 27.9	87.7 ± 33.9
Anemia (%)	94.7%	85.3%
Platelets ($\times 10^9$/L)	120.9 ± 61.2	260.2 ± 122.7
Leukocytes ($\times 10^9$/L)	9.0 ± 4.2	12.7 ± 8.0
ASAT (U/L)	52.5 ± 43.2	62.4 ± 242.3
ALAT (U/L)	39.1 ± 28.7	46.8 ± 77.4
Total bilirubin (μmol/L)	29.9 ± 22.3	21.7 ± 59.9
Direct bilirubin (μmol/L)	19.3 ± 20.6	14.6 ± 50.8
Albumin (g/L)	28.9 ± 8.0	34.0 ± 7.1
Creatinine (μmol/L)	106.5 ± 56.9	153.9 ± 154.0
Urea (mmol/L)	11.7 ± 7.1	16.8 ± 12.5
eGFR (ml/min/1.73 m²)	77.0 ± 32.7	63.0 ± 32.9
CRP (mg/L)	32.0 ± 46.9	48.2 ± 72.4
INR	1.63 ± 0.87	1.54 ± 1.03
Prothrombin index (%)	54.3 ± 14.5	65.9 ± 24.6
Fibrinogen (g/L)	2.40 ± 0.87	3.40 ± 1.32

1.4. Comorbidities.

Comorbidities are an important factor determining the clinical course, therapeutic approach, and prognosis in patients with acute upper gastrointestinal bleeding. The presence of comorbidities is associated with a more severe clinical presentation, a higher risk of complications, including rebleeding and in-hospital mortality. In the present study, concomitant diseases were grouped into major nosological categories, allowing a detailed assessment of the risk profile of the studied cohort.

Table 6. Comorbidities.

Group/condition	n (number of patients)	% (percentage)
Cardiovascular diseases	156	74.6
Status post acute vascular event	88	42.1
Status post vascular interventions	25	12.0
Diabetes mellitus	60	28.7
Pulmonary diseases	38	18.2
Oncological diseases	42	20.1
Chronic kidney disease	42	20.1
Chronic kidney disease on hemodialysis*	12	5.7
Liver cirrhosis	41	19.6
COVID-19 infection	9	4.3
Rheumatological disease	18	8.6
Recent surgical intervention (<1 month)	25	12.0
Coagulation disorders	3	1.4
Myeloproliferative disease	8	3.8

** The percentage is relative to the total cohort; within the CKD group, patients on hemodialysis account for 28.6%.*

Note: Patients may have more than one comorbidity, therefore the sum of percentages exceeds 100%.

1.4.1. Liver cirrhosis.

Cirrhosis was identified in 41 of 209 patients (19.6%), confirming the role of chronic liver disease as an important risk factor both for variceal and non-variceal bleeding from the upper gastrointestinal tract.

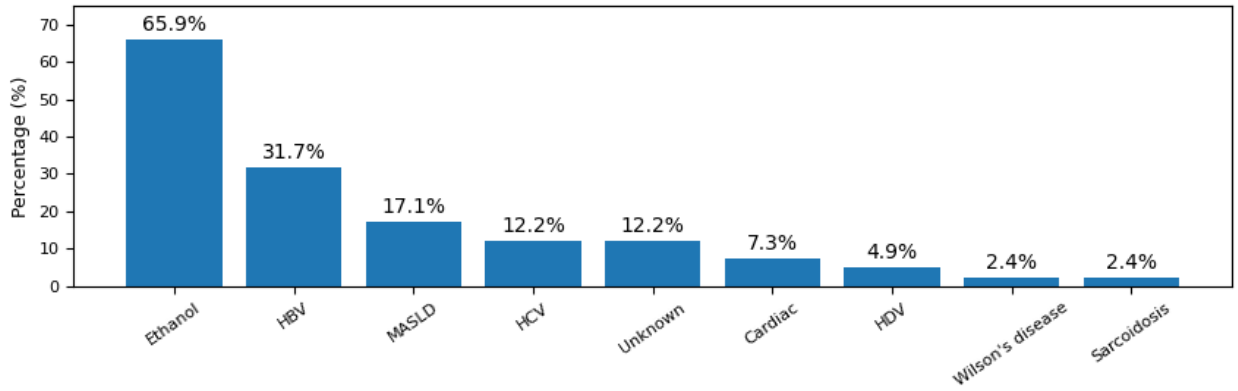
1.4.4.1. Etiology of cirrhosis.

The etiological analysis of cirrhosis shows a predominance of alcoholic etiology, identified in 27 patients (65.9% of patients with cirrhosis). Viral hepatitis also occupies a significant place, with HBV infection registered in 13 patients (31.7%), HCV – in 5 patients (12.2%), and HDV – in 2 patients (4.9%). In 7 patients (17.1%) cirrhosis was due to metabolic dysfunction-associated steatotic liver disease (MASLD). Less frequently, cardiac cirrhosis, Wilson's disease and sarcoidosis were identified, as well as cases with unspecified etiology.

Table 7. Etiology of liver cirrhosis

Etiology	Number of patients (n)	Percentage (%)
Alcoholic (ethanol)	27	65.9
HBV infection	13	31.7
HCV infection	5	12.2
HDV infection	2	4.9
MASLD	7	17.1
Cardiac cirrhosis	3	7.3
Wilson's disease	1	2.4
Sarcoidosis	1	2.4
Unspecified etiology	5	12.2

Figure 5. Distribution of etiological factors for liver cirrhosis in the studied cohort.



1.4.4.2. Degree of decompensation.

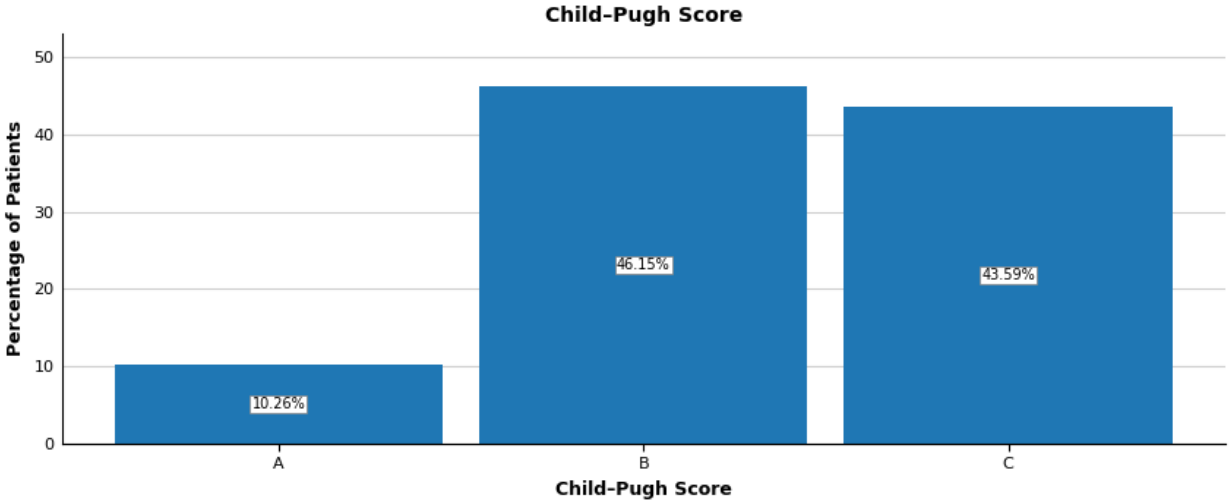
The degree of decompensation in patients with liver cirrhosis was assessed using the established prognostic systems *Child–Pugh* and *MELD*, which reflect the functional reserve of the liver and are directly associated with the risk of complications and adverse outcome.

Child–Pugh score

Child–Pugh scoring was possible in 39 of 41 patients with liver cirrhosis (95.1%). The distribution by class shows a clear predominance of advanced stages of the disease. Class A was identified in 4 patients (10.3%), class B – in 18 patients (46.2%), and class C – in 17 patients (43.6%). Accordingly, over 89% of patients with cirrhosis (class B and C) are in the stage of

decompensated liver disease. This distribution is in accordance with the high frequency of complications, including variceal bleeding, in these patients.

Figure 6. Distribution by Child-Pugh class in patients with liver cirrhosis.



MELD score

The MELD score was calculated in 38 patients with cirrhosis. The mean MELD is 18.03 ± 6.91, with a median of 17 and a range of 8 to 35 points. These values reflect moderately to severely impaired liver function and an increased short-term risk of adverse clinical outcome. The predominance of MELD values above 15 supports the observation that a substantial proportion of patients with cirrhosis had advanced hepatic dysfunction at the time of hospitalization.

Table 8. MELD score in patients with liver cirrhosis

Parameter	Value
Number of patients (n)	38
Mean ± SD	18.03 ± 6.91
Median (IQR)	17.0
Minimum – maximum	8 – 35

1.4.4.3. Varices in patients with liver cirrhosis.

Among patients with liver cirrhosis (n = 41), the presence and degree of varices were systematically assessed at emergency fibrogastroduodenoscopy. ***Esophageal varices*** were identified in the majority of cirrhotic patients (92.7%, n=38), and were classified according to the *Baveno criteria*. Small varices were recorded in 7 patients (17.1%), moderate varices – in 4 patients (9.8%), and large varices – in 14 patients (34.1%). In a significant proportion of patients, high-risk morphological features were identified at emergency endoscopy, such as red signs (*red wale markings, cherry red spots, hematocystic spots*), which were diagnosed in a total of 13 patients (31.8%). Of these, 9 patients (22.0%) had large varices with red signs, and 4 patients

(9.8%) – moderate varices with red signs. In summary, high-risk varices (moderate/large with red signs) were present in 27 of 41 patients with cirrhosis, representing 65.9% of this subgroup. ***Gastric varices*** were diagnosed in 5 patients (12.2%), and in some of them were combined with esophageal varices, reflecting advanced portal hypertension. With regard to the medical history, more than half of the patients with cirrhosis and varices (n = 24; 58.5%) had ***known varices in the past***, indicating a chronic and monitored nature of the disease in a substantial proportion of patients. Nevertheless, prophylactic strategies had been applied to a limited extent – only 12 patients (29.3%) were on ***primary or secondary prophylaxis with a non-selective β-blocker***, and ***prior endoscopic band ligation or sclerotherapy*** was documented in 14 patients (34.1%). These data highlight a significant discrepancy between the high endoscopic risk and the prophylactic measures actually applied, which likely contributes to the frequency of variceal bleeding in the studied population.

Table 9. Varices in patients with liver cirrhosis.

Parameter	Number of patients (n)	Percentage (%)
Esophageal varices	38	92.7
• Small	7	17.1
• Moderate	4	9.8
• Large	14	34.1
• Moderate with red signs	4	9.8
• Large with red signs	9	22.0
Gastric varices	5	12.2
Known varices in the past	24	58.5
Prophylaxis with non-selective β-blocker	12	29.3
Prior endoscopic ligation/sclerotherapy	14	34.1

1.5. Use of risk medications.

Pharmacological therapy represents an important modifiable factor that can significantly influence both the risk of onset and the clinical course of acute upper gastrointestinal bleeding. In this context, the analysis of high-risk medication use is of key importance for the comprehensive assessment of the patient, for risk stratification, and for optimizing the therapeutic strategy.

Table 10. Main groups of high-risk medications

Drug group	Number of patients (n)	Percentage (%)
NSAIDs	27	12.9
Glucocorticosteroids	10	4.8
Antiplatelet agents	54	25.8
Anticoagulants	72	34.4

Drug group	Number of patients (n)	Percentage (%)
SSRI	3	1.4

1.5.1. Antiplatelet agents.

Particular attention was paid to antiplatelet therapy, including monotherapy and dual antiplatelet therapy (DAPT). In the studied cohort, use of platelet antiplatelet agents was documented in 54 of the total 209 patients, representing 25.8% of all included patients. Among patients on antiplatelet therapy, the use of ***cyclooxygenase inhibitors*** predominated, recorded in 39 patients (18.7% of the entire cohort), with this group consisting primarily of *acetylsalicylic acid (aspirin)*. ***Thienopyridines*** – blockers of ADP receptors on the platelet membrane (e.g. *clopidogrel*) – were used in 22 patients (10.5%). Less frequently, the use of ***phosphodiesterase inhibitors*** was noted, identified in 4 patients (1.9%). Eight of the studied patients were on ***dual antiplatelet therapy (DAPT)***, representing 3.8% of the entire studied cohort and 14.8% of patients receiving antiplatelet treatment. This subgroup includes patients at high thrombotic risk, most often following coronary interventions, in whom the balance between prevention of stent occlusion and the risk of bleeding is particularly precarious.

Table 11. Antiplatelet therapy.

Group	Number of patients (n)	Percentage (%)
Patients on antiplatelet therapy (total)	54	25.8
Dual antiplatelet therapy (total)	8	3.8
– of antiplatelet therapy	8 / 54	14.8
Cyclooxygenase inhibitors (aspirin)	39	18.7
Thienopyridines (ADP-receptor blockers)	22	10.5
Phosphodiesterase inhibitors	4	1.9

1.5.2. Anticoagulants.

Anticoagulant treatment at admission was documented in 72 of the total 209 patients, representing 34.4% of the studied cohort. With regard to the class of anticoagulants used, the most frequently applied were the novel ***direct oral anticoagulants (DOACs)***, recorded in a total of 35 patients, corresponding to 16.7% of the entire cohort. Among DOACs, the most frequently used was *edoxaban* (12 patients; 34.3% of all on DOACs), followed by *rivaroxaban* and *apixaban* (9 patients each; 25.7% each), and *dabigatran* (5 patients; 14.3%). Nineteen patients (9.1% of all patients) were on treatment with ***vitamin K antagonists,*** reflecting their continued use in certain clinical indications despite the growing use of DOACs, likely related to their lower cost. Separately, ***direct anticoagulants for parenteral administration*** were analyzed, including low-molecular-weight heparins used at therapeutic and prophylactic doses in 23 patients (11.0%).

Table 12. Anticoagulant therapy.

Group	Number of patients (n)	% of total cohort
Patients on anticoagulant therapy	72	34.4%
Direct parenteral anticoagulants	23	11.0%
Vitamin K antagonists	19	9.1%
DOAC	35 1	6.7%
– Dabigatran	5 2	.4%
– Rivaroxaban	9 4	.3%
– Apixaban	9 4	.3%
– Edoxaban	12 5	.7%

1.5.3. Other risk medications and gastroprotective therapy.

Use of *NSAIDs* was identified in 27 of 209 patients (12.9%), *systemic glucocorticosteroids* – in 10 (4.8%), and *SSRIs* – in 3 patients (1.4%). *Gastroprotective therapy* with proton pump inhibitors or H_2-receptor blockers prior to hospitalization was documented in 33 patients (15.8%).

1.6. Other risk factors.

In the present study, non-pharmacological lifestyle-related risk factors were also analyzed. Alcohol use was documented in 79 of 209 patients (37.8%), tobacco smoking – in 84 (40.2%), and use of narcotic substances – in 6 patients (2.9%).

Table 13. Other risk factors

Risk factor	Number of patients (n)	Percentage (%)
Alcohol consumption	79	37.8
Tobacco smoking	84	40.2
Use of narcotic substances	6	2.9

1.7. Emergency fibrogastroduodenoscopy

1.7.1. Time to emergency fibrogastroduodenoscopy.

The time from admission to emergency fibrogastroduodenoscopy was analyzed in all 209 patients. The *mean time to endoscopy* was 4.04 ± 4.66 hours, median 2 hours. Half of the patients (50.2%) were examined within 2 hours, and 67.5% – within 3 hours. Upon stratification by ESGE categories, *emergent endoscopy* (< 6 hours) was performed in 82.8% of patients, *urgent* (< 12 hours) – in 13.9%, *early* (< 24 hours) – in 2.4%, and *delayed* (> 24 hours) – in 1.0%. Although ESGE recommends early EGD within 12 hours for suspected variceal bleeding and within 24 hours for most non-variceal cases, in our cohort a substantial proportion of patients

underwent emergent endoscopy, likely due to the high frequency of severe bleeding and the characteristics of local emergency organization. This approach is consistent with recommendations for severe cases, but raises the question of possible over-indication in some patients at lower risk and underscores the importance of systematic pre-endoscopic risk stratification.

Table 14. Distribution by time categories according to ESGE.

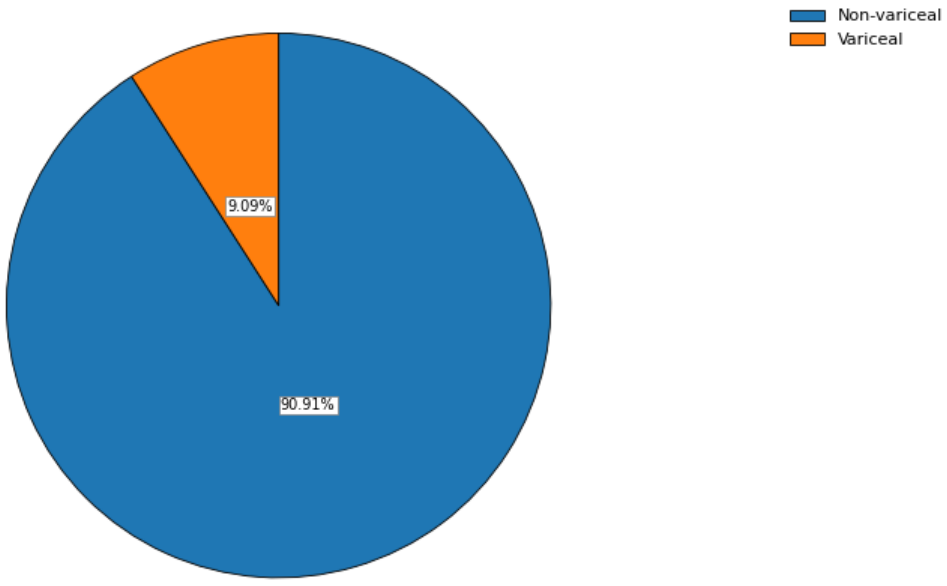
Time to EGD	Definition	Number of patients (n)	Percentage (%)	Cumulative percentage (%)
Emergent	< 6 hours	173	82.8	82.8
Urgent	6–12 hours	29	13.9	96.7
Early	12–24 hours	5	2.4	99.1
Delayed	> 24 hours	2	1.0	100.0
Total		209	100.0	

1.7.2. Endoscopic findings.

1.7.2.1. Type of bleeding: variceal versus non-variceal.

In the study cohort of 209 patients, non-variceal bleeding predominated – identified in 190 patients (90.9%), while variceal bleeding was diagnosed in 19 (9.1%). This distribution reflects the typical epidemiology of acute gastrointestinal bleeding, in which non-variceal etiologies are quantitatively dominant, but variceal bleeding, although less frequent, is clinically more severe and associated with a higher risk of rebleeding and adverse outcome.

Figure 7. Distribution according to type of bleeding.



1.7.2.2. Endoscopic etiology in non-variceal bleeding.

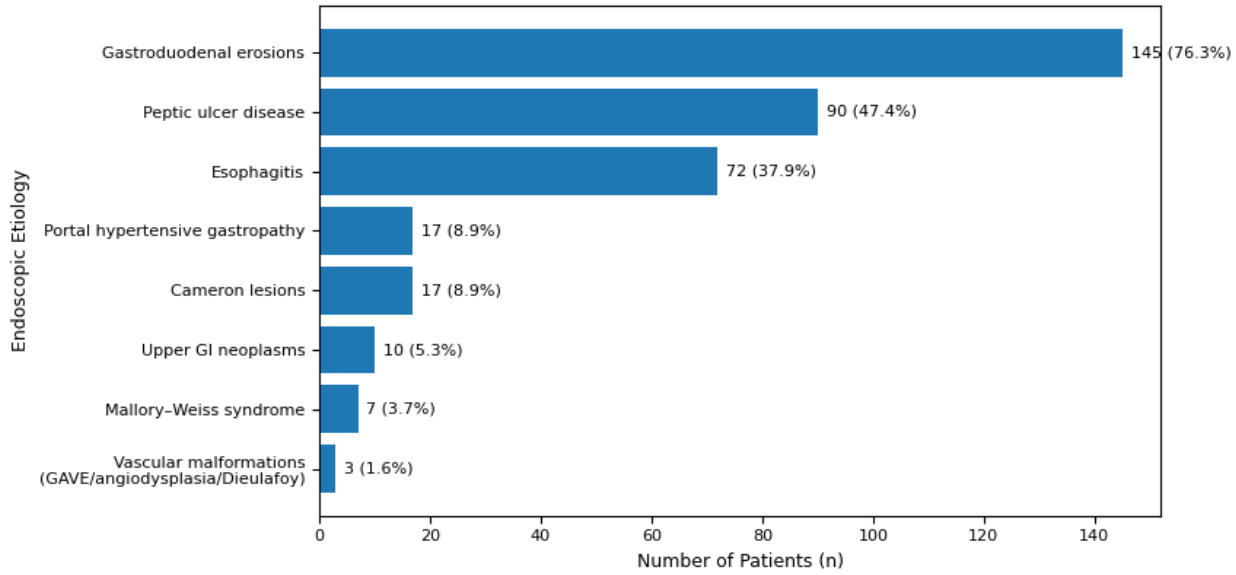
Analysis of the endoscopic findings in this group reveals a heterogeneous etiological structure, with dominance of peptic lesions, as erosive changes of the upper GI tract represent the most common endoscopic diagnosis. Despite their lower frequency, peptic ulcer disease and neoplastic lesions are associated with a higher risk of clinically significant bleeding and the need for endoscopic hemostasis.

Table 15. Endoscopic etiology in non-variceal upper gastrointestinal bleeding (n = 190)

Endoscopic finding	Number of patients (n)	Percentage (%)
Gastroduodenal erosions – total	145	76.3
Erosive gastritis	134	70.5
Erosive bulbitis	50	26.3
Peptic ulcer disease – total	90	47.4
Duodenal ulcer	56	29.5
Gastric ulcer	37	19.5
Anastomotic ulcer	6	3.2
Esophagitis – total	72	37.9
Reflux esophagitis	61	32.1
Peptic ulcer of the esophagus	6	3.2
Other forms / foreign body	5	2.6
Cameron ulcers	17	8.9
Portal hypertensive gastropathy	17	8.9
Mallory–Weiss syndrome	7	3.7
Neoplasms of the upper GI tract – total	10	5.3
Gastric neoplasms	7	3.7
Esophageal neoplasms	4	2.1
Vascular malformations (GAVE/angiodysplasia/Dieulafoy)	3	1.6

Note: In some patients more than one endoscopic finding was identified, therefore the sum of percentages exceeds 100%.

Figure 8. Endoscopic etiology in non-variceal upper GI bleeding.



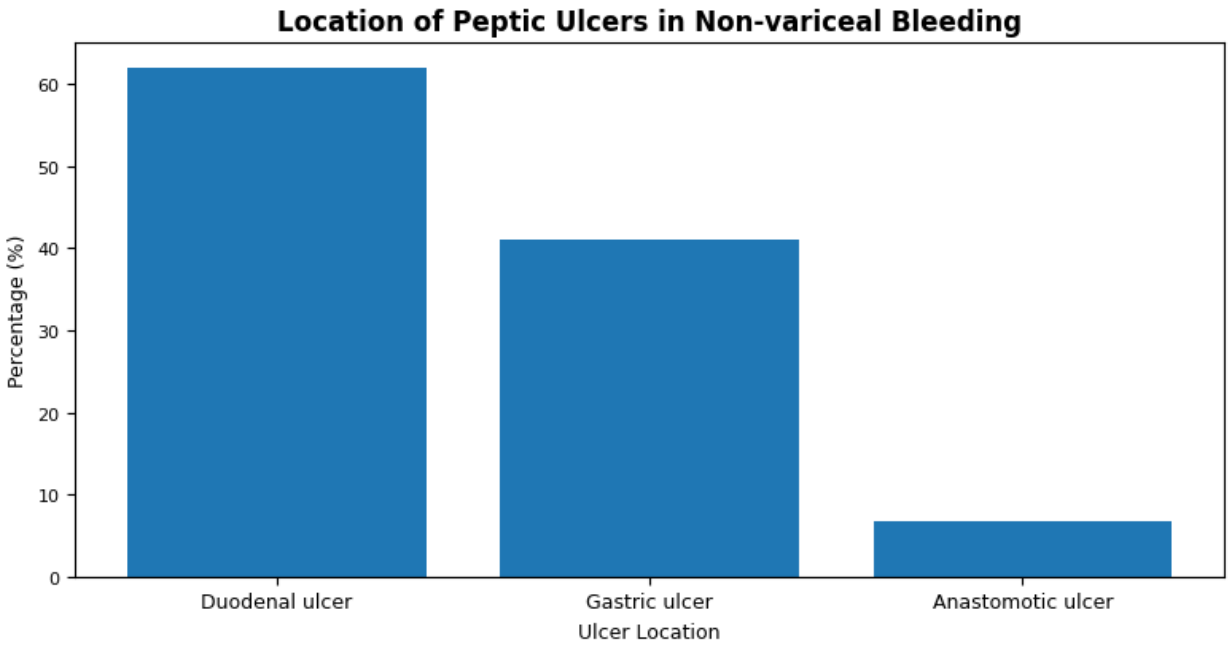
1. Gastroduodenal erosions.

Gastroduodenal erosions are the most common endoscopic finding in patients with non-variceal bleeding and were identified in 145 of 190 patients (76.3%). Erosive gastritis predominated in the group (134 patients, 92.4% of erosive lesions), while erosive bulbitis was observed in 50 patients (34.5%); their frequent coexistence reflects diffuse mucosal damage associated with pharmacological and systemic risk factors – advanced age, comorbidities, and use of gastrotoxic medications (NSAIDs, aspirin).

2. Peptic ulcer disease.

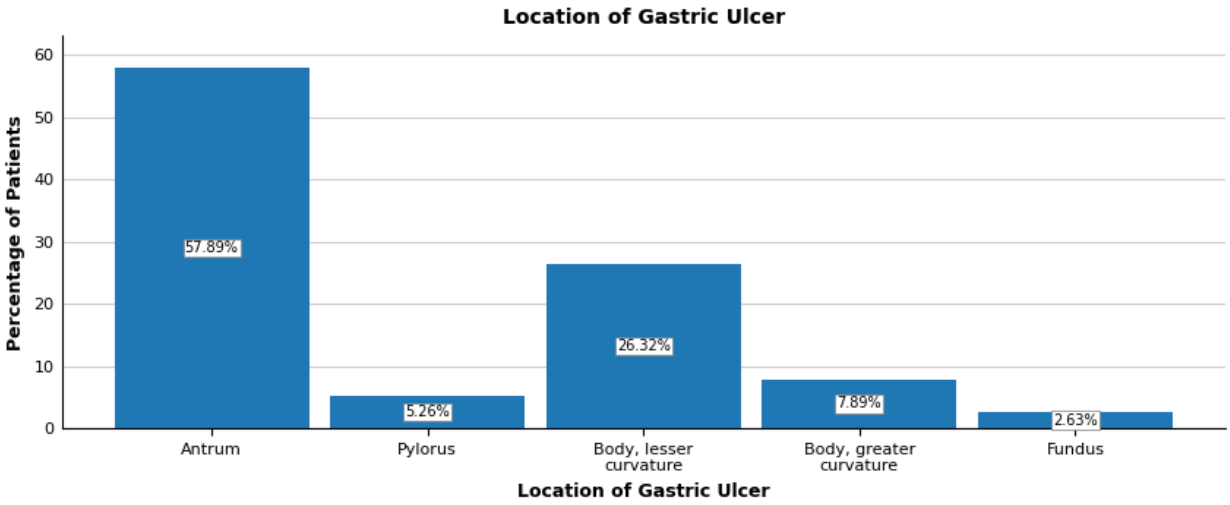
Peptic ulcer disease (PUD) was identified in 90 patients, corresponding to 47.4% of all cases with non-variceal bleeding. Analysis within the group demonstrates a clear predominance of duodenal ulcers. Duodenal ulcer was identified in 56 patients, corresponding to 62.2% of all cases of peptic ulcer disease. Gastric ulcers were diagnosed in 37 patients (41.1%), while anastomotic ulcers were recorded less frequently – in 6 patients (6.7%). Some patients had more than one ulcer site, which accounts for the sum of percentages exceeding 100%.

Figure 9. Distribution of peptic ulcers by location in patients with non-variceal bleeding.



More detailed analysis of the subgroup with gastric ulcer showed a predominance of the antral location, identified in 22 patients, corresponding to 57.9% of all cases of gastric ulcer disease. Less frequently, the ulcer lesions were located in the corpus of the stomach along the lesser curvature (26.3%), the greater curvature (7.9%), the pyloric region (5.3%), and the fundus (2.6%).

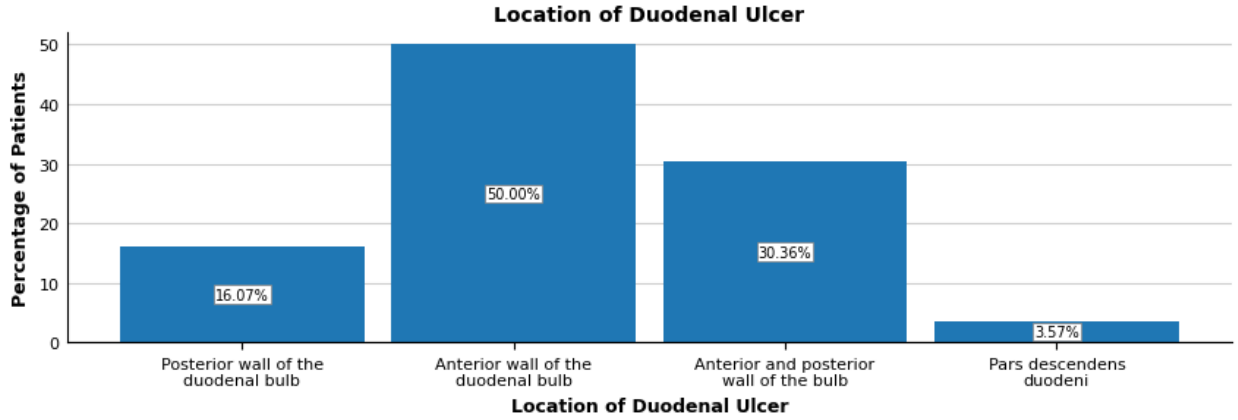
Figure 10. Distribution of gastric ulcers by location.



For duodenal ulcers, the most frequent location was the anterior wall of the duodenal bulb, identified in 28 patients (50.0%), followed by combined involvement of the anterior and posterior wall of the bulb (“kissing ulcers”) in 17 patients (30.4%). An isolated ulcer of the

posterior wall of the duodenal bulb was recorded in 9 patients (16.1%), while ulcer lesions in the pars descendens duodeni were observed rarely – in 2 patients (3.6%).

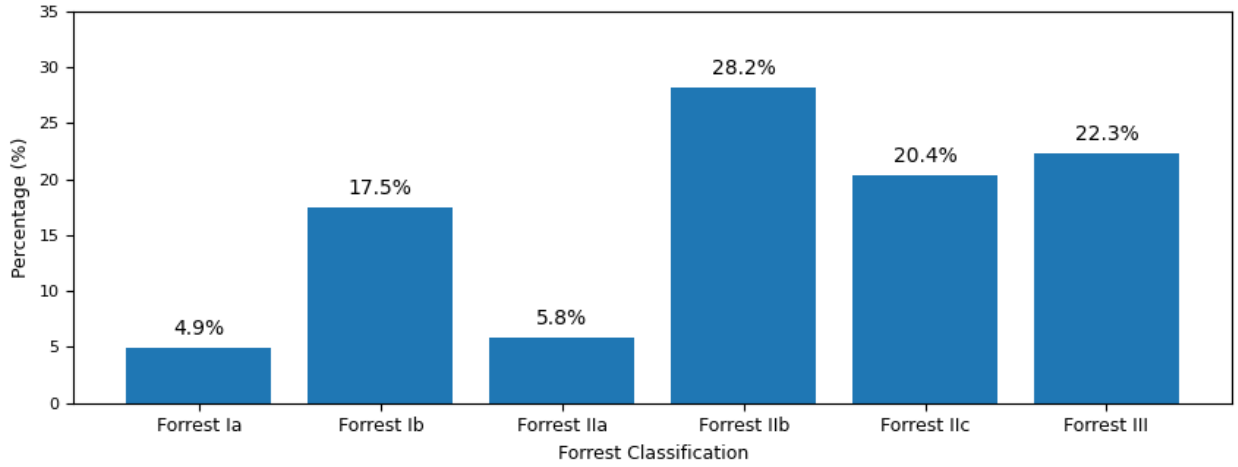
Figure 11. Distribution of duodenal ulcers by location.



Forrest classification of ulcer lesions.

The endoscopic activity of peptic ulcers was assessed according to the Forrest classification. The most common were Forrest IIb ulcers with an adherent clot – 29 patients (28.2%), followed by Forrest III – 23 (22.3%) and Forrest IIc – 21 (20.4%). Active bleeding was identified in 23 patients (22.4%), including Forrest Ib in 18 (17.5%) and Forrest Ia in 5 (4.9%), while Forrest IIa was observed in 6 patients (5.8%). A substantial proportion of patients presented with high-risk lesions (Forrest Ia, Ib, IIa, and IIb), underscoring the need for timely endoscopic assessment and hemostatic therapy.

Figure 12. Distribution of ulcer lesions according to the Forrest classification in patients with non-variceal bleeding.



3. Esophagitis

Esophagitis was identified in 72 of 190 patients with non-variceal bleeding (37.9%). Erosive esophagitis in the setting of gastroesophageal reflux disease predominated – 61 patients (84.7% of the group), while peptic ulcer of the esophagus and other forms of esophagitis were

recorded in 6 (8.3%) and 8 patients (11.1%), respectively. In 5 patients (6.9%) the bleeding was associated with a foreign body in the esophagus.

4. Mallory-Weiss syndrome.

Mallory–Weiss syndrome is a relatively rare cause of acute upper gastrointestinal bleeding in the studied population and was diagnosed in 7 of 190 patients with non-variceal bleeding (3.7%). The observed frequency is consistent with published data, according to which this syndrome represents a relatively rare but well-recognizable etiology of acute upper gastrointestinal bleeding.

5. Cameron ulcer.

Cameron ulcers were identified in 17 of 190 patients with non-variceal bleeding, corresponding to a frequency of 8.9% in this subgroup. Identification of these lesions in nearly one in ten patients with non-variceal bleeding underscores their importance as an underestimated source of blood loss, particularly in patients with large hiatal hernias.

6. Neoplasms of the upper gastrointestinal tract.

Malignant diseases of the upper gastrointestinal tract were diagnosed in 10 patients with non-variceal bleeding, corresponding to 5.3% of this subgroup. In the study cohort, gastric cancer as a cause of bleeding was identified in 7 patients (70.0%), while esophageal neoplasms were found in 4 (40.0%). In one patient, two synchronous carcinomas of the esophagus and stomach were confirmed, which accounts for the total percentage exceeding 100%.

7. Portal hypertensive gastropathy.

Portal hypertensive gastropathy was identified in 17 patients, representing 8.9% of all cases of non-variceal bleeding. It reflects chronic hemodynamic changes in the gastric mucosa in portal hypertension, most commonly in the setting of liver cirrhosis, and is endoscopically characterized by a mosaic pattern resembling “snakeskin” with an increased tendency toward superficial bleeding. Although it typically causes chronic or low-grade blood loss, in patients with advanced hepatic dysfunction and coagulopathy, PHG may lead to clinically significant acute bleeding.

8. Vascular malformations.

Vascular malformations represent a rare cause of bleeding in the study cohort. They were identified in only 3 of 190 patients with non-variceal bleeding, corresponding to 1.6% of cases. One patient each was found for each of the following etiologies grouped together (33.3%): gastric angiodysplasia, gastric antral vascular ectasia (GAVE syndrome), and Dieulafoy lesion.

1.7.2.2. Endoscopic findings in variceal bleeding.

In the study cohort, variceal bleeding from the upper gastrointestinal tract was identified in 20 patients; in all cases the source of hemorrhage was esophageal varices in the setting of clinically and endoscopically evident portal hypertension. In the majority of patients, large esophageal varices were identified (classified according to Baveno criteria), recorded in 17 of 20 patients (85.0%). Moderate varices were described in 3 patients (15.0%), and in almost all cases high-risk stigmata were present – *cherry red spots, red wale markings*. Active bleeding during

endoscopy was documented in 6 patients (30.0%). In the remaining 14 patients (70.0%), a recent bleeding episode was described, with the presence of high-risk varices and indirect signs of prior hemorrhage. Portal hypertensive gastropathy (PHG) was identified in 18 of 20 patients (90.0%); in several cases it was described as severe, and in some patients it was combined with erosive changes in the antrum. Gastric varices were identified in 2 patients (10.0%), of types GOV1 and GOV2, respectively, according to the Sarin classification. As additional findings on emergency endoscopy in some patients with variceal bleeding, erosive bulbitis was identified in 5 patients (25.0%), as well as erosive gastritis – in 2 patients (10.0%). An esophageal ulcer was observed in one patient (n = 1; 5.0%), and in another patient a concomitant duodenal ulcer classified as Forrest IIB was identified, which necessitated endoscopic hemostasis (n = 1; 5.0%). In one case (5.0%), gastric antral vascular ectasia (GAVE) syndrome with active bleeding was diagnosed.

Table 16. Endoscopic findings in variceal bleeding (n = 20)

Parameter	Number of patients (n)	Percentage (%)
Large esophageal varices	17	85.0
Moderate esophageal varices	3	15.0
Active variceal bleeding	6	30.0
Recent bleeding episode	14	70.0
Portal hypertensive gastropathy	18	90.0
Portal hypertensive duodenopathy	3	15.0
Gastric varices (GOV1/GOV2)	2	10.0
Erosive bulbitis	5	25.0
Erosive gastritis	2	10.0
Esophageal ulcer	1	5.0
GAVE syndrome	1	5.0

1.7.3. Endoscopic hemostasis.

Active bleeding during emergency fibrogastroduodenoscopy was identified in 43 of 209 patients (20.6%), while in the remaining 166 patients (79.4%) no active bleeding source was visualized, although stigmata of recent hemorrhage were frequently present. *High-risk endoscopic stigmata* (active bleeding, visible vessel, adherent clot, fresh blood, or a large amount of hematin-stained material) were recorded in 150 patients (71.8%), indicating a high proportion of patients at increased risk of rebleeding. *Endoscopic hemostasis* was performed in 79 patients (37.8%) with primary success in 65 of them (81.3%), reflecting good efficacy of the techniques used in emergency settings. Nevertheless, *rebleeding* during the hospital stay occurred in 58 patients (27.8%), and *repeat endoscopic hemostasis* was required in 46 patients (22.0%).

Table 17. Endoscopic hemostasis in patients with acute upper GI bleeding

Parameter	Number of patients (n)	Percentage (%)
Active bleeding at endoscopy	43	20.6
High-risk stigmata of recent bleeding	150	71.8
Endoscopic hemostasis performed	79	37.8
Successful primary hemostasis	65	81.3*
Failed primary hemostasis	15	18.8*
Rebleeding	58	27.8
Repeat endoscopic hemostasis	46	22.0

* Percentages are calculated relative to patients who underwent endoscopic hemostasis (n = 79).

1.8. Clinical follow-up and outcomes.

As mentioned in the previous section, **rebleeding** was observed in 58 patients (27.8%), attesting to the high risk of recurrent hemorrhage despite initial treatment and justifying the need for strict clinical follow-up and timely therapeutic interventions. In the majority of patients, rebleeding was controlled by repeat endoscopic hemostasis. **Interventional radiological and/or surgical treatment** was applied in 15 patients (7.2%), in whom endoscopic hemostasis had failed, was technically impossible, or was followed by clinical deterioration with persistent or recurrent hemorrhage. It may additionally be noted that **new-onset bleeding during the hospital stay** was recorded in 57 of the studied patients (27.3%). This subgroup represents a clinically significant contingent in whom hemorrhage develops in the course of hospitalization for another reason, likely in association with severe comorbidity, pharmacological factors, or stress-induced mucosal injury. **Blood transfusion** of at least one unit of packed red blood cells was administered to 157 of a total of 209 patients (75.1%), reflecting the high proportion of patients with substantial blood loss and underscoring the severity of the hemorrhagic episode in the study cohort. Within the present study, **in-hospital mortality** was recorded in 59 of a total of 209 patients, corresponding to 28.2% of the study cohort. Mortality should be assessed in the context of the combined impact of the acute hemorrhagic episode, comorbidities, the need for intensive care, and the presence of complications during hospitalization.

Table 18. Clinical follow-up and outcomes.

	Number (n)	Percentage (%)
New-onset bleeding during the hospital stay	57	27.3
Need for blood transfusion	157	75.1
Rebleeding	58	27.8

	Number (n)	Percentage (%)
Surgical treatment or TAE	15	7.2
In-hospital mortality	59	28.2

2. Risk factors for severe non-variceal upper gastrointestinal bleeding.

With the aim of achieving objective and clinically relevant risk stratification, in the present study a group with **severe non-variceal upper gastrointestinal bleeding** was defined using a combined clinical and endoscopic approach, intended to reflect both the local severity of the bleeding lesion and the systemic effect of blood loss. As the **mandatory criterion** for inclusion in the group, ***severe endoscopic findings*** were adopted, defined as at least one of the following parameters:

- presence of ***active bleeding*** during the endoscopic examination;
- presence of ***high-risk stigmata of recent bleeding***, including a visible non-bleeding vessel, adherent clot, presence of fresh blood, or a large amount of hematinous material in the upper GI tract;
- ***need for application of endoscopic hemostasis***.

For more precise differentiation of patients with severe non-variceal bleeding, the presence of **at least one additional criterion** reflecting clinical severity and/or adverse course was required, as follows:

A. Hemodynamic instability at admission, defined by:

- systolic blood pressure ≤ 90 mmHg and/or
- shock index ≥ 1.0.

B. Severe anemia at admission, defined as:

- hemoglobin ≤ 80 g/L (corresponding to the restrictive transfusion thresholds used in clinical practice).

C. Adverse clinical outcome during hospitalization, including at least one of the following:

- rebleeding during the hospital stay;
- need for surgical or interventional treatment (including transarterial embolization);
- in-hospital death.

Patients who fulfilled the **mandatory endoscopic criterion** and **at least one of the additional criteria (A–C)** were classified in the severe non-variceal bleeding group. This approach aims to minimize subjectivity, to avoid artificially inflating associations, and to ensure clear

differentiation between patients with mild and severe non-variceal bleeding, while maintaining the applicability of the definition in real clinical practice.

2.1. Frequency of severe non-variceal bleeding.

Of 190 patients with non-variceal bleeding, 115 (60.5%) met the criteria for severe non-variceal bleeding. The data show that more than half of non-variceal hemorrhages follow a clinically severe course and underscore the need for early identification of high-risk patients.

Table 19. Frequency of severe non-variceal bleeding

Characteristic	n	%
Severe non-variceal bleeding	115	60.5
Non-severe non-variceal bleeding	75	39.5
Total patients with non-variceal bleeding	190	100.0

To identify risk factors associated with severe non-variceal bleeding, a comparative analysis was performed between patients with severe and non-severe hemorrhage. The criteria included in the definition of severe course were not used in the analysis.

2.2. Demographic and clinical characteristics in patients with severe and non-severe non-variceal bleeding

No significant differences were found regarding age, sex, and time to EGD (3.78 vs. 4.79 hours; p=0.210). Patients with severe bleeding more frequently presented with melena (107/115 vs. 59/75; p=0.004), while the frequency of hematemesis and hematochezia was similar between the groups. The most pronounced difference was in respiratory failure at admission, recorded in 63 patients with severe bleeding vs. 7 with non-severe (p<0.001).

Table 20. Demographic and clinical characteristics in patients with non-variceal bleeding

Parameter	Severe non-variceal bleeding (n=115)	Non-severe non-variceal bleeding (n=75)	p
Sex — male, n (%)	75 (65.2%)	47 (62.7%)	0.720
Sex — female, n (%)	40 (34.8%)	28 (37.3%)	0.720
Age, mean (years)	67.76	65.41	0.302
Time to EGD, mean (hours)	3.78	4.79	0.210
Hematemesis, n (%)	40 (34.8%)	32 (42.7%)	0.274
Melena, n (%)	107 (93.0%)	59 (78.7%)	0.004
Hema | 17 (14.8%) tochezia/rectorrhagia, | n (%) |		7 (9.3%)	0.269

Parameter	Severe non-variceal bleeding (n=115)	Non-severe non-variceal bleeding (n=75)	p
Respiratory failure/ need for O2 at admission, n (%)	63 (54.8%)	7 (9.3%)	<0.001

Note: p-values were calculated using the χ^2-test/Fisher's exact test for categorical variables and Student's t-test for independent samples for continuous variables.

2.3. Laboratory parameters at admission.

Patients with severe non-variceal bleeding had more severe hematological abnormalities: lower hematocrit (0.23 vs. 0.32; p<0.001) and red blood cell count (2.60 vs. 3.65 $\times 10^{12}$/L; p<0.001), near-universal anemia (94.8% vs. 70.7%; p<0.001), and higher white blood cell count (13.82 vs. 11.06 $\times 10^{9}$/L; p=0.008). Severe non-variceal bleeding was associated with more pronounced renal dysfunction — higher creatinine values (178.81 vs. 115.26 μmol/L; p=0.003) and urea (18.87 vs. 12.52 mmol/L; p<0.001) and lower eGFR (56.03 vs. 73.93 ml/min/1.73 m^2; p<0.001), without substantial differences in liver enzymes and bilirubin. Patients with severe bleeding had marked hypoalbuminemia and hypoproteinemia (albumin 31.28 vs. 38.46 g/L; total protein 58.88 vs. 67.93 g/L; p<0.001), as well as higher CRP values (57.27 vs. 32.35 mg/L; p=0.023), which likely reflects a combined effect of chronic comorbidity and acute inflammatory response. INR, aPTT, and fibrinogen did not differ significantly between the groups (INR 1.65 vs. 1.45; p=0.208). In contrast, the prothrombin index was lower in patients with severe bleeding (61.96% vs. 71.45%; p=0.007), identifying a reduced prothrombin index as a sensitive marker of risk for severe disease course, particularly in patients with impaired or pharmacologically affected hemostasis.

Table 21. Laboratory parameters in patients with severe and non-severe non-variceal bleeding.

Parameter	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
Hematocrit	0.23	0.32	<0.001
Red blood cells	2.60	3.65	<0.001
White blood cells	13.82	11.06	0.008
Platelets	266.5	250.4	0.364
INR	1.65	1.45	0.208
Prothrombin index (%)	61.96	71.45	0.007
aPTT	31.91	31.67	0.868
Fibrinogen	3.38	3.43	0.814
ALAT	46.40	34.51	0.460
ASAT	76.60	39.09	0.308

Parameter	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
LDH	767.47	539.65	0.335
GGT	107.25	104.04	0.929
ALP	144.11	108.03	0.237
Total bilirubin	24.87	16.80	0.414
Direct bilirubin	17.67	9.80	0.363
Sodium	137.49	138.23	0.386
Potassium	4.33	4.30	0.761
Chloride	101.83	102.49	0.553
Creatinine	178.81	115.26	0.003
Urea	18.87	12.52	<0.001
eGFR	56.03	73.93	<0.001
Albumin	31.28	38.46	<0.001
Total protein	58.88	67.93	<0.001
CRP	57.27	32.35	0.023
ESR	38.11	38.07	0.993

Note: Data are presented as mean values. Comparison between the two independent groups was performed using Student's t-test for independent samples or the Mann–Whitney U test, according to the distribution of the data. Statistical significance was accepted at $p < 0.05$.

2.4. Endoscopic etiology in severe non-variceal bleeding

In the severe non-variceal bleeding group, peptic ulcer disease, particularly gastric ulcer, was significantly more frequent (52.2% vs. 24.0%; gastric ulcer 28.7% vs. 5.3%; p<0.001), emerging as the leading etiological cause of clinically severe hemorrhage. Conversely, Mallory–Weiss syndrome was more common in non-severe bleeding (8.0% vs. 0.9%; p=0.011), consistent with its milder clinical course, while other endoscopic findings (erosive esophagitis, Cameron ulcers, neoplasms, portal hypertensive gastropathy) showed no significant differences between the groups.

Table 22. Endoscopic etiology in severe and non-severe non-variceal bleeding

Endoscopic finding	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
Gastric ulcer	33 (28.7%)	4 (5.3%)	<0.001
Peptic ulcer disease (total)	60 (52.2%)	18 (24.0%)	<0.001
Mallory–Weiss syndrome	1 (0.9%)	6 (8.0%)	0.011

Endoscopic finding	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
Cameron ulcer	9 (7.8%)	8 (10.7%)	0.503
Esophagitis	5 (4.3%)	3 (4.0%)	0.907
Neoplasm of upper GI tract	6 (5.2%)	3 (4.0%)	0.699
Portal hypertensive gastropathy	10 (8.7%)	7 (9.3%)	0.880

Note: Data are presented as n (%). Comparison between the groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

2.5. Comorbidities.

Patients with severe non-variceal bleeding had higher overall comorbidity, but no significant differences were found for common cardiovascular diseases (arterial hypertension, ischemic heart disease, heart failure, arrhythmias, valve replacement, CABG). In contrast, peripheral arterial disease (PAD) (21.7% vs. 6.7%; p=0.005), pneumonia (18.3% vs. 1.3%; p<0.001), and chronic kidney disease (29.6% vs. 10.7%; p=0.002) were significantly more frequent in severe cases. Recent surgical intervention (≤1 month) was significantly more common in patients with severe bleeding (17.4% vs. 2.7%; p=0.002), pointing to postoperative stress, hemodynamic fluctuations, and pharmacological factors as potential triggers for a severe course of gastrointestinal hemorrhage.

Table 23. Comparison of comorbidities in severe and non-severe non-variceal bleeding

Parameter	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
Hypertension	89 (77.4%)	58 (77.3%)	0.993
Heart failure	44 (38.3%)	27 (36.0%)	0.753
Ischemic heart disease	54 (47.0%)	36 (48.0%)	0.888
Valve replacement	3 (2.6%)	3 (4.0%)	0.600
Arrhythmias	34 (29.6%)	19 (25.3%)	0.525
Status post CABG	3 (2.6%)	1 (1.3%)	0.549
Status post percutaneous intervention	9 (7.8%)	13 (17.3%)	0.045
Status post PE	9 (7.8%)	4 (5.3%)	0.506
Status post AMI	10 (8.7%)	5 (6.7%)	0.612
Status post IS	25 (21.7%)	13 (17.3%)	0.458
DVT	12 (10.4%)	8 (10.7%)	0.959

Parameter	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
PAD	25 (21.7%)	5 (6.7%)	0.005
Diabetes mellitus	33 (28.7%)	20 (26.7%)	0.761
Pneumonia	21 (18.3%)	1 (1.3%)	<0.001
COPD	8 (7.0%)	2 (2.7%)	0.196
Bronchial asthma	2 (1.7%)	2 (2.7%)	0.663
Oncological disease	30 (26.1%)	14 (18.7%)	0.236
Chronic kidney disease	34 (29.6%)	8 (10.7%)	0.002
CKD on hemodialysis	10 (8.7%)	2 (2.7%)	0.095
Liver cirrhosis	15 (13.0%)	7 (9.3%)	0.435
COVID-19 infection	7 (6.1%)	1 (1.3%)	0.111
Rheumatological disease	9 (7.8%)	9 (12.0%)	0.337
Recent surgical intervention (<1 month)	20 (17.4%)	2 (2.7%)	0.002
Coagulation disorders	2 (1.7%)	1 (1.3%)	0.826
H. pylori in the past	16 (13.9%)	12 (16.0%)	0.940
Chronic gastritis	90 (78.3%)	55 (73.3%)	0.435

Note: Data are presented as n (%). Comparison between the groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

2.6. Risk medications.

In the analysis of medications with potential risk for the development and aggravation of non-variceal bleeding, no statistically significant differences were found for most risk drugs. Anticoagulant therapy overall was frequent in both groups — 45 patients (39.1%) with severe and 26 patients (34.7%) with non-severe non-variceal bleeding ($p = 0.534$). However, subgroup analysis revealed a statistically significant difference with respect to *direct parenteral anticoagulants*, which were administered significantly more often in patients with severe non-variceal bleeding (17.4% vs. 4.0%; $p = 0.006$). In contrast, the use of vitamin K antagonists and novel oral anticoagulants (NOACs) did not show a statistically significant association with bleeding severity.

Table 24. Risk medications in severe and non-severe non-variceal bleeding

Medication	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
NSAIDs	19 (16.5%)	9 (12.0%)	0.481

Medication	Severe NVUGIB (n=115)	Non-severe NVUGIB (n=75)	p-value
Glucocorticosteroids	5 (4.3%)	5 (6.7%)	0.484
Antiplatelet agents — total	35 (30.4%)	18 (24.0%)	0.334
Dual antiplatelet therapy	3 (2.6%)	5 (6.7%)	0.173
Anticoagulants — total	45 (39.1%)	26 (34.7%)	0.534
Parenteral anticoagulants	20 (17.4%)	3 (4.0%)	0.006
Vitamin K antagonists	14 (12.2%)	5 (6.7%)	0.216
NOACs	15 (13.0%)	19 (25.3%)	0.192

Note: Data are presented as n (%). Comparison between the groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

2.7. Behavioral risk factors.

Behavioral risk factors in our cohort did not distinguish patients with severe from those with non-severe non-variceal bleeding. Risky alcohol use (31.3% vs. 40.0%; p=0.219), smoking (42.6% vs. 34.7%; p=0.274), and illicit drug use (1.7% vs. 2.7%; p=0.663) were similarly frequent in both groups, without statistically significant differences.

2.8. Other clinical characteristics.

A history of previous gastrointestinal bleeding was equally frequent in both groups (37.4% vs. 37.3%; p=0.994), and therefore did not differentiate clinical severity, but rather reflected the recurrent nature of the disease in some patients. In contrast, *the need for blood transfusion* and *in-hospital onset of bleeding* were significantly more frequent in severe cases — transfusion was performed in 88.7% of severe cases vs. 50.7% (p<0.001), and newly occurring bleeding during hospitalization for another reason was recorded in 37.4% vs. 13.3% (p<0.001). This reflects greater blood loss volume, more pronounced systemic injury, and a complicated clinical course with a higher risk of adverse outcome.

Table 25. Other clinical parameters associated with the severity of non-variceal bleeding.

Parameter	Severe non-variceal bleeding (n=115)	Non-severe non-variceal bleeding (n=75)	p-value
History of prior GI bleeding	43 (37.4%)	28 (37.3%)	0.994
Newly occurring bleeding during hospitalization	43 (37.4%)	10 (13.3%)	<0.001
Need for blood transfusion	102 (88.7%)	38 (50.7%)	<0.001

Note: Data are presented as n (%). Comparison between the groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

2.9. Independent risk factors for severe non-variceal bleeding.

With the aim of identifying independent predictors of severe non-variceal bleeding, a multivariable logistic regression analysis with three sequential models was conducted. **Model 1** included only categorical variables that showed a potential association in the univariable analysis or clinical relevance according to the literature. The model demonstrated a very good fit to the data (Hosmer–Lemeshow $\chi^2 = 2.93$; $p = 0.939$) and high classification accuracy of 82.1%, correctly classifying 84.3% of patients with severe and 78.7% of those without severe non-variceal bleeding. The following statistically significant independent predictors were identified: *respiratory failure* ($p < 0.001$; OR = 8.84), *anemia* ($p = 0.001$; OR = 8.86), *gastric ulcer* ($p = 0.038$; OR = 4.23), *peptic ulcer disease* as a generalized endoscopic diagnosis ($p = 0.001$; OR = 4.21), and *recent surgical intervention within 1 month* ($p = 0.022$; OR = 9.64). The remaining included variables, including melena, Mallory–Weiss syndrome, PAD, pneumonia, and chronic kidney disease, did not reach statistical significance. The data suggest that severe non-variceal bleeding is associated with systemic injury, active ulcer pathology, and recent surgical stress, underscoring the multifactorial nature of the severe clinical course.

Table 26. Model 1 — Logistic regression analysis (categorical variables)

Variable	B	SE	Wald	p-value	OR (Exp(B))
Melena	0.820	0.682	1.449	0.229	2.27
Respiratory failure	2.179	0.551	15.657	<0.001	8.84
Anemia	2.181	0.679	10.330	0.001	8.86
Gastric ulcer	1.442	0.695	4.311	0.038	4.23
Mallory–Weiss syndrome	-2.665	1.942	1.882	0.170	0.07
Peptic ulcer disease	1.437	0.448	10.275	0.001	4.21
Status post PCI	-1.748	0.710	6.062	0.014	0.17
PAD	0.744	0.702	1.123	0.289	2.11
Pneumonia	2.740	1.576	3.024	0.082	15.48
CKD	0.857	0.614	1.947	0.163	2.36
Recent surgery <1 month	2.266	0.988	5.256	0.022	9.64

Model 2 assessed the influence of quantitative laboratory parameters on the risk of severe non-variceal bleeding. It included hematocrit, red blood cells, white blood cells, prothrombin index, creatinine, urea, eGFR, serum albumin, total protein, and CRP. The model demonstrated a very good fit to the data (Hosmer–Lemeshow $p = 0.257$) and an overall classification accuracy of

81.1%, with better ability to identify patients with severe bleeding (88.0%) compared to those without severe bleeding (68.2%). Of all included parameters, only *serum albumin* was identified as an independent statistically significant predictor ($p = 0.001$). The negative regression coefficient ($B = -0.170$; $Exp(B) = 0.844$) indicates that an increase in albumin of 1 g/L is associated with an approximately 15.6% lower probability of severe non-variceal bleeding. The remaining laboratory parameters did not reach statistical significance.

Table 27. Model 2 — Logistic regression analysis (quantitative variables)

Variable	B	SE	Wald	p-value	Exp(B)	Interpretation
Hematocrit	-9.791	9.467	1.070	0.301	0.000	Non-significant
Red blood cells	0.328	0.754	0.189	0.664	1.388	Non-significant
White blood cells	0.024	0.037	0.432	0.511	1.024	Non-significant
Prothrombin index (%)	0.011	0.012	0.826	0.364	1.011	Non-significant
Creatinine	0.005	0.005	0.966	0.326	1.005	Non-significant
Urea	0.105	0.055	3.668	0.055	1.111	Borderline significance
eGFR	-0.011	0.015	0.622	0.430	0.989	Non-significant
Albumin	-0.170	0.052	10.557	0.001	0.844	Significant protective factor
Total protein	-0.044	0.031	2.029	0.154	0.957	Non-significant
CRP	-0.002	0.005	0.178	0.673	0.998	Non-significant

Model 3 is a combined logistic regression analysis including both quantitative and categorical variables — laboratory parameters, clinical characteristics, endoscopic etiology, comorbidities, and events before or during hospitalization. The model demonstrated a very good fit to the data (Hosmer–Lemeshow $\chi^2 = 6.380$; $p = 0.605$) and the highest overall classification accuracy — 94.5%, correctly classifying 93.2% of patients without severe and 95.2% of those with severe non-variceal bleeding. The following independent statistically significant predictors were identified: *respiratory failure* ($p = 0.033$; $Exp(B) = 54.3$), *anemia* ($p = 0.040$), *peptic ulcer disease* ($p = 0.012$; $Exp(B) = 39.1$), *chronic kidney disease* ($p = 0.046$; $Exp(B) = 2088$), and *recent surgical intervention within 1 month* ($p = 0.040$; $Exp(B) = 524.9$). The remaining included variables, including most laboratory parameters, newly occurring bleeding during hospitalization, and the need for blood transfusion, did not reach statistical significance. The combined model demonstrated the highest prognostic value and underscores the multifactorial nature of severe non-variceal bleeding, in which systemic injury, comorbidities, and the etiology of the hemorrhage play a leading role.

Table 28. Model 3 — Logistic regression analysis (combined model)

Variable	B	SE	Wald	p-value	Exp(B)
Hematocrit	-6.268	19.351	0.105	0.746	0.002

Variable	B	SE	Wald	p-value	Exp(B)
Red blood cells	-2.037	1.703	1.431	0.232	0.130
White blood cells	0.076	0.087	0.756	0.385	1.079
PI %	0.002	0.022	0.012	0.911	1.002
Creatinine	-0.002	0.010	0.050	0.824	0.998
Urea	0.037	0.106	0.120	0.729	1.037
eGFR	-0.074	0.041	3.271	0.070	0.929
Albumin	-0.178	0.112	2.499	0.114	0.837
Total protein	-0.112	0.062	3.292	0.070	0.894
CRP	-0.021	0.017	1.569	0.210	0.979
Melena	2.210	1.839	1.445	0.229	9.119
Respiratory failure	3.995	1.870	4.563	0.033	54.342
Anemia	-6.898	3.367	4.197	0.040	0.001
Gastric ulcer	2.654	1.449	3.353	0.067	14.214
Mallory-Weiss syndrome	-4.420	25.782	0.029	0.864	0.012
Peptic ulcer disease	3.667	1.460	6.310	0.012	39.138
Status post PCI	-8.879	3.482	6.504	0.011	0.000
PAD	3.957	2.384	2.755	0.097	52.297
Pneumonia	5.934	3.236	3.363	0.067	377.736
Chronic kidney disease	7.644	3.832	3.980	0.046	2088.047
Recent surgery	6.263	3.055	4.204	0.040	524.922
Direct anticoagulants (parent.)	14.598	7081.589	0.000	0.998	2186360
Blood transfusion	0.884	2.131	0.172	0.678	2.420
Newly occurring bleeding	-1.100	1.676	0.431	0.512	0.333

2.10. Discussion.

The multivariable analysis in the present study demonstrates that a severe clinical course in non-variceal upper gastrointestinal bleeding is determined by multiple predictors, with risk defined by a combination of the severity of the endoscopic finding and the overall condition of the patient (comorbidity, systemic injury, and early clinical markers). This observation is consistent with contemporary concepts for the management of NVUGIB. The predominance of *peptic ulcer disease* as an independent predictor (including gastric ulcer) is entirely expected, as

peptic ulcer is the leading cause of NVUGIB. Current ESGE and ACG recommendations explicitly distinguish high-risk endoscopic findings (active bleeding, visible non-bleeding vessel, adherent clot) from low-risk findings and recommend endoscopic hemostasis for high-risk stigmata, as well as subsequent intensified treatment and monitoring, since this subgroup carries the greatest risk of persistent/recurrent bleeding and adverse outcomes. In this context, the retention of ulcer etiology as a statistically significant predictor in Model 1 and Model 3 is logical, as it does not represent merely an etiological diagnosis but reflects the presence of high-risk morphological characteristics of the lesion, which largely determine the clinical course. This explains the leading role of early endoscopic assessment and timely therapy as key elements in the management of high-risk patients. A strong clinical predictor is *respiratory failure/need for oxygen therapy* at admission, which in the first model increases the risk nearly ninefold, and in the combined model retains statistical significance with a very large effect. This is consistent with the observations of Lazar et al. in a large series of non-variceal bleeding, showing that comorbidities and systemic complications (including respiratory diseases, sepsis) are key determinants of adverse course and in-hospital mortality, and often determine severity independently of the endoscopic finding itself. In Model 2, *serum albumin* remained the sole independent laboratory predictor of severe non-variceal bleeding ($p=0.001$). This result is fully consistent with the data of González et al., who demonstrate that hypoalbuminemia in patients with non-variceal bleeding is associated with a severe clinical course and adverse clinical outcome. In our cohort, the mean albumin value at admission was 33.4 ± 7.3 g/L, which is close to the thresholds reported by González. In their study of 185 patients, the mean albumin at admission was 29 ± 9 g/L, and hypoalbuminemia (<35 g/L) was found in 71.4%. ROC analysis determined a cut-off of 31 g/L for predicting in-hospital mortality (AUROC 0.738), with mortality being significantly higher in patients with lower albumin. These observations support the clinical interpretation of our model: the negative regression coefficient ($B=-0.170$) and $Exp(B)=0.844$ mean that with an increase in albumin of 1 g/L, the probability of a severe clinical course decreases by ~15.6%, which is logical, as higher albumin reflects better functional reserve and lower susceptibility to systemic decompensation in acute hemorrhage. Additionally, the fact that in the study by González albumin has prognostic performance comparable to Rockall (AUROC 0.738 vs. 0.715) shows that albumin provides integrative information about the overall condition of the patient and the severity of bleeding. This supports its inclusion as an early laboratory marker in multiple risk stratification scoring systems for patients with upper gastrointestinal bleeding. In our regression analysis, *chronic kidney disease* (CKD) also emerged as an independent predictor of severe non-variceal bleeding. This result is analogous to data from a meta-analysis by Hágendorn et al., comparing outcomes in patients with upper GI bleeding and underlying renal impairment. The authors found higher mortality ($OR\approx1.79$), greater blood transfusion requirements (mean +1.86 units), and a higher risk of rebleeding ($OR\approx2.51$) in patients with chronic kidney disease, especially those on hemodialysis. These findings clearly position CKD as a condition that worsens the clinical course and prognosis in patients with upper gastrointestinal bleeding. The independent association of *recent surgical intervention* (<1 month) with severe NVUGIB is also clinically justified: the postoperative period is associated with stress-induced mucosal injury, hemodynamic fluctuations, and frequent use of risk medications such as anticoagulants, antiplatelet agents, and NSAIDs. The literature on stress-related mucosal injury emphasizes that the severe postoperative period and impaired general condition are key prerequisites for upper GI bleeding with a severe course. In this context, our result supports the practical need to consider this patient subgroup as high-risk.

3. Risk factors for the occurrence of variceal bleeding in patients with chronic liver disease.

3.1. Characteristics of patients with liver cirrhosis

As already described in the present study, of the total 209 patients with acute upper gastrointestinal bleeding, 41 patients (19.6%) had a diagnosed liver cirrhosis, forming a specific subgroup at high risk of a severe clinical course. Analysis of the type of bleeding among patients with chronic liver disease revealed an almost equal distribution between variceal and non-variceal bleeding. Variceal bleeding was recorded in 19 patients (46.3%), while 22 patients (53.7%) had non-variceal bleeding. This result underscores that in patients with liver cirrhosis the risk of bleeding is not limited solely to complications of portal hypertension such as esophageal and gastric varices, but that a considerable proportion of patients have a non-variceal source of bleeding, probably in the context of coagulopathy and mucosal vulnerability against a background of severe general condition. The data obtained justify the need for a separate and thorough analysis of the factors associated with the type of bleeding in patients with chronic liver disease, which constitutes the main focus of the following sections within the framework of Objective 3.

Table 29. Distribution of patients with liver cirrhosis according to type of bleeding

Type of bleeding	Number of patients (n)	Percentage (%)	Cumulative percentage (%)
Non-variceal bleeding	22 53.7	53.7	
Variceal bleeding	19 46.3	100.0	
Total	41 100.0	100.0	

3.2. Demographic and clinical characteristics of patients with liver cirrhosis.

After preliminary selection of patients with liver cirrhosis (n = 41), the study population was divided into two subgroups: patients with variceal bleeding (n = 19; 46.3%) and patients with non-variceal bleeding (n = 22; 53.7%). No statistically significant differences were found between the two groups with respect to sex and age. The mean age was similar in patients with non-variceal (57.6 years) and variceal bleeding (58.2 years; p = 0.866), with males predominating in both groups (p = 0.839). In contrast to the demographic parameters, the anamnestic data related to portal hypertension showed substantial differences. *The presence of known esophageal varices in the past* was recorded significantly more often in patients with variceal bleeding (15 of 19 patients) compared with those with non-variceal bleeding (9 of 22 patients), with the difference reaching statistical significance (p = 0.014). Prophylaxis with a non-selective β-blocker was administered in 7 patients with variceal and in 5 patients with non-variceal bleeding, with no statistically significant difference identified between the groups (p = 0.322). Similarly, a history of previous gastrointestinal bleeding was noted in 14 patients with variceal and in 11 patients with non-variceal bleeding (p = 0.121). *Previous endoscopic band ligation* had been performed more frequently in patients with variceal bleeding (9 versus 5 cases), a difference that shows a trend but does not reach statistical significance (p = 0.097).

Table 30. Demographic and clinical characteristics in patients with liver cirrhosis

Parameter	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	p-value
Sex (M/F)	18 / 4	16 / 3	0.839
Mean age (years)	57.6	58.2	0.866
Known varices in the past	9 (40.9%)	15 (78.9%)	0.014
Prophylaxis with NSBB	5 (22.7%)	7 (36.8%)	0.322
Previous GI bleeding	11 (50.0%)	14 (73.7%)	0.121
Previous endoscopic ligation	5 (22.7%)	9 (47.4%)	0.097

Note: Categorical variables were compared using the χ^2-test or Fisher's exact test, and age was compared using Student's t-test for independent samples or the Mann–Whitney U test. Statistical significance was accepted at $p < 0.05$.

3.3. Laboratory parameters.

The laboratory profile in patients with cirrhosis demonstrates substantial differences between variceal and non-variceal bleeding, reflecting different degrees of portal hypertension, hepatic dysfunction, and hemostatic disturbances. Hemoglobin and erythrocyte indices did not differ statistically (Hb 85.23 g/L in non-variceal versus 83.05 g/L in variceal bleeding; p=0.772), with predominantly normocytic, normochromic anemia in both subgroups. In contrast, the platelet count was significantly lower in patients with variceal bleeding (120.95 versus 176.09 $\times 10^9$/L; p=0.019), which corresponds to more pronounced portal hypertension and hypersplenism. The hepatic biochemical parameters (ASAT, ALAT, γ-GGT, alkaline phosphatase) did not differ significantly between the groups, indicating that the activity of hepatocellular damage does not differentiate variceal from non-variceal bleeding in the study cohort. In contrast, total bilirubin was significantly higher in non-variceal bleeding (92.41 versus 29.94 μmol/L; p=0.042), and fibrinogen was lower (1.91 versus 2.40 g/L; p=0.048), suggesting more severe synthetic dysfunction and hemostatic disturbances in this group. INR, the prothrombin index, parameters of renal function (creatinine, urea, eGFR), as well as serum albumin and total protein showed no statistically significant differences, with hypoalbuminemia characteristic of advanced chronic liver disease observed in both subgroups.

Table 31. Laboratory parameters in patients with liver cirrhosis (variceal versus non-variceal bleeding)

Parameter	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	p-value
Hemoglobin (g/L)	85.23	83.05	0.772
MCV (fL)	92.59	91.47	0.745
MCH (pg)	30.09	29.11	0.476

Parameter	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	p-value
Platelets (x10⁹/L)	176.09	120.95	0.019
Leukocytes (x10⁹/L)	11.40	9.05	0.133
ALAT (U/L)	33.36	27.14	0.327
ASAT (U/L)	74.05	52.54	0.150
GGT (U/L)	232.72	286.94	0.730
ALP (U/L)	216.77	86.73	0.166
Urea (mmol/L)	16.04	11.70	0.202
Creatinine (μmol/L)	118.73	106.53	0.605
eGFR (ml/min)	73.50	76.95	0.721
Sodium (mmol/L)	135.09	136.00	0.562
Total bilirubin (μmol/L)	92.41	29.94	0.042
Direct bilirubin (μmol/L)	66.75	19.28	0.092
Total protein (g/L)	64.09	59.22	0.202
Albumin (g/L)	29.14	28.94	0.929
LDH (U/L)	439.25	358.17	0.264
INR	2.07	1.52	0.137
Prothrombin index (%)	46.77	54.33	0.153
Fibrinogen (g/L)	1.91	2.40	0.048

Note: Data are presented as mean values. Comparison between the two groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

3.4. Comorbidities and risk factors.

No statistically significant differences were found with respect to most comorbidities, including cardiovascular, metabolic, oncological, chronic kidney disease, infectious, and pulmonary comorbidity ($p>0.05$ for all parameters). Alcohol consumption and smoking were frequent but similarly distributed between the two groups, while the use of narcotic substances was rare, with no significant association with the type of bleeding. In summary, overall comorbidity and classic cardiovascular and metabolic risk factors do not substantially differentiate patients with variceal from those with non-variceal bleeding in the study cohort.

Table 32. Comorbidities and risk factors in patients with liver cirrhosis.

Parameter	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	Total (n=41)	p-value
Hypertension	9 (40.9%)	8 (42.1%)	17 (41.5%)	0.938
Heart failure	5 (22.7%)	1 (5.3%)	6 (14.6%)	0.115
Ischemic heart disease	4 (18.2%)	2 (10.5%)	6 (14.6%)	0.489
Arrhythmias	4 (18.2%)	1 (5.3%)	5 (12.2%)	0.207
Diabetes mellitus	6 (27.3%)	7 (36.8%)	13 (31.7%)	0.511
Pneumonia	3 (13.6%)	3 (15.8%)	6 (14.6%)	0.846
Oncological disease	2 (9.1%)	2 (10.5%)	4 (9.8%)	0.877
Chronic kidney disease	2 (9.1%)	0 (0.0%)	2 (4.9%)	0.178
Alcohol	16 (72.7%)	13 (68.4%)	29 (70.7%)	0.763
Smoking	12 (54.5%)	9 (47.4%)	21 (51.2%)	0.647
Substance abuse	1 (4.5%)	2 (10.5%)	3 (7.3%)	0.463

Note: Data are presented as n (%). Comparison between patients with non-variceal and variceal bleeding was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

3.5. Degree of hepatic decompensation.

The degree of hepatic decompensation in patients with chronic liver disease was assessed using the Child–Pugh classification and the MELD score, both of which reflect the functional reserve of the liver and the risk of an adverse outcome. In the study subgroup of 41 patients with liver cirrhosis, the distribution by **Child–Pugh** class shows a clear predominance of patients with advanced hepatic dysfunction. In both groups — with variceal and with non-variceal bleeding — classes B and C dominate, attesting to a substantial proportion of patients in the decompensated stage. In patients with non-variceal bleeding, 2 patients were recorded in class A (9.1%), 9 (40.9%) in class B, and 9 (40.9%) in class C, while in patients with variceal bleeding the distribution was 2 (10.5%) patients in class A, 9 (47.4%) in class B, and 8 (42.1%) in class C. The absence of a substantial difference between the two groups underscores that advanced hepatic decompensation is a frequent characteristic of cirrhotic patients with acute upper GI bleeding, regardless of the etiology of the hemorrhage. Assessment by **MELD** revealed a statistically significant difference between the two groups. Patients with non-variceal bleeding demonstrate a higher mean MELD value (19.95) compared with patients with variceal bleeding (15.65), with the difference reaching statistical significance ($p = 0.046$). This indicates that in patients with chronic liver disease, non-variceal bleeding is associated with more severe systemic impairment, reflected by a higher MELD score, despite the fact that variceal bleeding is traditionally regarded as the more severe complication of portal hypertension.

Non-invasive scores for assessment of hepatic fibrosis

Structural hepatic damage in patients with cirrhosis was assessed using the non-invasive indices FIB-4 and APRI. The mean values of FIB-4 (4.94 in non-variceal versus 6.33 in variceal bleeding; p=0.334) and APRI (1.46 versus 1.94; p=0.414) did not differ in a statistically significant manner, although a trend toward higher values was observed in patients with variceal bleeding. In both subgroups the score values were within the range of advanced chronic liver disease.

Table 33. Degree of hepatic decompensation and non-invasive fibrosis indices.

Par ameter	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	p-v alue	Comment
Child – Pugh class A/B/C	2 / 9 / 9 (9.1%) /(40.9%)/(40.9%)	2 / 9 / 8 (10.5%)/(47.4%)/(42.1%)	0 .984	Similar dis tribution
MELD score (mean value)	19.95	15.65	0 .046	Higher in non-variceal
FIB-4	4.94	6.33	0 .334	No significant difference
APRI	1.46	1.94	0 .414	No significant difference

Note: Data are presented as n (%) for Child–Pugh classes and as mean values for MELD, FIB-4, and APRI. Comparison of the distribution by Child–Pugh class was performed using the χ^2-test, and of quantitative parameters using Student's t-test for independent samples or the Mann–Whitney U test, according to the data distribution. Statistical significance was accepted at $p < 0.05$.

3.6. Endoscopic findings.

After selection of patients with liver cirrhosis (n = 41) and stratification according to the type of bleeding, the endoscopic findings revealed expected but clinically important differences between patients with variceal and non-variceal bleeding. In the variceal bleeding group (n = 19), the presence of high-risk esophageal varices — large varices and/or varices with red spots — dominated, with this finding significantly more frequent compared with patients with non-variceal bleeding. Large esophageal varices were found in 9 patients, and large varices with red spots in 7 patients, underscoring the high risk of rupture and active hemorrhage in this subgroup. In contrast, in patients with non-variceal bleeding, small varices were more commonly observed (n = 7), a finding entirely absent in the variceal bleeding group (p = 0.011). Portal hypertensive gastropathy was widespread in both groups, but with a trend toward higher frequency in variceal bleeding (18 of 19 patients versus 16 of 22 in non-variceal bleeding; p = 0.062), reflecting more severe portal hypertension in this group. Gastric varices were found in a limited number of patients and without a statistically significant difference between the groups (3 patients with non-

variceal versus 2 with variceal bleeding; p = 0.762). In summary, the endoscopic findings in patients with liver cirrhosis clearly demonstrate that variceal bleeding is associated with high-risk esophageal varices and signs of advanced portal hypertension. These results support the concept that the morphological characteristics of varices, and not merely their presence, are a key factor in the clinical manifestation of bleeding in patients with cirrhosis.

Table 34. Endoscopic findings in patients with liver cirrhosis

Endoscopic finding	Non-variceal bleeding (n=22)	Variceal bleeding (n=19)	p-value
Esophageal varices – small	7 (31.8%)	0 (0.0%)	0.011
Esophageal varices – moderate	2 (9.1%)	2 (10.5%)	1.000
Esophageal varices – large	5 (22.7%)	9 (47.4%)	0.115
Varices with red spots	5 (22.7%)	8 (42.1%)	0.313
Gastric varices	3 (13.6%)	2 (10.5%)	0.762
Portal hypertensive gastropathy	16 (72.7%)	18 (94.7%)	0.062

Note: Data are presented as n (%). Comparison between the groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

3.7. Independent risk factors for variceal bleeding.

In order to identify factors associated with variceal bleeding in patients with liver cirrhosis, a logistic regression analysis was performed in 41 patients divided into groups with variceal (n = 19) and non-variceal bleeding (n = 22). In the preliminary univariate analysis, the presence of known varices in the past, the MELD score, platelet count, total bilirubin, fibrinogen, and the presence and grade of esophageal varices were selected as potential predictors, with the last variable transformed into a dichotomous variable to avoid statistical bias. In this transformation, small and moderate varices were classified as mild varices, and large varices, moderate varices with red spots, and large varices with red spots were classified as severe varices. The logistic model demonstrated a good fit to the data (Hosmer–Lemeshow $\chi^2 = 14.336$; $p = 0.073$) and high classification accuracy of 83.9%, correctly classifying 93.3% of patients with variceal and 75.0% of those with non-variceal bleeding. Nevertheless, none of the included variables reached statistical significance as an independent predictor in the multivariate model ($p > 0.05$ for all factors). Some variables demonstrated a trend toward association with variceal bleeding, in particular the presence of *known varices in the past* (OR > 1) and lower values of *fibrinogen*. The absence of statistically significant independent factors is most likely attributable to the limited sample size (n = 41), which substantially reduces the statistical power of the analysis and increases the risk of a β-error. This result is expected given the specifics of the patient population and the retrospective design of the study. In summary, the analyses performed allow **main trends** regarding the risk factors for variceal bleeding in patients with liver cirrhosis

to be outlined, without identifying independent statistically significant predictors. The data support the hypothesis that ***known esophageal varices, greater severity of hepatic dysfunction as assessed by MELD, thrombocytopenia, hyperbilirubinemia, and hemostatic disturbances*** play a substantial role in the pathogenesis of variceal bleeding. The results obtained should be interpreted as a basis for future studies that could validate these observations in a larger sample size.

Table 35. Logistic regression analysis — factors associated with variceal bleeding in patients with liver cirrhosis

Variable	B	SE	Wald	p-value	OR (Exp(B))	95% CI
Known varices in the past	1.409	0.971	2.106	0.147	4.09	–
MELD score	0.177	0.138	1.641	0.200	1.19	–
Platelets	-0.003	0.008	0.168	0.682	0.99	–
Total bilirubin	-0.023	0.020	1.361	0.243	0.98	–
Fibrinogen	0.962	0.810	1.413	0.235	2.62	–
Esophageal varices (dichotomous)	-1.279	1.497	0.731	0.393	0.28	–

3.8. Discussion.

The absence of statistically significant independent predictors in the multivariate model with a limited sample (n=41) is explicable from a methodological standpoint — with a small number of "events" relative to the number of included variables, logistic regression becomes unstable, standard errors increase, and the risk of a β-error (missing a real effect) rises. Nevertheless, the trends emerging from the analysis (history of known varices in the past, greater severity of hepatic dysfunction by MELD, thrombocytopenia, hyperbilirubinemia, and hemostatic disturbances) are entirely consistent with established concepts of portal hypertension. The Baveno VII consensus emphasizes that the risk of decompensation and variceal bleeding is determined by the severity of portal hypertension and the stage of liver disease, with endoscopic findings (variceal size, high-risk stigmata such as red wale marks) being key for clinical stratification. *Known varices in the past* show OR=4.09 (p=0.147), which is in the expected direction — a history of varices would logically increase the probability of variceal bleeding, but the present sample is not sufficient to render this association statistically convincing. The observed endoscopic differences between patients with variceal and non-variceal bleeding in cirrhosis support the established concept that the risk of variceal hemorrhage is determined primarily by the morphological characteristics of varices (size and high-risk stigmata), and not merely by their presence. In our cohort, variceal bleeding is associated with more frequent presence of high-risk varices (large varices and/or varices with red spots), while small varices are found more commonly in cirrhotic patients with non-variceal bleeding and are absent in the variceal bleeding group (p=0.011). These findings are consistent with the classic study by Merkel et al., in which variceal size and red wale signs are independent predictors of the first episode of variceal bleeding. The trend toward a higher frequency of portal hypertensive

gastropathy in the variceal bleeding group (p=0.062) further points to more severe portal hypertension in these patients. In the regression model, *MELD score* also has OR>1 (OR=1.19; p=0.200), suggesting a trend toward higher risk of variceal bleeding with more severe hepatic dysfunction. The literature supports its prognostic role primarily for adverse outcomes in acute variceal bleeding and early stratification of high-risk patients. For example, Reverter et al. demonstrate that MELD is a strong prognostic tool for 6-week mortality in acute variceal bleeding. In the univariate analysis, a statistically significant difference in *platelet count* was found between patients with variceal and non-variceal bleeding (120.95 $\times 10^9$/L versus 176.09 $\times 10^9$/L; p=0.019). However, when platelets were included in the subsequent logistic regression model, this association was not preserved as independent (p>0.05), suggesting that the observed univariate effect is likely mediated by other interrelated patient characteristics (e.g., severity of hepatic dysfunction, presence and characteristics of varices) or is influenced by the limited sample size and limited statistical power of the multivariate analysis. The more pronounced thrombocytopenia in variceal bleeding observed by us is consistent with the pathophysiology of portal hypertension, where lower platelet counts frequently reflect hypersplenism in advanced cirrhosis. The Baveno VII consensus uses platelets as part of the non-invasive stratification of clinically significant portal hypertension (CSPH), with low values serving as an indirect marker of more severe portal hypertension and higher risk of decompensation, including variceal bleeding. Published clinical data also demonstrate an inverse relationship between platelet count and the grade of esophageal varices. In a 2021 study, Afsar et al. demonstrate a significant negative correlation between platelets and variceal grade, with progressively lower platelets in higher-risk varices, consistent with the observation in our cohort. Our results of a lower platelet count in patients with variceal bleeding are also consistent with data from Cifci et al., in whose study thrombocytopenia emerges as the best non-invasive predictor of esophageal variceal bleeding. In the same study, indices such as *APRI* and *FIB-4* demonstrate moderate discriminative ability, while in our cohort the non-invasive fibrosis scores showed no statistically significant differences between variceal and non-variceal bleeding (p=0.334 for FIB-4 and p=0.414 for APRI). In the multivariate logistic regression model, *total bilirubin* was not identified as an independent predictor of variceal bleeding (B=−0.023; OR=0.98; p=0.243), which probably reflects limited sample power and collinearity with MELD, as well as the fact that the etiology of bleeding in cirrhosis is determined mainly by portal hypertension and the endoscopic characteristics of varices.

4. Assessment of the prognostic value of clinical scoring systems in patients with acute upper gastrointestinal bleeding.

In view of the high clinical heterogeneity of patients with acute upper gastrointestinal bleeding, the present study included an assessment of the prognostic value of established clinical scoring systems. The main aim of this analysis was to compare the ability of individual scores to predict key clinical outcomes, including in-hospital mortality, rebleeding, need for endoscopic or surgical intervention, and blood transfusion. For this purpose, the corresponding prognostic scores were calculated for all included patients on the basis of clinical, laboratory, and endoscopic data at admission and during hospitalization. Their prognostic performance was assessed by ROC analysis, with the area under the curve (AUC), optimal cut-off values, sensitivity, and specificity relative to the individual clinical outcomes determined for each score. The analyses were conducted both for the entire study cohort and stratified according to the

etiology of bleeding (variceal and non-variceal), with the aim of a more precise assessment of the clinical applicability of the scoring systems in different patient subgroups. In this way, the present section aims to outline the comparative advantages and limitations of the individual prognostic models and to assess their practical value as tools for early risk stratification and clinical decision-making in patients with acute upper gastrointestinal bleeding. We initially performed a descriptive analysis of all prognostic scoring systems used, with the aim of providing an overall characterization of the severity of the study cohort. Table 36 presents mean values, standard deviations, and medians for each score, allowing orientation regarding the distribution and variability of scores prior to the subsequent analysis.

Table 36. Distribution of prognostic scoring system values in the study cohort.

Score	**Mean value**	**SD**	**Median**
Glasgow–Blatchford score (GBS)	12.25	4.45	13.00
AIMS65	2.19	1.32	2.00
ABC score	6.91	3.70	7.00
CANUKA	10.17	3.31	10.00
MAP(ASH)	4.73	2.29	5.00
pre-endoscopy Rockall	4.48	1.45	5.00
Complete Rockall score	6.88	2.05	7.00
Progetto Nazionale Emorragia Digestiva (PNED)	7.06	4.00	7.00
Cedars Sinai Medical Centre Predictive Index (CSMCPI)	6.05	2.39	7.00

4.1. Glasgow–Blatchford score (GBS).

4.1.1. Distribution and descriptive characteristics of Glasgow–Blatchford score.

Glasgow–Blatchford score showed a statistically significant association with the main adverse clinical outcomes in the study cohort. Patients with in-hospital mortality had a higher mean GBS compared with survivors (14.95 ± 3.15 versus 11.33 ± 4.48; $p < 0.001$). An analogous relationship was observed for rebleeding, where the mean value was 14.40 ± 3.67 compared with 11.55 ± 4.48 in patients without rebleeding ($p < 0.001$). In patients requiring endoscopic hemostasis, GBS was also significantly higher (13.96 ± 3.47 versus 11.39 ± 4.70; $p < 0.001$), as well as in the presence of active bleeding at endoscopy (14.35 ± 3.39 versus 11.82 ± 4.56; $p < 0.001$). These data indicate that higher GBS values are associated with a more severe clinical course, higher risk of rebleeding, and increased probability of interventional treatment and fatal outcome.

Table 37. Distribution and descriptive characteristics of Glasgow–Blatchford score (GBS) in the study cohort

Score	Status	n	Mean value	SD	p mean value	p SD
Glasgow–Blatchford score (GBS)	Deceased	58	14.95	3.15	0.000	0.001
	Survivors	148	11.33	4.48		
	With rebleeding	58	14.40	3.67	0.000	0.053
	Without rebleeding	148	11.55	4.48		
	Requiring surgical intervention	15	14.67	3.40	0.036	0.281
	Not requiring surgical intervention	191	12.17	4.48		
	Requiring endoscopic hemostasis	77	13.96	3.47	0.000	0.002
	Not requiring endoscopic hemostasis	129	11.39	4.70		
	With active bleeding	43	14.35	3.39	0.000	0.050
	Without active bleeding	163	11.82	4.56		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.1.2. Prognostic value of Glasgow–Blatchford score (GBS) for in-hospital mortality.

In order to assess the discriminative ability of Glasgow–Blatchford score (GBS) for predicting in-hospital mortality, a ROC (Receiver Operating Characteristic) analysis was conducted, with patients considered in two separate subgroups according to the etiology of bleeding — variceal and non-variceal upper gastrointestinal bleeding. This stratification allows a more precise interpretation of the prognostic value of the score, taking into account the differences in pathophysiology, clinical course, and risk of adverse outcomes between the two types of bleeding. For non-variceal bleeding, the ROC analysis included 187 patients, of whom 49 (26.2%) died. GBS demonstrated good prognostic value for in-hospital mortality, with AUC 0.753 (95% CI: 0.680–0.827; $p<0.001$). The optimal threshold GBS ≥13.5 provides sensitivity of

77.6% and specificity of 65.9% (Youden J=0.435), enabling identification of a subgroup of patients at increased risk of fatal outcome already at admission. For variceal bleeding (n=19, 9 fatal outcomes), the AUC was 0.639 (95% CI: 0.370–0.907; p=0.307); the model did not reach statistical significance and no valid cut-off values were determined. This limits the applicability of GBS for mortality prediction in variceal bleeding in our cohort.

Table 38. Prognostic value of Glasgow–Blatchford score for in-hospital mortality in non-variceal and variceal bleeding (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	95% CI	Youden	Cut-off	Sens	Spec
Non-variceal bleeding	GBS	In-hospital mortality	49	0.753	0.000	0.680–0.870	0.435	13.50	77.6%	65.9 %
Variceal bleeding			9	0.639	0.307	0.370–0.907	-	-	-	-

4.1.3. Prognostic value of Glasgow–Blatchford score (GBS) for rebleeding.

GBS was statistically significantly higher in patients with rebleeding during hospitalization (14.40 ± 3.67 vs. 11.55 ± 4.48; p<0.001). In non-variceal bleeding, the AUC for rebleeding was 0.670 (95% CI: 0.580–0.760; p=0.001), with a threshold of GBS ≥13.5 providing sensitivity of 67.4% and specificity of 61.1% (Youden J=0.285), indicating moderate but clinically relevant discriminative ability. In the small subgroup with variceal bleeding (n=19, 15 with rebleeding), GBS demonstrated high discrimination – AUC 0.858 (95% CI: 0.684–1.000; p=0.032), with a threshold of ≥11.0 yielding sensitivity of 86.7% and specificity of 75.0% (Youden J=0.617). These results, however, should be interpreted with caution due to the limited sample size and high event rate.

Table 39. Prognostic value of Glasgow–Blatchford score for rebleeding in non-variceal and variceal bleeding (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	GBS	Rebleeding	43	0.670	0.001	0.580-0.760	0.285	13.50	67.4 %	61.1 %
Variceal			15	0.858	0.032	0.684-1.000	0.617	11.00	86.7 %	75.0 %

4.1.4. Prognostic value of Glasgow–Blatchford score (GBS) for the need for endoscopic hemostasis

Analysis of the Glasgow–Blatchford score (GBS) demonstrates a statistically significant association between higher score values and the need for endoscopic hemostasis, particularly in patients with non-variceal bleeding. Endoscopic hemostasis was performed in 59 non-variceal patients (31.6%), with the mean GBS in this group being higher compared to patients without intervention (13.96 ± 3.47 vs. 11.39 ± 4.70; p<0.001), which underscores the clinical

applicability of the score at initial assessment. ROC analysis in non-variceal bleeding demonstrates good prognostic value of GBS for predicting the need for endoscopic hemostasis (AUC 0.653; 95% CI: 0.572–0.733; p=0.001). A threshold of GBS ≥9.5 provides high sensitivity (93.2%) with lower specificity (32.8%; Youden J=0.26), establishing GBS as a particularly sensitive tool for early identification of patients with an anticipated need for endoscopic therapy. In variceal bleeding, nearly all patients required endoscopic hemostasis (18 of 19; 94.7%), and ROC analysis yielded an AUC of 0.583 (95% CI: 0.354–0.813; p=0.784), without statistical significance.

Table 40. Prognostic value of Glasgow–Blatchford score for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	95% CI	Youden	Cut-off	Sens	Spec
Non-variceal	GBS	Need for endoscopic hemostasis	59	0.653	0.001	0.572-0.733	0.186	12.50	67.8%	50.8 %
Variceal			18	0.583	0.784	0.354-0.813	-	-	-	-

4.1.5. Prognostic value of Glasgow–Blatchford score (GBS) for the need for surgical treatment.

Assessment of the Glasgow–Blatchford score showed that higher score values were statistically significantly associated with the need for surgical treatment, particularly in non-variceal bleeding. Surgical intervention was performed in 14 patients (7.5%), in whom the mean GBS was higher compared to patients without surgical intervention (14.67 ± 3.40 vs. 12.17 ± 4.48; p=0.036). ROC analysis in non-variceal bleeding demonstrates moderate but statistically significant prognostic value of GBS for surgical treatment (AUC 0.662; 95% CI: 0.516–0.808; p=0.044). A threshold of GBS ≥12.5 provides the best balance between sensitivity (71.4%) and specificity (46.2%; Youden J=0.176), with lower cut-off values being more sensitive but less specific. In the variceal bleeding subgroup, surgical treatment was performed in only one patient, and consequently, despite a high AUC (0.833), the model did not reach statistical significance (p=0.273; 95% CI: 0.661–1.000), and derivation of reliable cut-off values was not considered appropriate.

Table 41. Prognostic value of Glasgow–Blatchford score for the need for surgical treatment. (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	95% CI	Youden	Cut-off	Sens	Spec
Non-variceal bleeding	GBS	Need for operative treatment	14	0.662	0.044	0.516–0.808	0.176	12.50	71.4%	46.2%
Variceal bleeding			1	0.833	0.273	0.661–1.000	-	-	-	-

4.1.6 Prognostic value of Glasgow–Blatchford score (GBS) for the need for blood transfusion

GBS demonstrates a pronounced and statistically significant association with the need for blood transfusion in acute upper gastrointestinal bleeding. In non-variceal bleeding, blood transfusion was administered in 73.3% of patients, and in variceal bleeding – in 89.5%. ROC analysis in non-variceal patients demonstrates excellent prognostic ability of GBS for the need for blood transfusion (AUC 0.890; 95% CI: 0.834–0.946; p<0.001). A threshold of GBS ≥9.5 provides sensitivity of 92.0% and specificity of 70.0% (Youden J=0.62), attesting to very good diagnostic performance at initial assessment. In variceal bleeding, blood transfusion was administered in 89.5% of patients; despite the high AUC (0.868), the model did not reach statistical significance (p=0.097), and therefore reliable cut-off values were not derived and the results are interpreted with caution.

Table 42. Prognostic value of Glasgow–Blatchford score for the need for blood transfusion. (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95%)	Youden	Cut-off	Sens	Spec
Non-variceal	GBS	Need for blood transfusion	137	0.890	0.000	0.834-0.946	0.62	9.50	92.0%	60.0 %
Variceal			17	0.868	0.097 /stat. non-significant/	0.644-1.000	-	-	-	-

4.2. AIMS65

4.2.1. Distribution and descriptive characteristics of AIMS65.

AIMS65 demonstrates significant differences according to clinical outcome in the studied cohort. The mean score value was higher in deceased patients compared to survivors (3.51 ± 0.90 vs. 1.68 ± 1.09; p<0.001), as well as in patients with rebleeding (2.80 ± 1.05 vs. 1.92 ± 1.34; p<0.001) and in those requiring endoscopic hemostasis (2.66 ± 1.22 vs. 1.89 ± 1.30; p<0.001). In the presence of active bleeding at endoscopy, AIMS65 was also significantly higher (2.80 ± 1.13 vs. 2.02 ± 1.32; p=0.002). No statistically significant difference was found with respect to surgical treatment (p=0.122)

Table 43. Distribution and descriptive characteristics of AIMS65 in the studied cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
AIMS65	Deceased	45	3.51	0.90	0.000	0.102
	Survivors	117	1.68	1.09		
	With rebleeding	50	2.80	1.05	0.000	0.022
	Without rebleeding	112	1.92	1.34		
	With need for surgical intervention	14	2.71	0.99	0.122	0.121

Score	Status	n	Mean value	SD	p mean value	p SD
	Without need for surgical intervention	148	2.14	1.34		
	With need for endoscopic hemostasis	64	2.66	1.22	0.000	0.506
	Without need for endoscopic hemostasis	98	1.89	1.30		
	With active bleeding present	35	2.80	1.13	0.002	0.129
	Without active bleeding present	127	2.02	1.32		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$

4.2.2. Prognostic value of AIMS65 for in-hospital mortality.

AIMS65 demonstrates a pronounced and statistically significant association between higher score values and in-hospital mortality, with patients who had a fatal outcome having a significantly higher mean AIMS65 compared to survivors (3.51 ± 0.90 vs. 1.68 ± 1.09; $p<0.001$). In non-variceal bleeding, ROC analysis (145 patients, 26.2% case fatality rate) demonstrates excellent prognostic value of AIMS65 for in-hospital mortality (AUC 0.882; 95% CI: 0.827–0.936; $p<0.001$). A threshold of AIMS65 ≥2.5 provides optimal balance between sensitivity and specificity (86.8% and 75.7%; Youden J=0.625) and emerges as most appropriate for risk stratification. In the variceal bleeding subgroup (n=17, 41.2% fatal outcome), AIMS65 also demonstrates very high discriminative ability (AUC 0.943; 95% CI: 0.836–1.000; p=0.002). At a threshold of ≥2.5, sensitivity of 100% and specificity of 60% are achieved (Youden J=0.6), but due to the small sample size the results must be interpreted with caution.

Table 44. Prognostic value of AIMS65 for in-hospital mortality in non-variceal and variceal bleeding (ROC analysis)

Patient group	Score	Outcome	**n (yes)*	AUC*	p	**CI (95 %)*	*Youden	Cut-off	Sens	Spec
Non-variceal	**AIMS65**	In-hospital mortality	38	0.882	0.000	0.827-0.936	0.625	2.50	86.8 %	75.7 %
Variceal			7	0.943	0.002	0.836-1.000	0.6	2.50	100 %	60 %

4.2.3. Prognostic value of AIMS65 for rebleeding.

Analysis of AIMS65 demonstrates a statistically significant association between higher score values and the risk of rebleeding, particularly in non-variceal bleeding. Patients with rebleeding had a higher mean AIMS65 compared to those without recurrent bleeding (2.80 ±

1.05 vs. 1.92 ± 1.34; p<0.001), confirming the increasing risk with higher score values. In non-variceal bleeding, ROC analysis (145 patients, 25.5% with rebleeding) demonstrates moderate but statistically significant prognostic value for rebleeding (AUC 0.689; 95% CI: 0.597–0.781; p=0.001). A threshold of AIMS65 ≥2.5 provides balanced sensitivity and specificity (67.6% and 68.5%; Youden J=0.362). In variceal bleeding, the analysis encompasses a small number of patients (n=17, of whom 76.5% had rebleeding), and AIMS65 demonstrated an AUC of 0.760 without statistical significance (p=0.126; 95% CI: 0.489–1.000), and therefore no optimal cut-off was determined. In summary, AIMS65 has moderate but significant prognostic value for rebleeding in non-variceal bleeding, whereas in variceal bleeding its performance remains limited in the present cohort.

Table 45. Prognostic value of AIMS65 for rebleeding (ROC analysis)

Patient group	**Score**	**Outcome**	n (yes)	**AUC**	**p**	**CI (95 %)*	**Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**AIMS65**	Rebleeding	37	0.689	0.001	0.597-0.781	0.362	2.50	67.6 %	68.5 %
Variceal			13	0.760	0.126	0.489-1.000	-	-	-	-

4.2.4. Prognostic value of AIMS65 for the need for endoscopic hemostasis.

AIMS65 demonstrates a statistically significant association between higher score values and the need for endoscopic hemostasis. Patients who underwent endoscopic intervention had a higher mean AIMS65 compared to those without hemostasis (2.66 ± 1.22 vs. 1.89 ± 1.30; p<0.001), supporting its clinical applicability. In non-variceal bleeding, ROC analysis (145 patients, 33.1% with hemostasis) demonstrates moderate but statistically significant prognostic value of AIMS65 for the need for endoscopic hemostasis (AUC 0.655; 95% CI: 0.563–0.748; p=0.002). A threshold of AIMS65 ≥2.5 provides sensitivity of 58.3% and specificity of 68.0% (Youden J=0.263) and is most appropriate for identifying patients with an increased probability of endoscopic intervention. In variceal bleeding, AIMS65 achieved a high AUC (0.906; 95% CI: 0.759–1.000), but without statistical significance (p=0.185) due to the small number of cases and imbalanced outcome distribution, and therefore no valid cut-off values were derived. In summary, AIMS65 has a statistically significant, albeit moderate, prognostic value for the need for endoscopic hemostasis in non-variceal bleeding.

Table 46. Prognostic value of AIMS65 for the need for endoscopic hemostasis (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC**	**p**	**CI (95 %)*	* **Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**AIMS65**	Need for endoscopic hemostasis	48	0.655	0.002	0.563-0.748	0.263	2.50	58.3 %	68.0 %
Variceal			16	0.906	0.185	0.759-1.000	-	-	-	-

4.2.5. Prognostic value of AIMS65 for the need for surgical treatment.

In the analysis of AIMS65 in relation to the need for surgical treatment, a trend toward higher score values was observed in patients who underwent surgical intervention, but the difference in mean values did not reach statistical significance (2.71 ± 0.99 vs. 2.14 ± 1.34; p=0.122). In non-variceal bleeding, ROC analysis (145 patients, 8.97% operated) demonstrates statistically significant but weak to moderate discriminative ability of AIMS65 for the need for surgery (AUC 0.671; SE=0.069; p=0.043; 95% CI: 0.536–0.805). The optimal threshold of AIMS65 ≥2.5 (Youden J=0.313) provides sensitivity of 69.2% and specificity of 62.1%, which limits the practical utility of the score as a standalone predictor of surgical intervention. In the variceal bleeding group, only one patient underwent surgery; the resulting AUC of 0.250 (p=0.414) was statistically non-significant and does not allow derivation of a reliable cut-off. In summary, AIMS65 has statistically significant but limited prognostic value for surgical treatment in non-variceal bleeding.

Table 47. Prognostic value of AIMS65 for the need for surgical treatment (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95 %)*	***Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**AIMS65**	Need for surgical treatment	13	0.671	0.043	0.536-0.805	0.313	2.50	69.2 %	62.1 %
Variceal			1	0.250	0.414 /stat non-signifi	0.027-0.473	-	-	-	-

4.2.6 Prognostic value of AIMS65 for the need for blood transfusion.

We found a statistically significant association between higher AIMS65 values and the need for blood transfusion in acute upper gastrointestinal bleeding. In non-variceal bleeding, blood transfusion was administered in 75.86% of patients, and in variceal bleeding – in 88.24%. In non-variceal patients, ROC analysis demonstrates moderate but significant prognostic ability of AIMS65 for the need for blood transfusion (AUC 0.704; 95% CI: 0.605–0.804; p<0.001). The optimal threshold of AIMS65 ≥1.5 provides balanced sensitivity and specificity (71.8% and 65.7%; Youden J=0.375). In variceal bleeding, AIMS65 demonstrates excellent prognostic value (AUC 0.983; 95% CI: 0.923–1.000; p=0.031), with the same threshold of ≥1.5 achieving sensitivity of 93.3% and specificity of 100% (Youden J=0.933). In summary, AIMS65 demonstrates statistically significant prognostic value for the need for blood transfusion, with moderate discrimination in non-variceal and excellent discrimination in variceal bleeding.

Table 48. Prognostic value of AIMS65 for the need for blood transfusion (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95 %)**	**Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**AIMS65**	Need for blood transfusion	110	0.704	0.000	0.605 –	0.375	1.50	71.8 %	65.7 %

Patient group	Score	Outcome	**n (yes) *	AUC *	p	CI (95 %)	Youden	Cut-off	Sens	Spec
						0.804				
Variceal			15	0.983	0.031	0.923 – 1.000	0.933	1.50	93.3%	100 %

4.3. ABC score.

4.4.1. Distribution and descriptive characteristics of ABC.

ABC score was calculated in 165 patients and demonstrated a trend toward higher values with unfavorable clinical outcomes. Deceased patients had a significantly higher mean ABC compared to survivors (10.67 ± 2.17 vs. 5.37 ± 3.03; p<0.001), as did patients with rebleeding compared to those without rebleeding (9.06 ± 2.85 vs. 5.97 ± 3.65; p<0.001). Higher score values were also found in the presence of active bleeding at emergency endoscopy (8.67 ± 3.23 vs. 6.42 ± 3.68; p=0.001) and in patients requiring endoscopic hemostasis (8.38 ± 3.28 vs. 5.95 ± 3.65; p<0.001). In patients who underwent surgical treatment, ABC was also higher, but the difference did not reach statistical significance (p=0.168).

Table 49. Distribution and descriptive characteristics of ABC score in the studied cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
ABC score	Deceased	48	10.67	2.17	0.000	0.008
	Survivors	117	5.37	3.03		
	With rebleeding	50	9.06	2.85	0.000	0.035
	Without rebleeding	115	5.97	3.65		
	With need for surgical intervention	14	8.21	2.64	0.168	0.102
	Without need for surgical intervention	151	6.79	3.77		
	With need for endoscopic hemostasis	65	8.38	3.28	0.000	0.221
	Without need for endoscopic hemostasis	100	5.95	3.65		
	With active bleeding present	36	8.67	3.23	0.001	0.308
	Without active bleeding present	129	6.42	3.68		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.3.2. Prognostic value of ABC for in-hospital mortality.

In our study, deceased patients had a significantly higher mean ABC compared to survivors (10.67 ± 2.17 vs. 5.37 ± 3.03; p<0.001), which confirms the strong association between the score and fatal outcome. In non-variceal bleeding, ROC analysis (147 patients, 27.2% case fatality rate) demonstrates excellent and statistically significant prognostic value of ABC for in-hospital mortality (AUC 0.919; 95% CI: 0.873–0.965; p<0.001). The optimal threshold of ABC ≥8.5 provides sensitivity of 87.5% and specificity of 87.9% (Youden J=0.754), allowing reliable early identification of high-risk non-variceal patients. In the variceal bleeding subgroup (18 patients, 44.4% case fatality rate), ABC also demonstrates excellent and statistically significant discriminative ability (AUC 0.919; 95% CI: 0.789–1.000; p=0.003). A threshold of ABC ≥9.0 achieves sensitivity of 87.5% and specificity of 80.0% (Youden J=0.675). In summary, ABC score demonstrates excellent prognostic value for in-hospital mortality in both non-variceal and variceal bleeding.

Table 50. Prognostic value of ABC score for in-hospital mortality (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	**Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	ABC score	In-hospital mortality	40	0.919	0.000	0.873-0.965	0.754	8.50	87.5%	87.9%
Variceal			8	0.919	0.003	0.789-1.000	0.675	9.00	87.5%	80.0%

4.3.3. Prognostic value of ABC for rebleeding.

The results show that ABC score was significantly higher in patients with rebleeding (9.06 ± 2.85 vs. 5.97 ± 3.65; p<0.001), supporting its use as an early indicator of the risk of recurrent bleeding. In non-variceal bleeding, ROC analysis demonstrates statistically significant prognostic value for rebleeding (AUC 0.736; 95% CI: 0.649–0.822; p<0.001). The optimal threshold of ABC ≥8.5 provides sensitivity of 66.7% and specificity of 78.4% (Youden J=0.451). In the variceal bleeding subgroup, ABC also demonstrates high and statistically significant discriminative ability (AUC 0.857; 95% CI: 0.666–1.000; p=0.034), with a threshold of ABC ≥9.0 achieving sensitivity of 64.3% and specificity of 100% (Youden J=0.643).

Table 51. Prognostic value of ABC score for rebleeding (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	**Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	ABC score	Rebleeding	36	0.736	0.000	0.649-0.822	0.451	8.50	66.7%	78.4%

Patient group	Score	Outcome	**n (yes)*	AUC*	p	**CI (95 %)*	Youden	Cut-off	Sens	Spec
Variceal			14	0.857	0.034	0.666-1.000	0.643	9	64.3 %	100 %

4.3.4. Prognostic value of ABC for the need for endoscopic hemostasis.

We find a statistically significant association between higher ABC score values and the need for endoscopic hemostasis. Patients who underwent hemostasis had a higher mean ABC compared to those without intervention (8.38 ± 3.28 vs. 5.95 ± 3.65; p<0.001). In non-variceal bleeding, ROC analysis (147 patients, 32.7% with hemostasis) demonstrates statistically significant but moderate prognostic value of ABC for the need for endoscopic hemostasis (AUC 0.676; 95% CI: 0.588–0.764; p=0.001). A threshold of ABC ≥5.5 provides sensitivity of 77.1% and specificity of 50.5% (Youden J=0.276). In the variceal bleeding group, ABC score had a high AUC (0.941; 95% CI: 0.829–1.000), but the model did not reach statistical significance (p=0.148) due to the small number of cases, and therefore reliable cut-off values were not derived.

Table 52. Prognostic value of ABC score for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	**n (yes)*	AUC*	p	**CI (95 %)*	Youden	Cut-off	Sens	Spec
Non-variceal	ABC score	Need for endoscopic hemostasis	48	0.676	0.001	0.588-0.764	0.276	5.50	77.1 %	50.5 %
Variceal			17	0.941	0.148 /	0.829-1.000	-	-	-	-

4.3.5. Prognostic value of ABC for the need for surgical treatment.

With respect to the need for surgical treatment, ABC did not demonstrate convincing discriminative ability, although patients who underwent surgical intervention showed a trend toward higher score values. The mean ABC was higher in operated patients (8.21 ± 2.64) compared to non-operated patients (6.79 ± 3.77), but the difference did not reach statistical significance (p=0.168). In non-variceal bleeding, ROC analysis (147 patients, 8.84% operated) yielded an AUC of 0.662 (95% CI: 0.538–0.785; p=0.054), representing borderline non-significant discrimination and not allowing reliable identification of patients at risk for surgery. A threshold of ABC ≥5.5 provides sensitivity of 84.6% and specificity of 44.0% (Youden J=0.286) and should be interpreted as indicative only. In the variceal bleeding subgroup (18 patients, 1 surgical case), discrimination was extremely low (AUC 0.176; p=0.289), rendering the model statistically non-significant. In our cohort, ABC score demonstrates limited prognostic value for surgical treatment in both non-variceal and variceal bleeding.

Table 53. Prognostic value of ABC score for the need for surgical treatment (ROC analysis)

Patient group	Score	Outcome	**n (yes)*	AUC*	p	**CI (95 %)*	Youden	Cut-off	Sens	Spec
Non-variceal	ABC score	Need for surgical treatme	13	0.662	0.054	0.538-0.785	0.286	5.50	84.6 %	44.0 %
Variceal			1	0.176	0.289	0.000-0.369	-	-	-	-

4.3.6. Prognostic value of ABC for the need for blood transfusion.

We found a statistically significant prognostic value of ABC score for the need for blood transfusion in patients with acute bleeding. In non-variceal bleeding, transfusion was performed in 75.51% of patients with available ABC data, and in variceal bleeding — in 88.88%. In non-variceal patients, ROC analysis demonstrated good and statistically significant discriminative ability (AUC 0.761; 95% CI: 0.661–0.860; $p<0.001$). The optimal threshold ABC ≥4.5 provides sensitivity 79.3% and specificity 69.4% (Youden J=0.487). In the variceal bleeding subgroup, ABC score demonstrated excellent prognostic value for blood transfusion (AUC 0.938; 95% CI: 0.804–1.000; p=0.049). Threshold ABC ≥6.5 achieves sensitivity 81.3% and specificity 100% (Youden J=0.813). In summary, ABC score is a reliable predictor for the need for blood transfusion in both subgroups, with optimal cut-off values ≥4.5 (non-variceal) and ≥6.5 (variceal bleeding).

4.4. Canada-United Kingdom-Adelaide (CANUKA)

4.4.1. Distribution and descriptive characteristics of CANUKA.

CANUKA score was calculated for 206 patients from the study cohort. Descriptive analysis revealed a consistent trend toward higher CANUKA values in patients with unfavorable outcomes and more severe bleeding course. Deceased patients had a significantly higher mean CANUKA compared to survivors (13.33 ± 1.89 vs. 8.93 ± 2.90; $p<0.001$), as did patients with rebleeding compared to those without (12.34 ± 2.48 vs. 9.32 ± 3.21; $p<0.001$). Higher score values were also found in patients requiring endoscopic hemostasis (11.90 ± 2.57 vs. 9.14 ± 3.28; $p<0.001$), with active bleeding during endoscopy (12.30 ± 2.10 vs. 9.61 ± 3.34; $p<0.001$), and requiring surgical treatment (11.80 ± 2.60 vs. 10.04 ± 3.33; p=0.047).

Table 54. Distribution and descriptive characteristics of CANUKA in the study cohort

Score	Status	n	Mean value	SD	p mean value	p SD
CANUKA	Deceased	58	13.33	1.89	0.000	0.000
	Survivors	148	8.93	2.90		
	With rebleeding	58	12.34	2.48	0.000	0.006
	Without rebleeding	148	9.32	3.21		
	Requiring surgical intervention	15	11.80	2.60	0.047	0.210

Score	Status	n	Mean value	SD	p mean value	p SD
	Not requiring surgical intervention	191	10.04	3.33		
	Requiring endoscopic hemostasis	77	11.90	2.57	0.000	0.007
	Not requiring endoscopic hemostasis	129	9.14	3.28		
	With active bleeding	43	12.30	2.10	0.000	0.001
	Without active bleeding	163	9.61	3.34		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.4.2. Prognostic value of CANUKA for in-hospital mortality.

We found a statistically significant association between higher CANUKA score values and in-hospital mortality, with deceased patients having a significantly higher mean CANUKA compared to survivors (13.33 ± 1.89 vs. 8.93 ± 2.90; p<0.001). In non-variceal bleeding, ROC analysis (187 patients, 26.2% lethality) demonstrated excellent prognostic value of CANUKA for in-hospital mortality (AUC 0.913; 95% CI: 0.871–0.955; p<0.001). The optimal threshold CANUKA ≥11.5 provides sensitivity 85.7% and specificity 80.4% (Youden J=0.661). In the variceal bleeding subgroup (19 patients, 47.4% lethality), CANUKA also demonstrated good and statistically significant discriminative ability (AUC 0.811; 95% CI: 0.593–1.000; p=0.022), with threshold ≥12.5 achieving sensitivity 77.8% and specificity 80.0% (Youden J=0.578). In summary, CANUKA demonstrates very high prognostic value for in-hospital mortality in non-variceal and good prognostic value in variceal bleeding, with optimal cut-off values ≥11.5 and ≥12.5 for early identification of high-risk patients.

Table 55. Prognostic value of CANUKA for in-hospital mortality (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	CANUKA score	Mortality within hospitalization	49	0.913	0.000	0.871-0.955	0.661	11.50	85.7 %	80.4 %
Variceal			9	0.811	0.022	0.593-1.000	0.578	12.50	77.8 %	80.0 %

4.4.3. Prognostic value of CANUKA for rebleeding.

CANUKA score was statistically significantly higher in patients with rebleeding (12.34 ± 2.48 vs. 9.32 ± 3.21; p<0.001), supporting the association between the score and the risk of recurrent hemorrhage. In non-variceal bleeding, ROC analysis (187 patients, 22.99% with rebleeding) demonstrated good and statistically significant prognostic value for rebleeding (AUC 0.772; 95% CI: 0.692–0.853; p<0.001). Threshold CANUKA ≥11.5 provides sensitivity 76.7% and specificity 75.0% (Youden J=0.517). In the variceal bleeding subgroup (19 patients), CANUKA also demonstrated high and statistically significant discriminative ability for rebleeding (AUC 0.883; 95% CI: 0.713–1.000; p=0.021), with threshold ≥10.5 achieving sensitivity 93.3% and specificity 75.0% (Youden J=0.683). In summary, CANUKA has significant prognostic value for rebleeding in both subgroups, with optimal cut-off values ≥11.5 (non-variceal) and ≥10.5 (variceal bleeding).

Table 56. Prognostic value of CANUKA for rebleeding (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	CANUKA score	Rebleeding	43	0.772	0.000	0.692-0.853	0.517	11.50	76.7 %	75.0 %
Variceal			15	0.883	0.021	0.713-1.000	0.683	10.50	93.3 %	75.0 %

4.4.4. Prognostic value of CANUKA for the need for endoscopic hemostasis.

CANUKA was significantly higher in patients requiring endoscopic hemostasis compared to those without intervention (11.90 ± 2.57 vs. 9.14 ± 3.28; p<0.001), supporting the association between the score and the need for endoscopic treatment. In non-variceal bleeding, ROC analysis (187 patients, 31.6% with hemostasis) demonstrated statistically significant prognostic value of CANUKA for the need for endoscopic hemostasis (AUC 0.723; 95% CI: 0.647–0.798; p<0.001). Threshold CANUKA ≥10.5 provides sensitivity 69.5% and specificity 64.1% (Youden J=0.336). In the variceal bleeding subgroup (19 cases, 94.7% with hemostasis), CANUKA had a high AUC (0.944; 95% CI: 0.822–1.000), but the model did not reach statistical significance (p=0.144) due to the minimal number of patients without intervention.

Table 57. Prognostic value of CANUKA for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CANUKA**	Need for endoscopic hemostasis	59	0.723	0.000	0.647-0.798	0.336	10.50	69.5 %	64.1 %
Variceal			18	0.944	0.144/s	0.822-1.000	-	-	-	-

4.4.5. Prognostic value of CANUKA for the need for surgical treatment.

We found that higher CANUKA values were associated with a greater probability of surgical treatment, with operated patients having a statistically significantly higher score (11.80 ± 2.60 vs. 10.04 ± 3.33; p=0.047). In non-variceal bleeding, ROC analysis (187 patients, 7.49% operated) demonstrated statistically significant but moderate prognostic value of CANUKA for the need for surgery (AUC 0.687; 95% CI: 0.549–0.825; p=0.020). Threshold CANUKA ≥11.5 provides sensitivity 71.4% and specificity 65.9% (Youden J=0.373). In the variceal bleeding group, discrimination was low and statistically non-significant (AUC 0.278; 95% CI: 0.062–0.494; p=0.465), and therefore the Youden index and a reliable cut-off were not calculated.

Table 58. Prognostic value of CANUKA for the need for surgical treatment (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CANUKA**	Need for surgical treatm	14 ent	0.687	0.020	0.549-0.825	0.373	11.50	71.4 %	65.9 %
Variceal			1	0.278	0.465 /stat non-sig/	0.062-0.494	-	-	-	-

4.4.6. Prognostic value of CANUKA for the need for blood transfusion.

CANUKA demonstrated a statistically significant association between higher score values and the need for blood transfusion in acute upper gastrointestinal bleeding. ROC analysis in non-variceal bleeding showed high and statistically significant prognostic ability of CANUKA for the need for blood transfusion (AUC 0.838; 95% CI: 0.766–0.910; p<0.001). Optimal threshold CANUKA ≥8.5 provides sensitivity 81.8% and specificity 72.0% (Youden J=0.538). In variceal bleeding, CANUKA achieved AUC 0.853 (95% CI: 0.657–1.000), but the model was not statistically significant (p=0.111), so due to the small sample size, a reliable cut-off and Youden index were not determined.

Table 59. Prognostic value of CANUKA for the need for blood transfusion (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CANUKA**	Need for blood transfusi	137 on	0.838	0.000	0.766-0.910	0.538	8.50	81.8 %	72.0 %
Variceal			17	0.853	0.111	0.657-1.000	-	-	-	-

4.5. MAP(ASH).

4.5.1. Distribution and descriptive characteristics of MAP(ASH).

In the study cohort, MAP(ASH) demonstrated a clearly expressed risk gradient, with higher score values consistently associated with unfavorable clinical outcomes and the need for therapeutic intervention. Patients with in-hospital mortality had a significantly higher mean MAP(ASH) compared to survivors (6.52 ± 1.35 vs. 4.02 ± 2.19; p<0.001), as did patients with rebleeding compared to those without (6.20 ± 1.71 vs. 4.09 ± 2.22; p<0.001). Higher score values were also found in patients requiring endoscopic hemostasis (5.78 ± 1.96 vs. 4.07 ± 2.23; p<0.001), with active bleeding during endoscopy (5.81 ± 1.80 vs. 4.44 ± 2.32; p<0.001), and requiring surgical treatment (6.29 ± 1.98 vs. 4.59 ± 2.27; p=0.008).

Table 60. Distribution and descriptive characteristics of MAP(ASH) score in the study cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
MAP(ASH)	Deceased	48	6.52	1.35	0.000	0.002
	Survivors	120	4.02	2.19		
	With rebleeding	51	6.20	1.71	0.000	0.026
	Without rebleeding	117	4.09	2.22		
	Requiring surgical intervention	14	6.29	1.98	0.008	0.366
	Not requiring surgical intervention	154	4.59	2.27		
	Requiring endoscopic hemostasis	65	5.78	1.96	0.000	0.199
	Not requiring endoscopic hemostasis	103	4.07	2.23		
	With active bleeding	36	5.81	1.80	0.000	0.037
	Without active bleeding	132	4.44	2.32		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at p < 0.05.

4.5.2. Prognostic value of MAP(ASH) for in-hospital mortality.

We found a pronounced and statistically significant association between higher MAP(ASH) values and in-hospital mortality, with deceased patients having a significantly higher mean score compared to survivors (6.52 ± 1.35 vs. 4.02 ± 2.19; p<0.001). ROC analysis in non-variceal patients demonstrated good and statistically significant prognostic ability of MAP(ASH) for in-hospital mortality (AUC 0.802; 95% CI: 0.735–0.870; p<0.001). The optimal threshold MAP(ASH) ≥4.5 provides very high sensitivity of 97.5% with specificity 61.8% (Youden J=0.593). In variceal bleeding, MAP(ASH) demonstrated excellent discriminative ability (AUC 0.950; 95% CI: 0.845–1.000; p=0.001), with threshold ≥6.5 achieving sensitivity 87.5% and specificity 100% (Youden J=0.875). In summary, MAP(ASH) is a reliable predictor for in-hospital mortality in both bleeding types, with its higher values identifying patients at increased risk of fatal outcome during hospitalization.

Table 61. Prognostic value of MAP(ASH) for fatal outcome during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**MAP (ASH) score**	Mortality within hospitalization	40	0.802	0.000	0.735-0.870	0.593	4.50	97.5 %	61.8 %
Variceal			8	0.950	0.001	0.845-1.000	0.875	6.50	87.5 %	100 %

4.5.3. Prognostic value of MAP(ASH) for rebleeding.

MAP(ASH) showed a clear risk gradient for rebleeding: patients with a recurrent episode had significantly higher score values compared to those without rebleeding (6.20 ± 1.71 vs. 4.09 ± 2.22; p<0.001), with a difference in variances also observed (p=0.026). Rebleeding was recorded in 32.74% of non-variceal and 77.77% of variceal patients with available data. In non-variceal bleeding, ROC analysis demonstrated acceptable to good discriminative ability of MAP(ASH) for predicting rebleeding (AUC 0.749; 95% CI: 0.666–0.832; p<0.001). Threshold MAP(ASH) ≥4.5 provides sensitivity 83.8% and specificity 55.8% (Youden J=0.396), with the score capturing most patients at risk of rebleeding at the cost of lower specificity. In the variceal bleeding subgroup, MAP(ASH) demonstrated very high prognostic value (AUC 0.938; 95% CI: 0.826–1.000; p=0.009), with cut-off ≥4.5 achieving sensitivity 85.7% and specificity 100% (Youden J=0.857).

Table 62. Prognostic value of MAP(ASH) for rebleeding during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)		Youden	Cut-off	Sens	Spec
Non-variceal	**MAP (ASH) score**	Rebleeding	37	0.749	0.000		0.666-0.832	0.396	4.50	83.8 %	55.8 %

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)		Youden	Cut-off	Sens	Spec
Variceal			14	0.938	0.009	0.826-1.000		0.857	4.50	85.7 %	100 %

4.5.4. Prognostic value of MAP(ASH) for the need for endoscopic hemostasis.

MAP(ASH) was significantly higher in patients who underwent endoscopic hemostasis compared to those without intervention (5.78 ± 1.96 vs. 4.07 ± 2.23; p<0.001), demonstrating adequate discriminative ability of the score. The need for hemostasis was established in 32.0% of non-variceal and 94.44% of variceal patients with available MAP(ASH) data. In non-variceal bleeding, ROC analysis demonstrated borderline to acceptable prognostic value for the need for endoscopic hemostasis (AUC 0.700; 95% CI: 0.614–0.786; p<0.001). Threshold MAP(ASH) ≥3.5 provides high sensitivity of 91.7% with specificity 41.2% (Youden J=0.329), making the score more suitable for "capturing" patients with likely need for hemostasis than for ruling them out. In the variceal bleeding subgroup, AUC was 0.765 (95% CI: 0.553–0.976), but the model did not reach statistical significance (p=0.386), and therefore the Youden index and reliable cut-off values were not calculated.

Table 63. Prognostic value of MAP(ASH) for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**MAP (ASH) score**	Need for endoscopic hemostasis	48	0.700	0.000	0.614-0.786	0.329	3.50	91.7 %	41.2 %
Variceal			17	0.765	0.386	0.553-0.976	-	-	-	-

4.5.5. Prognostic value of MAP(ASH) for the need for surgical treatment.

There is a statistically significant association between higher MAP(ASH) values and the need for surgical treatment, with operated patients having a higher mean score compared to non-operated patients (6.29 ± 1.98 vs. 4.59 ± 2.27; p=0.008). In non-variceal bleeding, surgical treatment was performed in 8.67% of patients with available MAP(ASH) data. ROC analysis demonstrated statistically significant but moderate prognostic value (AUC 0.720; 95% CI: 0.577–0.863; p=0.009). The optimal threshold MAP(ASH) ≥4.5 provides sensitivity 84.6% and specificity 48.9% (Youden J=0.335). In the variceal bleeding subgroup, there was only one operated patient; the obtained AUC 0.500 (95% CI: 0.243–0.757; p=1.000) was statistically non-significant and does not allow derivation of a reliable cut-off.

Table 64. Prognostic value of MAP(ASH) for the need for surgical treatment (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**MAP (ASH) score**	Need for surgical treatme	13 nt	0.720	0.009	0.577-0.863	0.335	4.50	84.6 %	48.9 %
Variceal			1	0.500	1.000	0.243-0.757	-	-	-	-

4.5.6. Prognostic value of MAP(ASH) for the need for blood transfusion.

MAP(ASH) showed a clear association with the need for blood transfusion in acute upper gastrointestinal bleeding. In non-variceal patients, ROC analysis demonstrated good and statistically significant prognostic ability (AUC 0.817; 95% CI: 0.731–0.903; p<0.001). The optimal threshold MAP(ASH) ≥2.5 provides sensitivity 94.7% and specificity 59.5% (Youden J=0.542). In the variceal bleeding subgroup, MAP(ASH) demonstrated excellent prognostic value for blood transfusion (AUC 0.984; 95% CI: 0.928–1.000; p=0.029). Threshold ≥3.5 achieves sensitivity 93.8% and specificity 100% (Youden J=0.938). In summary, MAP(ASH) is a reliable predictor for the need for blood transfusion in both bleeding types.

Table 65. Prognostic value of MAP(ASH) for the need for blood transfusion (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**MAP (ASH) score**	Need for blood transfusio	113 n	0.817	0.000	0.731-0.903	0.542	2.50	94.7 %	59.5 %
Variceal			16	0.984	0.029	0.928-1.000	0.938	3.50	93.8 %	100 %

4.6. Pre-endoscopic (clinical) Rockall score.

4.6.1. Distribution and descriptive characteristics of the pre-endoscopic Rockall.

In the study cohort, the pre-endoscopic Rockall score showed a relatively compact distribution, with its values changing predictably according to clinical outcome and severity of bleeding. At the descriptive level, the score was most distinctly associated with mortality and indicators of a “more severe” course, while for some endpoints the differences remained less pronounced. Patients with in-hospital mortality had a higher mean score compared to survivors (5.36 ± 1.01 vs. 4.14 ± 1.45; p<0.001), as did patients with rebleeding compared to those without rebleeding (4.97 ± 1.21 vs. 4.29 ± 1.49; p=0.002). Higher values were also found in patients requiring endoscopic hemostasis (4.94 ± 1.08 vs. 4.21 ± 1.57; p<0.001) and with active bleeding during endoscopy (5.05 ± 1.05 vs. 4.34 ± 1.50; p=0.001). No statistically significant difference was found with respect to surgical treatment (p=0.379), suggesting limited value of the score for predicting this outcome.

Table 66. Distribution and descriptive characteristics of the pre-endoscopic Rockall score in the study cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
pre-endoscopy Rockall	Deceased	59	5.36	1.01	0.000	0.086
	Survivors	150	4.14	1.45		
	With rebleeding	60	4.97	1.21	0.002	0.116
	Without rebleeding	149	4.29	1.49		
	Requiring surgical intervention	15	4.80	1.01	0.379	0.101
	Not requiring surgical intervention	194	4.46	1.47		
	Requiring endoscopic hemostasis	79	4.94	1.08	0.000	0.007
	Not requiring endoscopic hemostasis	130	4.21	1.57		
	With active bleeding	43	5.05	1.05	0.001	0.023
	Without active bleeding	166	4.34	1.50		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.6.2. Prognostic value of the pre-endoscopic Rockall for in-hospital mortality.

The pre-endoscopic Rockall score was significantly higher in deceased patients compared to survivors (5.36 ± 1.01 vs. 4.14 ± 1.45; $p<0.001$), linking it to an increased risk of fatal outcome during hospitalization. In non-variceal cases, the pre-endoscopic Rockall demonstrated moderate to good discriminative ability for predicting in-hospital mortality (AUC 0.765; 95% CI: 0.691–0.839; $p<0.001$). Threshold Rockall ≥ 4.5 provides sensitivity 82.0% and specificity 62.9% (Youden J=0.449). In the variceal bleeding subgroup, AUC was 0.644 (95% CI: 0.383–0.906), but the model did not reach statistical significance ($p=0.288$), and therefore reliable cut-off values and Youden index were not determined. In summary, the pre-endoscopic Rockall has significant prognostic value for mortality in non-variceal bleeding, while in variceal bleeding the strength of evidence is limited.

Table 67. Prognostic value of the pre-endoscopic Rockall for fatal outcome during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Pre-endoscopy Rockall**	Mortality within hospitalization	50	0.765	0.000	0.691-0.839	0.449	4.50	82 %	62.9 %
Variceal			9	0.644	0.288/stat non-sig/	0.383-0.906	-	-	-	-

4.6.3. Prognostic value of the pre-endoscopic Rockall for rebleeding.

The pre-endoscopic Rockall score demonstrated a statistically significant but limited association with the risk of rebleeding, with patients with rebleeding having a higher mean score compared to those without rebleeding (4.97 ± 1.21 vs. 4.29 ± 1.49; p=0.002). In non-variceal bleeding, the pre-endoscopic Rockall demonstrated weak but statistically significant discrimination for rebleeding (AUC 0.633; 95% CI: 0.542–0.724; p=0.007). Threshold Rockall ≥4.5 provides sensitivity 66.7% and specificity 56.6% (Youden J=0.233), which limits its practical value for reliable stratification. In the variceal bleeding subgroup, AUC was 0.667 (95% CI: 0.420–0.914), but the model was not statistically significant (p=0.317) and reliable threshold value and Youden index were not determined.

Table 68. Prognostic value of the pre-endoscopic Rockall for rebleeding during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Pre-endoscopy Rockall**	Rebleeding	45	0.633	0.007	0.542-0.724	0.233	4.50	66.7 %	56.6 %
Variceal			15	0.667	0.317/stat non-sig/	0.420-0.914	-	-	-	-

4.6.4. Prognostic value of the pre-endoscopic Rockall for the need for endoscopic hemostasis.

The pre-endoscopic Rockall score was statistically significantly higher in patients requiring endoscopic hemostasis compared to those without intervention (4.94 ± 1.08 vs. 4.21 ± 1.57; p<0.001), demonstrating an association between the score and the probability of therapeutic endoscopy. In non-variceal bleeding, ROC analysis demonstrated weak to moderate but statistically significant discriminative ability of the pre-endoscopic Rockall for predicting the need for endoscopic hemostasis (AUC 0.636; 95% CI: 0.555–0.716; p=0.003). The optimal

threshold Rockall ≥4.5 provides sensitivity 62.3% and specificity 57.4% (Youden J=0.197). In the variceal bleeding subgroup, the model was not informative (AUC 0.472; 95% CI: 0.196–0.749; p=0.927), and therefore reliable cut-off values and Youden index were not determined. In summary, the pre-endoscopic Rockall has limited, albeit statistically significant, prognostic value for the need for endoscopic hemostasis in non-variceal bleeding and lacks reliable discrimination in variceal bleeding.

Table 69. Prognostic value of the pre-endoscopic Rockall for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Pre-endoscopy Rockall**	Need for endoscopic hemostasis	61	0.636	0.003	0.555-0.716	0.197	4.50	62.3 %	57.4 %
Variceal			18	0.472	0.927	0.196-0.749	-	-	-	-

4.6.5. Prognostic value of the pre-endoscopic Rockall for the need for surgical treatment.

The pre-endoscopic Rockall score did not show a convincing association with the need for surgical treatment: mean values in operated and non-operated patients did not differ statistically significantly (4.80 ± 1.01 vs. 4.46 ± 1.47; p=0.379). In non-variceal bleeding, surgical treatment was performed in 14 patients (7.95%), and ROC analysis demonstrated low and statistically non-significant prognostic value (AUC 0.567; 95% CI: 0.431–0.702; p=0.408), and therefore an optimal cut-off and Youden index were not determined. In the variceal bleeding subgroup, there was only one operated patient; AUC was 0.528 (95% CI: 0.251–0.804; p=0.927), also without statistical significance and without derivation of threshold values.

4.6.6. Prognostic value of the pre-endoscopic Rockall for the need for blood transfusion.

The pre-endoscopic Rockall score was statistically significantly associated with the need for blood transfusion. In non-variceal patients, ROC analysis demonstrated moderate and statistically significant prognostic ability of the score (AUC 0.717; 95% CI: 0.634–0.801; p<0.001). Threshold Rockall ≥4.5 provides sensitivity 57.1% and specificity 74.0% (Youden J=0.311), representing a balanced but not optimal level of discrimination. In the variceal bleeding subgroup, AUC was 0.824 (95% CI: 0.632–1.000), but the model did not reach statistical significance (p=0.144), and therefore a reliable threshold value and Youden index were not determined. In summary, the pre-endoscopic Rockall has moderate prognostic value for blood transfusion in non-variceal bleeding, but limited strength of evidence in the variceal subgroup.

Table 70. Prognostic value of the pre-endoscopic Rockall for the need for blood transfusion (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Pre-endoscopy Rockall**	Need for blood transfusion	140	0.717	0.000	0.634-0.801	0.311	4.50	57.1 %	74.0 %
Variceal			17	0.824	0.144/ stat non-sig/	0.632-1.000	-	-	-	-

4.7. Rockall score.

4.7.1. Distribution and descriptive characteristics of Rockall score.

The complete (post-endoscopic) Rockall score showed a clear association with unfavorable clinical outcome in the study cohort. Patients with in-hospital mortality had a higher mean score compared to survivors (8.27 ± 1.11 vs. 6.33 ± 2.08; p<0.001), as did patients with rebleeding compared to those without rebleeding (8.00 ± 1.34 vs. 6.43 ± 2.12; p<0.001). Higher values were also found in patients requiring endoscopic hemostasis (7.97 ± 1.15 vs. 6.22 ± 2.19; p<0.001), with active bleeding during endoscopy (8.09 ± 1.13 vs. 6.57 ± 2.20; p<0.001), and requiring surgical treatment (7.67 ± 1.11 vs. 6.82 ± 2.10; p=0.016). These results indicate that higher complete Rockall is associated with a more severe clinical course and a higher probability of interventional treatment.

Table 71. Distribution and descriptive characteristics of Rockall score in the study cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
Complete Rockall score	Deceased	59	8.27	1.11	0.000	0.000
	Survivors	150	6.33	2.08		
	With rebleeding	60	8.00	1.34	0.000	0.000
	Without rebleeding	149	6.43	2.12		
	Requiring surgical intervention	15	7.67	1.11	0.016	0.017
	Not requiring surgical intervention	194	6.82	2.10		
	Requiring endoscopic hemostasis	79	7.97	1.15	0.000	0.000

Score	Status	n	Mean value	SD	p mean value	p SD
	Not requiring endoscopic hemostasis	130	6.22	2.19		
	With active bleeding	43	8.09	1.13	0.000	0.000
	Without active bleeding	166	6.57	2.20		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.7.2. Prognostic value of Rockall for in-hospital mortality.

The complete Rockall score was significantly higher in deceased patients compared to survivors (8.27 ± 1.11 vs. 6.33 ± 2.08; p<0.001), delineating a clear distinction between groups with respect to the risk of fatal outcome. ROC analysis in non-variceal patients demonstrates good prognostic value of the complete Rockall for in-hospital mortality (AUC 0.795; 95% CI: 0.731–0.859; p<0.001). The most informative threshold is ≥7.5, at which sensitivity is 76.0% and specificity is 70.7% (Youden J=0.467), providing a good balance between detection of high-risk patients and limiting false-positive cases. In the variceal bleeding subgroup the AUC is 0.667 (95% CI: 0.407–0.926), but the model does not reach statistical significance (p=0.221), and therefore no reliable cut-off or Youden index were determined. In this cohort, the complete Rockall has good prognostic value for mortality in non-variceal bleeding, whereas in variceal bleeding the assessment remains limited.

Table 72. Prognostic value of Rockall for fatal outcome during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Rockall score**	In-hospital mortality	50	0.795	0.000	0.731-0.859	0.467	7.50	76.0 %	70.7 %
Variceal			9	0.667	0.221 /stat n.s./	0.407-0.926	-	-	-	-

4.7.3. Prognostic value of Rockall for rebleeding.

The complete Rockall score was significantly higher in patients with rebleeding compared to those without rebleeding (8.00 ± 1.34 vs. 6.43 ± 2.12; p<0.001), with a substantial difference also in variances between groups (p<0.001). Rebleeding was recorded in 23.68% of non-variceal and in 78.95% of variceal patients with available data. In non-variceal bleeding ROC analysis shows moderate and statistically significant discriminative ability of the complete Rockall for predicting rebleeding (AUC 0.714; 95% CI: 0.636–0.793; p<0.001). An optimal threshold of ≥6.5 provides high sensitivity of 91.1% at specificity 45.5% (Youden J=0.366),

making it suitable for early “capture” of high-risk patients, albeit with limited specificity. In the variceal bleeding subgroup the AUC is 0.733 (95% CI: 0.504–0.962), but the model does not reach statistical significance (p=0.162), and therefore no threshold value or Youden index were determined. In summary, the complete Rockall has a statistically significant but moderate prognostic value for rebleeding in non-variceal bleeding, while in variceal patients the informativeness is limited.

Table 73. Prognostic value of Rockall for rebleeding during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Rockall score**	Rebleeding	45	0.714	0.000	0.636-0.793	0.366	6.50	91.1 %	45.5 %
Variceal			15	0.733	0.162 /stat n.s./	0.504-0.962	-	-	-	-

4.7.4. Prognostic value of Rockall for the need for endoscopic hemostasis.

The complete Rockall score was statistically significantly higher in patients requiring endoscopic hemostasis compared to those without intervention (7.97 ± 1.15 vs. 6.22 ± 2.19; p<0.001), with a substantial difference also in variances between groups. In non-variceal bleeding ROC analysis shows a statistically significant, acceptable discriminative ability of the complete Rockall for predicting the need for endoscopic hemostasis (AUC 0.734; 95% CI: 0.665–0.803; p<0.001). A threshold of ≥6.5 provides sensitivity 91.8% and specificity 50.4% (Youden J=0.422), which represents a good compromise between “capturing” those in need and limiting false positives. In the variceal bleeding subgroup the AUC is 0.778 (95% CI: 0.512–1.000), but without statistical significance (p=0.361), likely due to the small sample size and imbalance between groups.

Table 74. Prognostic value of Rockall for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**Rockall score**	Need for endoscopic hemostasis	61	0.734	0.000	0.665-0.803	0.422	6.50	91.8 %	50.4 %
Variceal			18	0.778	0.361 /stat n.s./	0.512-1.000	-	-	-	-

4.7.5. Prognostic value of Rockall for the need for surgical treatment.

Patients who required surgical treatment had a statistically significantly higher Rockall score compared to those without surgery (7.67 ± 1.11 vs. 6.82 ± 2.10; p=0.016), with a

difference also in variances between groups (p=0.017). In non-variceal bleeding ROC analysis shows weak and statistically non-significant discriminative ability of the complete Rockall for predicting surgical treatment (AUC 0.608; 95% CI: 0.493–0.722; p=0.181), and therefore no Youden index or cut-off were calculated. In variceal bleeding the discriminative ability is also statistically non-significant (AUC 0.556; 95% CI: 0.296–0.816; p=0.855), again without a calculated Youden index or threshold value. In summary, despite higher mean Rockall values in operated patients, ROC analysis does not confirm reliable prognostic value for the need for surgical treatment in either non-variceal or variceal bleeding.

Table 75. Prognostic value of Rockall for the need for surgical treatment (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**complete Rockall score**	Need for surgical treatment	14	0.608	0.181 /stat n.s./	0.493-0.722	-	-	-	-
Variceal			1	0.556	0.855 /stat n.s./	0.296-0.816	-	-	-	-

4.7.6. Prognostic value of Rockall for the need for blood transfusion.

Patients who received a blood transfusion during hospitalization had higher values of the complete Rockall score compared to those without the need for transfusion, which is also confirmed by ROC analysis. In non-variceal bleeding ROC analysis shows a statistically significant, acceptable discriminative ability of Rockall for predicting the need for transfusion (AUC 0.726; 95% CI: 0.645–0.808; p<0.001). A threshold of ≥6.5 provides a balance between sensitivity 73.6% and specificity 66.0% (Youden J=0.396), representing the highest value of the index for the thresholds examined. In variceal bleeding the AUC is 0.794 (95% CI: 0.583–1.000), but the model does not reach statistical significance (p=0.184), likely due to the small sample size and imbalance between groups.

Table 76. Prognostic value of Rockall for the need for blood transfusion (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)		Youden	Cut-off	Sens	Spec
Non-variceal	**Rockall score**	Need for blood transfusion	140	0.726	0.000	0.645-0.808		0.396	6.50	73.6 %	66.0 %
Variceal			17	0.794	0.184 /stat n.s./	0.583-1.000		-	-	-	-

4.8. Progetto Nazionale Emorragia Digestiva (PNED).

4.8.1. Distribution and descriptive characteristics of PNED.

In the studied cohort, PNED (Progetto Nazionale Emorragia Digestiva) has a mean value of 7.06 ± 4.00 and a median of 7, reflecting a wide range of post-endoscopic risk among patients with acute upper gastrointestinal bleeding. Higher score values were found in in-hospital mortality (11.32 ± 3.14 vs. 5.37 ± 2.90; p<0.001), rebleeding (11.22 ± 3.33 vs. 5.41 ± 2.90; p<0.001), need for endoscopic hemostasis (9.72 ± 3.86 vs. 5.43 ± 3.12; p<0.001), active bleeding at the time of endoscopy (10.95 ± 3.99 vs. 6.04 ± 3.33; p<0.001), and surgical treatment (9.80 ± 4.21 vs. 6.84 ± 3.91; p=0.006). These results indicate that higher PNED is associated with a more severe clinical course and a higher probability of adverse outcome and interventional treatment.

Table 77. Distribution and descriptive characteristics of PNED score in the studied cohort.

Score	Status	n	Mean value	SD	p mean value	p SD
PNED score	Deceased	59	11.32	3.14	0.000	0.355
	Survivors	149	5.37	2.90		
	With rebleeding	59	11.22	3.33	0.000	0.251
	Without rebleeding	149	5.41	2.90		
	With need for surgical intervention	15	9.80	4.21	0.006	0.697
	Without need for surgical intervention	193	6.84	3.91		
	With need for endoscopic hemostasis	79	9.72	3.86	0.000	0.107
	Without need for endoscopic hemostasis	129	5.43	3.12		
	With active bleeding present	43	10.95	3.99	0.000	0.059
	Without active bleeding present	165	6.04	3.33		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at p < 0.05.

4.8.2. Prognostic value of PNED for in-hospital mortality.

Higher PNED values are associated with significantly higher in-hospital mortality in acute upper gastrointestinal bleeding — patients with fatal outcome had a significantly higher mean PNED compared to survivors (11.32 ± 3.14 vs. 5.37 ± 2.90; p<0.001). In non-variceal patients ROC analysis shows excellent prognostic value of PNED for in-hospital mortality (AUC

0.923; 95% CI: 0.886–0.960; p<0.001). A threshold of PNED ≥8.5 provides sensitivity 82.0% and specificity 86.3% (Youden J=0.683), reflecting very good discriminative ability. In variceal bleeding PNED again demonstrates excellent prognostic value (AUC 0.939; 95% CI: 0.838–1.000; p=0.001), with an optimal threshold of ≥11.0, sensitivity 77.8%, and specificity 90.0% (Youden J=0.678). Thus PNED reliably identifies patients at high risk of fatal outcome in both non-variceal and variceal bleeding.

Table 78. Prognostic value of PNED for fatal outcome during hospitalization (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	**Youden*	**Cut-off**	**Sens**	**Spec**
Non-variceal	**PNED**	In-hospital mortality	50	0.923	0.000	0.886 – 0.960	0.683	8.50	82.0 %	86.3 %
Variceal			9	0.939	0.001	0.838-1.000	0.678	11.00	77.8 %	90.0 %

4.8.3. Prognostic value of PNED for rebleeding.

Patients with rebleeding had a significantly higher mean PNED compared to those without rebleeding (11.22 ± 3.33 vs. 5.41 ± 2.90; p<0.001). In non-variceal bleeding PNED shows excellent prognostic value for rebleeding (AUC 0.894; 95% CI: 0.843–0.946; p<0.001). An optimal threshold of ≥6.5 provides sensitivity 97.7% and specificity 64.1% (Youden J=0.618), with a priority toward high sensitivity. In variceal bleeding PNED again demonstrates excellent prognostic value (AUC 0.958; 95% CI: 0.872–1.000; p=0.006), although the presence of *ties* requires cautious interpretation. Analysis determines a threshold of ≥9.5 with sensitivity 86.7%, specificity 100%, and Youden J=0.867.

Table 79. Prognostic value of PNED for rebleeding during hospitalization (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	**Youden*	**Cut-off**	**Sens**	**Spec**
Non-variceal	**PNED**	Rebleeding	44	0.894	0.000	0.843 – 0.946	0.618	6.50	97.7 %	64.1 %
Variceal			15	0.958	0.006	0.872-1.000	0.867	9.50	86.7 %	100 %

4.8.4. Prognostic value of PNED for the need for endoscopic hemostasis.

Higher PNED values are statistically associated with the need for endoscopic therapy — patients who underwent hemostasis had a significantly higher mean PNED (9.72 ± 3.86 vs. 5.43 ± 3.12; p<0.001). In non-variceal bleeding ROC analysis shows good and statistically significant prognostic ability of PNED for the need for endoscopic hemostasis (AUC 0.769; 95% CI: 0.699–0.838; p<0.001). An optimal threshold of PNED ≥6.5 provides sensitivity 78.7% and specificity 63.3% (Youden J=0.42), reflecting good discrimination already at the post-endoscopic assessment. In variceal bleeding the AUC reaches 1.000, but without statistical significance (p=0.100) due to the small number of patients and strong imbalance (18 with hemostasis vs. 1 without), and therefore no cut-off or Youden index were determined. In summary, PNED is a

statistically significant and clinically applicable predictor for the need for endoscopic hemostasis in non-variceal bleeding, while in variceal bleeding interpretation is limited by the small sample.

Table 80. Prognostic value of PNED for the need for endoscopic hemostasis (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	***Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**PNED**	Need for endoscopic hemostasis	15	0.769	0.000	0.699-0.838	0.42	6.50	78.7%	63.3%
Variceal			18	1.000	0.1000	1.000-1.000	-	-	-	-

4.8.5. Prognostic value of PNED for the need for surgical treatment.

Patients who required surgical treatment had a significantly higher mean PNED compared to those without surgery (9.80 ± 4.21 vs. 6.84 ± 3.91; p=0.006), without substantial differences in variances (p=0.697). In non-variceal bleeding ROC analysis shows good and statistically significant prognostic ability of PNED for the need for surgical intervention (AUC 0.722; 95% CI: 0.580–0.864; p=0.006). An optimal threshold of PNED ≥6.5 provides sensitivity 85.7% and specificity 52.6% (Youden J=0.383), indicating moderate diagnostic effectiveness with an emphasis on sensitivity. In variceal bleeding the AUC is 0.444 (95% CI: 0.184–0.704; p=0.855), and the absence of statistical significance and the small number of events (only one operated patient) preclude determination of reliable threshold values and Youden index. Therefore PNED is a significant predictor for surgical treatment in non-variceal, but not in variceal bleeding.

Table 81. Prognostic value of PNED for the need for surgical treatment (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95%)*	***Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**PNED**	Need for surgical treatment	14	0.722	0.006	0.580-0.864	0.383	6.50	85.7%)	52.6%)
Variceal			1	0.444	0.855	0.184-0.704	-	-	-	-

4.8.6. Prognostic value of PNED for the need for blood transfusion.

Higher PNED values are statistically associated with the need for blood transfusion. In non-variceal bleeding ROC analysis shows good and statistically significant prognostic ability of PNED for the need for transfusion (AUC 0.821; 95% CI: 0.750–0.893; p<0.001). An optimal threshold of PNED ≥4.5 provides sensitivity 80.6% and specificity 74.0% (Youden J=0.546), reflecting good diagnostic effectiveness. In variceal bleeding PNED demonstrates excellent prognostic value (AUC 0.941; 95% CI: 0.829–1.000; p=0.046); a threshold of ≥7.5 achieves sensitivity 94.1%, specificity 100%, and Youden J=0.941. Thus PNED is a statistically

significant predictor for the need for transfusion in both subgroups, with good discrimination in non-variceal and excellent discrimination in variceal bleeding.

Table 82. Prognostic value of PNED for the need for blood transfusion (ROC analysis)

Patient group	**Score**	**Outcome**	**n (yes)*	**AUC*	**p**	**CI (95 %)*	***Youden**	**Cut-off**	**Sens**	**Spec**
Non-variceal	**PNED**	Need for blood transfusion	139	0.821	0.000	0.750-0.893	0.546	4.50	80.6 %	74.0 %
Variceal			17	0.941	0.046	0.829 – 1.000	0.941	7.50	94.1 %	100 %

4.9. Cedars Sinai Medical Centre Predictive Index (CSMCPI)

4.9.1. Distribution and descriptive characteristics of CSMCPI.

In our cohort, the Cedars Sinai Medical Centre Predictive Index (CSMCPI) shows good variability and clear differentiation of patients according to clinical outcome, with higher values in adverse events. For in-hospital mortality the mean CSMCPI was 8.27 ± 0.99 in deceased patients vs. 5.17 ± 2.20 in survivors ($p<0.001$), with significant differences also in variances ($p<0.001$). A similar profile is observed for rebleeding — 8.10 ± 1.43 in patients with rebleeding vs. 5.22 ± 2.19 in those without ($p<0.001$; p for SD<0.001). CSMCPI is also higher for the need for endoscopic hemostasis (7.71 ± 1.38 vs. 5.04 ± 2.31; $p<0.001$) and for active bleeding at the time of endoscopy (8.35 ± 1.13 vs. 5.45 ± 2.26; $p<0.001$). Regarding surgical treatment, patients with surgical intervention had a significantly higher CSMCPI (7.33 ± 1.29) compared to those without surgery (5.95 ± 2.43; $p=0.001$; p for SD=0.004), further supporting the ability of the index to stratify risk.

Table 83. Distribution and descriptive characteristics of CSMCPI score in the studied cohort.

Score	**Status**	**n**	**Mean value**	**SD**	**p mean value**	**p SD**
Cedars Sinai Medical Centre Predictive Index (CSMCPI)	Deceased	59	8.27	0.99	0.000	0.000
	Survivors	150	5.17	2.20		
	With rebleeding	60	8.10	1.43	0.000	0.000
	Without rebleeding	149	5.22	2.19		
	With need for surgical intervention	15	7.33	1.29	0.001	0.004

Score	Status	n	Mean value	SD	p mean value	p SD
	Without need for surgical intervention	194	5.95	2.43		
	With need for endoscopic hemostasis	79	7.71	1.38	0.000	0.000
	Without need for endoscopic hemostasis	130	5.04	2.31		
	With active bleeding present	43	8.35	1.13	0.000	0.000
	Without active bleeding present	166	5.45	2.26		

Note: Data are presented as n, mean value, and standard deviation (SD). Comparison of mean values between two independent groups was performed using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

4.9.2. Prognostic value of CSMCPI for in-hospital mortality.

Higher CSMCPI values are markedly and statistically significantly associated with in-hospital mortality in acute upper gastrointestinal bleeding — deceased patients had a mean CSMCPI of 8.27 ± 0.99 vs. 5.17 ± 2.20 in survivors ($p<0.001$), with significant differences in variances ($p<0.001$). In non-variceal patients ROC analysis shows excellent prognostic value of CSMCPI for in-hospital mortality (AUC 0.901; 95% CI: 0.858–0.944; $p<0.001$). An optimal threshold of ≥6.5 provides sensitivity 96.0% and specificity 70.7% (Youden J=0.667), with a good balance between the two. In variceal bleeding CSMCPI also demonstrates very good prognostic value (AUC 0.878; 95% CI: 0.717–1.000; $p=0.006$); a threshold of ≥8.5 yields sensitivity 88.9%, specificity 80.0%, and Youden J=0.689. Thus CSMCPI reliably identifies patients at increased risk of fatal outcome in both non-variceal and variceal bleeding.

Table 84. Prognostic value of CSMCPI for fatal outcome during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CSMCPI**	In-hospital mortality	50	0.901	0.000	0.858-0.944	0.667	6.50	96.0%	70.7 %
Variceal			9	0.878	0.006	0.717-1.000	0.689	8.50	88.9 %	80.0 %

4.9.3. Prognostic value of CSMCPI for rebleeding.

Patients with rebleeding had a significantly higher CSMCPI compared to those without a repeated episode (8.10 ± 1.43 vs. 5.22 ± 2.19; $p<0.001$), with statistically significant differences also in variances ($p<0.001$), indicating more homogeneous high values in the adverse outcome group. In non-variceal bleeding CSMCPI demonstrates very good prognostic value for

rebleeding (AUC 0.854; 95% CI: 0.790–0.918; p<0.001). A threshold of ≥6.5 provides sensitivity 88.9% and specificity 66.2% (Youden J=0.551), making it particularly useful for early identification of patients at increased risk at acceptable specificity. In variceal bleeding CSMCPI shows excellent prognostic value (AUC 0.950; 95% CI: 0.853–1.000; p=0.007); a threshold of ≥7.5 yields sensitivity 80.0%, specificity 100%, and Youden J=0.800, effectively "screening out" patients without rebleeding. The index provides reliable risk stratification for rebleeding in both subgroups with clearly defined clinical thresholds.

Table 85. Prognostic value of CSMCPI for rebleeding during hospitalization (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CSMCPI**	Rebleeding	45	0.854	0.000	0.790-0.918	0.551	6.50	88.9 %	66.2 %
Variceal			15	0.950	0.007	0.853-1.000	0.800	7.50	80 %	100 %

4.9.4. Prognostic value of CSMCPI for the need for endoscopic hemostasis.

CSMCPI was significantly higher in patients requiring endoscopic hemostasis compared to those without intervention (7.71 ± 1.38 vs. 5.04 ± 2.31; p<0.001). Hemostasis was performed in 32.11% of non-variceal and in 94.74% of variceal patients with available data. In non-variceal bleeding ROC analysis shows good and statistically significant discriminative ability of CSMCPI for predicting the need for endoscopic hemostasis (AUC 0.804; 95% CI: 0.743–0.865; p<0.001). An optimal threshold of ≥5.5 provides sensitivity 93.4% and specificity 55.0% (Youden J=0.484). In variceal bleeding the AUC is 0.778 (95% CI: 0.550–1.000), but without statistical significance (p=0.361), likely due to the small number of patients and outcome imbalance, and therefore no reliable cut-off or Youden index were determined.

Table 86. Prognostic value of CSMCPI for the need for endoscopic hemostasis (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CSMCPI**	Need for endoscopic hemostasis	61	0.804	0.000	0.743-0.865	0.484	5.50	93.4 %	55.0 %
Variceal			18	0.778	0.361 /stat n.s./	0.550-1.000	-	-	-	-

4.9.5. Prognostic value of CSMCPI for the need for surgical treatment.

CSMCPI was significantly higher in patients requiring surgical treatment compared to those without surgical intervention (7.33 ± 1.29 vs. 5.95 ± 2.43; p=0.001), with a statistically significant difference also in variances (p=0.004). In non-variceal bleeding ROC analysis shows

a statistically significant but moderate discriminative ability of CSMCPI for predicting surgical intervention (AUC 0.694; 95% CI: 0.583–0.806; p=0.016). An optimal threshold of ≥5.5 provides sensitivity 92.9% and specificity 42.0% (Youden J=0.349), making the index more suitable as a screening marker than for ruling out cases without surgery. In variceal bleeding only 1 patient (5.27%) underwent surgery, and therefore AUC 0.222 (95% CI: 0.000–0.450; p=0.361) is not statistically significant and no threshold or Youden index were calculated. In summary, CSMCPI has significant but moderate prognostic value for the need for surgery in non-variceal bleeding, while reliable interpretation is lacking in variceal bleeding.

Table 87. Prognostic value of CSMCPI for the need for surgical treatment. (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CSMCPI**	Need for surgical treatment	14	0.694	0.016	0.583-0.806	0.349	5.50	92.9 %	42.0 %
Variceal			1	0.222	0.361 / stat n.s./	0.000-0.450	-	-	-	-

4.9.6. Prognostic value of CSMCPI for the need for blood transfusion.

ROC analysis in non-variceal patients shows good and statistically significant prognostic ability of CSMCPI for the need for transfusion (AUC 0.783; 95% CI: 0.709–0.857; p<0.001). An optimal threshold of ≥4.5 provides sensitivity 82.1% and specificity 64.0% (Youden J=0.461), reflecting good discrimination already at initial assessment. In variceal bleeding the AUC is 0.794 (95% CI: 0.598–0.990), but without statistical significance (p=0.184) due to the small number of patients and imbalance between groups, so no threshold or Youden index were determined. As a result, CSMCPI is a reliable predictor for blood transfusion in non-variceal bleeding, while in variceal bleeding the assessment is limited.

Table 88. Prognostic value of CSMCPI for the need for blood transfusion. (ROC analysis)

Patient group	Score	Outcome	n (yes)	AUC	p	CI (95 %)	Youden	Cut-off	Sens	Spec
Non-variceal	**CSMCPI**	Need for blood transfusion	140	0.783	0.000	0.709-0.857	0.461	4.50	82.1 %	64.0 %
Variceal			17	0.794	0.184	0.598-0.990	-	-	-	-

4.10. Discussion.

In the present analysis, the prognostic value of several established scoring systems was evaluated in patients with variceal and non-variceal upper gastrointestinal bleeding with respect to the risk of rebleeding, in-hospital mortality, and the need for intervention (endoscopic hemostasis, surgical treatment, and blood transfusion). For each scale, the distribution and descriptive characteristics in the studied cohort were analyzed, along with its discriminative

ability via ROC analysis with determination of optimal thresholds (cut-offs) and diagnostic indicators (sensitivity/specificity). In summary, the prognostic scoring systems demonstrated good and clinically useful prognostic value for "hard" endpoints, particularly for in-hospital mortality and the need for blood transfusion, while prediction of surgical treatment was more limited and less stable across subgroups. When patients were divided into non-variceal and variceal bleeding, it was confirmed that in variceal cases interpretation is often limited by the small number of patients and outcome imbalance, which is why some ROC models remain statistically non-significant despite high AUC values. The results support the applicability of the scoring systems already at initial assessment for early risk stratification, providing a basis for subsequent direct comparison between individual scores with respect to prognostic effectiveness for each endpoint.

5. Comparison of scoring systems by prognostic effectiveness for adverse outcomes and the need for intervention during hospitalization.

Following the individual assessment of the prognostic value of each instrument separately, we undertook a direct comparison between the scoring systems. The present analysis aims to determine which scores have the best discriminative ability and which of them are most suitable for early risk stratification in patients with acute upper gastrointestinal bleeding. The comparative analysis includes nine scoring systems: Glasgow–Blatchford score (GBS), AIMS65, ABC, CANUKA, MAP(ASH), Rockall (pre-endoscopic and complete), PNED, and CSMCPI. Scores were compared by prognostic effectiveness for the main clinically significant endpoints during hospitalization: in-hospital mortality, rebleeding, need for endoscopic hemostasis, need for surgical treatment, and need for blood transfusion. To account for the influence of etiology and the different therapeutic approach, results were interpreted separately in patients with non-variceal and variceal bleeding.

5.1. In-hospital mortality.

5.1.1. Non-variceal bleeding.

In non-variceal bleeding all analyzed scoring systems demonstrate statistically significant discriminative ability for predicting in-hospital mortality, with substantial differences in their performance by AUC. The highest AUC values are observed for PNED and ABC, positioning them as leading instruments for distinguishing patients at high risk of fatal outcome during hospitalization. PNED achieves AUC=0.923 (95% CI: 0.886–0.960) at an optimal threshold of ≥8.5, which provides a high balance between sensitivity and specificity (Sens 82.0%; Spec 86.3%; Youden 0.683). ABC is practically at the same level — AUC=0.919 (95% CI: 0.873–0.965) with a cut-off of ≥8.5, at which simultaneously high sensitivity and specificity are achieved (Sens 87.5%; Spec 87.9%; Youden 0.754). Very close to them are CANUKA and the Cedars–Sinai Index (CSMCPI). CANUKA shows AUC=0.913 (95% CI: 0.871–0.955) with a threshold of ≥11.5 (Sens 85.7%; Spec 80.4%; Youden 0.661), while CSMCPI shows AUC=0.901 (95% CI: 0.858–0.944) with a threshold of ≥6.5, characterized by very high sensitivity (96.0%) at the cost of more moderate specificity (70.7%; Youden 0.667). This means that CSMCPI can be used as a good "screening tool" to avoid missing high-risk patients. AIMS65 also demonstrates excellent prognostic value — AUC=0.882 (95% CI: 0.827–0.936) with a threshold of ≥2.5 and a good balance between sensitivity and specificity (Sens 86.8%;

Spec 75.7%; Youden 0.625). Compared to PNED/ABC/CANUKA/CSMCPI it is slightly weaker by AUC, but remains highly competitive and clinically useful, especially as a rapid score on patient admission. Lower AUC values were found for MAP(ASH) (AUC=0.802; 95% CI: 0.735–0.870) and the complete Rockall (AUC=0.795; 95% CI: 0.731–0.859), while the pre-endoscopic Rockall (AUC=0.765; 95% CI: 0.691–0.839) and GBS (AUC=0.753; 95% CI: 0.680–0.827) are characterized by the most limited discriminative ability for mortality in this subgroup. In summary, in non-variceal bleeding the strongest predictors of in-hospital mortality are PNED and ABC, followed by CANUKA and CSMCPI, with CSMCPI and MAP(ASH) distinguished by the highest sensitivity, while ABC provides the best overall balance between sensitivity and specificity.

Table 89. Prognostic effectiveness of scoring systems for in-hospital mortality in non-variceal bleeding (AUC)

Score	AUC	SE	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
PNED	0.923	0.019	0.000	0.886–0.960	0.683	8.50	82.0%	86.3%
ABC	0.919	0.023	0.000	0.873–0.965	0.754	8.50	87.5%	87.9%
CANUKA	0.913	0.021	0.000	0.871–0.955	0.661	11.50	85.7%	80.4%
Cedars–Sinai (CSMCPI)	0.901	0.022	0.000	0.858–0.944	0.667	6.50	96.0%	70.7%
AIMS65	0.882	0.028	0.000	0.827–0.936	0.625	2.50	86.8%	75.7%
MAP(ASH)	0.802	0.035	0.000	0.735–0.870	0.593	4.50	97.5%	61.8%
Rockall (complete)	0.795	0.033	0.000	0.731–0.859	0.467	7.50	76.0%	70.7%
Rockall (pre-endoscopic)	0.765	0.038	0.000	0.691–0.839	0.449	4.50	82.0%	62.9%
GBS	0.753	0.038	0.000	0.680–0.827	0.435	13.50	77.6%	65.9%

5.1.2. Variceal bleeding.

In our cohort, patients with variceal bleeding constituted a small subgroup with a limited number of events. The scores demonstrated variable discriminative ability, with ROC models for some of them failing to reach statistical significance, which limits the interpretation and derivation of reliable thresholds. The best AUC performance was demonstrated by MAP(ASH) with AUC=0.950 (95% CI: 0.845–1.000; p=0.001), positioning it as the most discriminative model for mortality in variceal bleeding. The threshold value with real clinical interpretation is MAP(ASH) ≥ 6.5, achieving Spec 100% at Sens 87.5% (Youden 0.875) — i.e., a threshold with very strong “rule-in” value for high risk. Nearly identical high AUC values are demonstrated by

AIMS65 (AUC=0.943; p=0.002; 95% CI: 0.836–1.000) and PNED (AUC=0.939; p=0.001; 95% CI: 0.838–1.000). For AIMS65, a threshold of ≥2.5 yields maximum sensitivity (100%), but with more moderate specificity (60%), making it more suitable for early identification (triage). For PNED, a threshold of ≥11 provides a more balanced profile with Spec 90% and Sens 77.8%, positioning it as a more selective tool for identifying high-risk patients. ABC demonstrated excellent discrimination for variceal bleeding as well (AUC=0.919; p=0.003; 95% CI: 0.789–1.000). The threshold value ABC ≥ 9 is associated with a favorable balance (Sens 87.5%; Spec 80.0%), supporting its applicability as a stable predictor of in-hospital mortality also in patients with variceal bleeding. Also statistically significant are CSMCPI (AUC=0.878; p=0.006; 95% CI: 0.717–1.000) and CANUKA (AUC=0.811; p=0.022; 95% CI: 0.593–1.000). For GBS (AUC=0.639; p=0.307), pre-endoscopic Rockall (AUC=0.644; p=0.288), and complete Rockall (AUC=0.667; p=0.221), the ROC models are statistically non-significant in variceal bleeding. This likely reflects the limited sample and imbalance of events. Therefore, it is not appropriate to interpret thresholds or draw firm conclusions regarding their clinical superiority/inferiority in this subgroup.

Table 90. Prognostic performance of scoring systems for in-hospital mortality in variceal bleeding

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
MAP(ASH)	0.950	0.001	0.845–1.000	0.875	6.50	87.5%	100%
AIMS65	0.943	0.002	0.836–1.000	0.600	2.50	100%	60.0%
PNED	0.939	0.001	0.838–1.000	0.678	11.00	77.8%	90.0%
ABC	0.919	0.003	0.789–1.000	0.675	9.00	87.5%	80.0%
Cedars–Sinai (CSMCPI)	0.878	0.006	0.717–1.000	0.689	8.50	88.9%	80.0%
CANUKA	0.811	0.022	0.593–1.000	0.578	12.50	77.8%	80.0%
Rockall (complete)	0.667	0.221	0.407–0.926	–	–	–	–
Rockall (pre-endoscopic)	0.644	0.288	0.383–0.906	–	–	–	–
GBS	0.639	0.307	0.370–0.907	–	–	–	–

For models with p≥0.05 (GBS and both variants of Rockall), Youden/cut-off/sens/spec are not interpreted.

5.2. Rebleeding.

5.2.1. In non-variceal bleeding.

All examined scoring systems demonstrated statistically significant discriminative ability for predicting rebleeding in non-variceal bleeding (p≤0.007), with their performance ranging from high (AUC≈0.85–0.89) to moderate/limited (AUC≈0.63–0.69). In the interpretation, the varying number of missing data should also be taken into account, since for AIMS65 (45

missing), MAP(ASH) (40), and ABC (43), the estimates are based on a smaller sample, potentially affecting the stability of the calculated thresholds and diagnostic indicators cut-off, sensitivity, and specificity. Among the compared models, PNED demonstrated the highest prognostic performance (AUC=0.894), with an optimal threshold of ≥6.5 achieving very high sensitivity (97.7%) at moderate specificity (64.1%), which delineates a profile suitable for early identification of nearly all patients with subsequent rebleeding, albeit at the cost of a higher number of false positives. Second in strength is Cedars–Sinai (CSMCPI) (AUC=0.854), where a cut-off of ≥6.5 provides a more even balance (Sens 88.9%; Spec 66.2%; Youden 0.551) and may be more practical when the goal is to simultaneously minimize missed cases and limit over-stratification. In the "intermediate" zone, CANUKA (AUC=0.772) stands out with the most symmetric profile at a threshold of ≥11.5 (Sens 76.7%; Spec 75.0%; Youden 0.517). MAP(ASH) (AUC=0.749) at a threshold of ≥4.5 is more "sensitive" (sensitivity 83.8%), but with lower specificity (55.8%), while ABC (AUC=0.736) has the opposite profile – higher specificity (78.4%) at lower sensitivity (66.7%) and is more suitable for a "rule-in" approach. Lower values are observed for Rockall (complete) (AUC=0.714), which at a threshold of ≥6.5 achieves high sensitivity (91.1%), but with very low specificity (45.5%) and accordingly "classifies" a significant number of patients without rebleeding. AIMS65 (AUC=0.689) and GBS (AUC=0.670) remain statistically significant, but with moderate discrimination and no advantage over the leading models, which is expected given their stronger orientation toward other endpoints. The most limited prognostic value belongs to pre-endoscopic Rockall (AUC=0.633; Youden 0.233), likely due to the absence of endoscopic components that are relevant to the risk of rebleeding.

Table 91. Prognostic performance of scoring systems for rebleeding in non-variceal bleeding

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
PNED	0.894	0.000	0.843–0.946	0.618	6.50	97.7%	64.1%
CSMCPI	0.854	0.000	0.790–0.918	0.551	6.50	88.9%	66.2%
CANUKA	0.772	0.000	0.692–0.853	0.517	11.50	76.7%	75.0%
MAP(ASH)	0.749	0.000	0.666–0.832	0.396	4.50	83.8%	55.8%
ABC	0.736	0.000	0.649–0.822	0.451	8.50	66.7%	78.4%
Rockall (complete)	0.714	0.000	0.636–0.793	0.366	6.50	91.1%	45.5%
AIMS65	0.689	0.001	0.597–0.781	0.362	2.50	67.6%	68.5%
GBS	0.670	0.001	0.580–0.760	0.285	13.50	67.4%	61.1%
Rockall (pre-endoscopic)	0.633	0.007	0.542–0.724	0.233	4.50	66.7%	56.6%

5.2.2. In variceal bleeding.

In variceal bleeding, the analysis was conducted on a small sample, which implies wider confidence intervals and potential instability of threshold values; nevertheless, some scores showed very high AUC and statistically significant ROC models, allowing comparative conclusions with moderate caution in generalization. In predicting rebleeding, the best

performance was demonstrated by PNED (AUC=0.958; p=0.006), CSMCPI (AUC=0.950; p=0.007), and MAP(ASH) (AUC=0.938; p=0.009). For these, the optimal thresholds lead to specificity of 100%, defining a strong "rule-in" profile for high risk: PNED ≥9.5 (Sens 86.7%; Spec 100%; Youden 0.867), CSMCPI ≥7.5 (Sens 80.0%; Spec 100%; Youden 0.800), and MAP(ASH) ≥4.5 (Sens 85.7%; Spec 100%; Youden 0.857), with differences among them mainly in sensitivity (higher for PNED and MAP(ASH), lower for CSMCPI). CANUKA (AUC=0.883; p=0.021) and GBS (AUC=0.858; p=0.032) demonstrate good discrimination, but with lower specificity (75%) at their optimal thresholds — CANUKA ≥10.5 (Sens 93.3%; Spec 75.0%; Youden 0.683) and GBS ≥11.0 (Sens 86.7%; Spec 75.0%; Youden 0.617), with CANUKA distinguished by higher sensitivity and better balance for clinical use. ABC (AUC=0.857; p=0.034) is close to GBS in AUC, but at ABC ≥9.0, Spec 100% is observed at lower Sens 64.3% (Youden 0.643), characterizing it as a more selective tool for confirming high risk, but with greater risk of missing some future rebleeding events. In contrast, AIMS65 (AUC=0.760; p=0.126), complete Rockall (AUC=0.733; p=0.162), and pre-endoscopic Rockall (AUC=0.667; p=0.317) do not reach statistical significance, and therefore it is not justified to derive and interpret reliable cut-off values for them in this subgroup. In conclusion, in variceal bleeding, PNED, CSMCPI, and MAP(ASH) demonstrated the highest prognostic performance for rebleeding (AUC 0.938–0.958) with specificity of 100% at optimal thresholds and a clearly expressed "rule-in" potential, while CANUKA and GBS remain clinically useful but with a compromise in specificity, and AIMS65 and Rockall should be interpreted with caution due to lack of statistical significance in the present sample.

Table 92. Prognostic performance of scoring systems for rebleeding in variceal bleeding

Score	**AUC**	**p**	**95% CI**	**Youden (J)**	**Cut-off (≥)**	**Sens**	**Spec**
PNED	0.958	0.006	0.872–1.000	0.867	9.50	86.7%	100%
Cedars–Sinai (CSMCPI)	0.950	0.007	0.853–1.000	0.800	7.50	80.0%	100%
MAP(ASH)	0.938	0.009	0.826–1.000	0.857	4.50	85.7%	100%
CANUKA	0.883	0.021	0.713–1.000	0.683	10.50	93.3%	75.0%
GBS	0.858	0.032	0.684–1.000	0.617	11.00	86.7%	75.0%
ABC	0.857	0.034	0.666–1.000	0.643	9.00	64.3%	100%
AIMS65	0.760	0.126	0.489–1.000	–	–	–	–
Rockall (complete)	0.733	0.162	0.504–0.962	–	–	–	–
Rockall (pre-endoscopic)	0.667	0.317	0.420–0.914	–	–	–	–

For models with a statistically non-significant ROC (p≥0.05), cut-off values, sensitivity, and specificity are not interpreted

5.3. Need for endoscopic hemostasis.

5.3.1. In non-variceal bleeding.

In non-variceal bleeding, all scoring systems demonstrated statistically significant prognostic value for the need for endoscopic hemostasis ($p \leq 0.003$), but with different discriminative accuracy (AUC 0.636–0.804). For this endpoint, most models were positioned in a moderately good range without a "perfect" predictor, which is expected since the indication for hemostasis is determined by endoscopic findings, which some scores do not include. The highest AUC was demonstrated by Cedars–Sinai (CSMCPI) (AUC=0.804; 95% CI: 0.743–0.865), with a threshold of ≥5.5 achieving very high sensitivity (93.4%) at moderate specificity (55.0%) (Youden 0.484), which delineates a profile of a suitable triage tool for early identification of patients likely to require endoscopic intervention. In second place is PNED (AUC=0.769; 95% CI: 0.699–0.838), which at a threshold of ≥6.5 provides a more balanced ratio between sensitivity and specificity (Sens 78.7%; Spec 63.3%; Youden 0.420), i.e., potentially more appropriate when the aim is to limit over-stratification. Complete Rockall (AUC=0.734) follows immediately, achieving high sensitivity (91.8%) at a threshold of ≥6.5 at the expense of lower specificity (50.4%) (Youden 0.422) — behavior close to that of CSMCPI, but with weaker overall discrimination. In the intermediate range, CANUKA (AUC=0.723) offers the most symmetric balance at a threshold of ≥10.5 (Sens 69.5%; Spec 64.1%; Youden 0.336), but with lower sensitivity and correspondingly greater risk of missing patients who will require hemostasis compared to more sensitive models. MAP(ASH) (AUC=0.700) demonstrates very good sensitivity at a threshold of ≥3.5 (Sens 91.7%), but with very low specificity (41.2%) (Youden 0.329), which limits its utility for identifying low-risk patients. Lower AUC values were found for ABC (AUC=0.676) and AIMS65 (AUC=0.655). ABC at a threshold of ≥5.5 is moderately sensitive (77.1%) with specificity 50.5%, while AIMS65 at a threshold of ≥2.5 has relatively higher specificity (68.0%) at the expense of low sensitivity (58.3%) (Youden 0.263), characterizing it as more selective but with a risk of missing clinically significant cases. GBS (AUC=0.653) is similar in AUC to AIMS65 and demonstrates moderate sensitivity and specificity at a threshold of ≥12.5 (67.8%/50.8%) with the lowest Youden (0.186), which is consistent with its orientation toward overall severity/resource demand rather than specifically toward therapeutic endoscopic intervention. The lowest discrimination was observed for pre-endoscopic Rockall (AUC=0.636; p=0.003). In conclusion, for non-variceal bleeding, the post-endoscopic scores CSMCPI (AUC=0.804), followed by PNED (AUC=0.769) and complete Rockall (AUC=0.734), expectedly showed the best prognostic performance for the need for endoscopic hemostasis, with CSMCPI and Rockall being more suitable for triage due to their very high sensitivity at optimal thresholds, while PNED offers a more balanced profile.

Table 93. Prognostic performance of scoring systems for the need for endoscopic hemostasis in non-variceal bleeding.

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
Cedars–Sinai (CSMCPI)	0.804	0.000	0.743–0.865	0.484	5.50	93.4%	55.0%
PNED	0.769	0.000	0.699–0.838	0.420	6.50	78.7%	63.3%

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
Rockall (complete)	0.734	0.000	0.665–0.803	0.422	6.50	91.8%	50.4%
CANUKA	0.723	0.000	0.647–0.798	0.336	10.50	69.5%	64.1%
MAP(ASH)	0.700	0.000	0.614–0.786	0.329	3.50	91.7%	41.2%
ABC	0.676	0.001	0.588–0.764	0.276	5.50	77.1%	50.5%
AIMS65	0.655	0.002	0.563–0.748	0.263	2.50	58.3%	68.0%
GBS	0.653	0.001	0.572–0.733	0.186	12.50	67.8%	50.8%
Rockall (pre-endoscopic)	0.636	0.003	0.555–0.716	0.197	4.50	62.3%	57.4%

5.3.2. In variceal bleeding.

In variceal bleeding, the comparison of scoring systems with regard to the need for endoscopic hemostasis is limited due to the small subgroup size and the strong imbalance of the endpoint (almost all patients underwent hemostasis). As a result, the ROC analysis did not identify statistically significant discriminative ability for any of the scores ($p \geq 0.05$), and therefore it was not methodologically appropriate to produce reliable rankings by AUC or to interpret threshold values (cut-off) and sensitivity/specificity indicators. Consequently, in the present analysis this outcome should be considered descriptively, and comparative conclusions should be limited to the non-variceal subgroup, where the models are statistically significant.

5.4. Need for surgical treatment.

5.4.1. In non-variceal bleeding.

The analysis showed that in non-variceal bleeding, predicting the need for surgical treatment is possible, but overall discrimination is moderate and the best models do not exceed AUC≈0.72. Leading by AUC are PNED (AUC=0.722; p=0.006) and MAP(ASH) (AUC=0.720; p=0.009), with both having comparatively good sensitivity at optimal thresholds (PNED ≥6.5: sensitivity 85.7%; MAP(ASH) ≥4.5: sensitivity 84.6%), but with limited specificity (52.6% and 48.9%), i.e., more suitable for early selection of patients with increased risk of surgical intervention than for reliably "clearing" low-risk patients. Immediately after them, CSMCPI (AUC=0.694; p=0.016) stands out with the highest sensitivity in the analysis (threshold ≥5.5: Sens 92.9%), but also the lowest specificity (42.0%), positioning it as a triage tool. CANUKA (AUC=0.687; p=0.020) and AIMS65 (AUC=0.671; p=0.043) show similar, statistically significant, but lower discrimination. In them, the balance between sensitivity and specificity is more even (e.g., CANUKA ≥11.5: 71.4%/65.9%; AIMS65 ≥2.5: 69.2%/62.1%), making them relatively more convenient from a practical standpoint for risk stratification, albeit without an advantage in AUC over the leaders. GBS (AUC=0.662; p=0.044) remains statistically significant, but with the lowest Youden among the models (J=0.176) and more limited specificity (46.2%). ABC is on the borderline of significance (AUC=0.662; p=0.054) and should be interpreted with caution, despite the high sensitivity at the selected threshold (84.6%). Both variants of Rockall (complete and pre-endoscopic) are statistically non-significant (p=0.181 and p=0.408), meaning that in this cohort they do not provide reliable discrimination for the need for

surgical treatment. In conclusion, in the non-variceal bleeding group, PNED and MAP(ASH) are the most informative for predicting surgical intervention (by AUC), CSMCPI is the most sensitive “alerting” score, while the remaining models showed moderate and clinically acceptable but limited prognostic value.

Table 94. Prognostic performance of scoring systems for the need for surgical treatment in non-variceal bleeding.

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
PNED	0.722	0.006	0.580–0.864	0.383	6.50	85.7%	52.6%
MAP(ASH)	0.720	0.009	0.577–0.863	0.335	4.50	84.6%	48.9%
CSMCPI	0.694	0.016	0.583–0.806	0.349	5.50	92.9%	42.0%
CANUKA	0.687	0.020	0.549–0.825	0.373	11.50	71.4%	65.9%
AIMS65	0.671	0.043	0.536–0.805	0.313	2.50	69.2%	62.1%
GBS	0.662	0.044	0.516–0.808	0.176	12.50	71.4%	46.2%
ABC	0.662	0.054	0.538–0.785	0.286	5.50	84.6%	44.0%
Rockall (complete)	0.608	0.181	0.493–0.722	–	–	–	–
Rockall (pre-endoscopic)	0.567	0.408	0.431–0.702	–	–	–	–

For statistically non-significant ROC models (p≥0.05), cut-off values, sensitivity, and specificity are not interpreted.

ABC is on the borderline of statistical significance (p=0.054)

5.4.2. In variceal bleeding.

In the variceal bleeding group, the comparison of scoring systems with regard to the need for surgical treatment is methodologically limited due to the extremely rare occurrence of the event in the analyzed subgroup (only 1 case). As a result, the ROC analysis does not demonstrate statistically significant discriminative ability for any of the scores (p≥0.05), which does not allow reliable ranking by AUC or interpretation of threshold values (cut-off) and sensitivity/specificity indicators.

5.5. Need for blood transfusion.

5.5.1. In non-variceal bleeding.

We found that in non-variceal bleeding, all examined scoring systems have statistically significant discriminative ability for predicting the need for blood transfusion (p=0.000), with AUC ranging from 0.704 to 0.890. First by AUC in the study was GBS (AUC=0.890; 95% CI: 0.834–0.946), demonstrating the strongest overall separation between patients with and without need for blood transfusion. At an optimal threshold, GBS ≥9.5 yields very high sensitivity (92.0%) at more moderate specificity (60.0%) and the highest Youden J=0.620, characterizing it

as an effective tool for capturing the majority of patients requiring blood transfusion. This is conceptually expected, as GBS includes parameters directly related to the likelihood of transfusion. The next most effective scores were CANUKA (AUC=0.838) and PNED (AUC=0.821), both demonstrating good prognostic value and a more balanced profile compared to GBS. CANUKA at cut-off ≥8.5 achieves sensitivity of 81.8% and specificity 72.0% (J=0.538), and PNED at ≥4.5 – sensitivity 80.6% and specificity 74.0% (J=0.546). Compared to GBS, they have a more balanced profile, which may be useful when the clinical goal is to limit over-stratification (fewer patients without need for transfusion being classified as high-risk). MAP(ASH) (AUC=0.817) is very close to PNED in AUC and has the highest sensitivity in the analysis at a threshold of ≥2.5 (94.7%), but at the expense of low specificity (59.5%) (J=0.542). With moderate performance are CSMCPI (AUC=0.783) and ABC (AUC=0.761). CSMCPI at threshold ≥4.5 has sensitivity 82.1% and specificity 64.0% (J=0.461) – a moderately balanced profile, but weaker than CANUKA/PNED in AUC. Lower AUC values were observed for both Rockall variants: complete Rockall (AUC=0.726) and pre-endoscopic Rockall (AUC=0.717). The lowest AUC was retained by AIMS65 (AUC=0.704; 95% CI: 0.605–0.804), though still statistically significant. For non-variceal bleeding, the strongest predictor for the need for blood transfusion in our cohort is GBS (highest AUC and Youden, with high sensitivity), followed by CANUKA, PNED, and MAP(ASH).

Table 95. Prognostic performance of scoring systems for the need for blood transfusion in non-variceal bleeding.

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
GBS	0.890	0.000	0.834–0.946	0.620	9.50	92.0%	60.0%
CANUKA	0.838	0.000	0.766–0.910	0.538	8.50	81.8%	72.0%
PNED	0.821	0.000	0.750–0.893	0.546	4.50	80.6%	74.0%
MAP(ASH)	0.817	0.000	0.731–0.903	0.542	2.50	94.7%	59.5%
CSMCPI	0.783	0.000	0.709–0.857	0.461	4.50	82.1%	64.0%
ABC	0.761	0.000	0.661–0.860	0.487	4.50	79.3%	69.4%
Rockall (complete)	0.726	0.000	0.645–0.808	0.396	6.50	73.6%	66.0%
Rockall (pre-endoscopic)	0.717	0.000	0.634–0.801	0.311	4.50	57.1%	74.0%
AIMS65	0.704	0.000	0.605–0.804	0.375	1.50	71.8%	65.7%

5.5.2. In variceal bleeding.

In the variceal bleeding group, some scores showed very high AUC values, but in the context of a small sample (n=19) and a strongly imbalanced endpoint (blood transfusion administered in 17 of 19 patients with variceal bleeding). Nevertheless, four models demonstrated statistically significant discriminative ability ($p<0.05$) and allowed interpretation of threshold values, sensitivity, and specificity. MAP(ASH) has the highest AUC (0.984; p=0.029) and at a threshold of ≥3.5 achieves sensitivity of 93.8% and specificity 100% (Youden 0.938); AIMS65 is practically identical (AUC 0.983; p=0.031) and at a threshold of ≥1.5 sensitivity is

93.3% and specificity 100% (Youden 0.933). PNED also showed excellent discrimination (AUC 0.941; p=0.046). ABC is close in AUC (0.938; p=0.049), but with lower sensitivity at ≥6.5 (Sens 81.3%, Spec 100%; Youden 0.813), making it more "selective" and potentially more prone to missing some patients requiring blood transfusion. The remaining scores – GBS (AUC 0.868; p=0.097), CANUKA (AUC 0.853; p=0.111), pre-endoscopy Rockall (AUC 0.824; p=0.144), complete Rockall (AUC 0.794; p=0.184), and CSMCPI (AUC 0.794; p=0.184) – have comparatively high AUC but did not reach statistical significance.

Table 96. Prognostic performance of scoring systems for the need for blood transfusion in variceal bleeding

Score	AUC	p	95% CI	Youden (J)	Cut-off (≥)	Sens	Spec
MAP(ASH)	0.984	0.029	0.928–1.000	0.938	3.50	93.8%	100%
AIMS65	0.983	0.031	0.923–1.000	0.933	1.50	93.3%	100%
PNED	0.941	0.046	0.829–1.000	0.941	7.50	94.1%	100%
ABC	0.938	0.049	0.804–1.000	0.813	6.50	81.3%	100%
GBS	0.868	0.097	0.644–1.000	–	–	–	–
CANUKA	0.853	0.111	0.657–1.000	–	–	–	–
Rockall (pre-endoscopic)	0.824	0.144	0.632–1.000	–	–	–	–
Rockall (complete)	0.794	0.184	0.583–1.000	–	–	–	–
Cedars–Sinai (CSMCPI)	0.794	0.184	0.598–0.990	–	–	–	–

For statistically non-significant ROC models (p≥0.05), threshold values, sensitivity, and specificity were not interpreted.

5.6. Discussion.

In our cohort, the highest discriminative ability for **in-hospital mortality** in non-variceal bleeding was demonstrated by PNED and ABC, which is consistent with the primary endpoints for which these scores were developed. Our result for PNED (AUC=0.923) is in concordance with the data of Marmo et al., who validated the Italian PNED and showed that it predicts mortality better than Rockall (AUC approximately 0.81 for PNED versus approximately 0.66 for Rockall in their series), with the model also demonstrating good calibration. This supports the interpretation that PNED is particularly suitable for predicting in-hospital mortality in non-variceal bleeding. Also, the excellent performance of ABC in our study (AUC=0.919) is logical, as Laursen et al. developed ABC as an international multicenter model oriented toward mortality in gastrointestinal bleeding, demonstrating high prognostic performance for 30-day mortality in upper GI bleeding (AUROC ~0.81 in the main cohorts). In the same study, ABC provides clear separation of patients into risk groups by points (ABC ≤3: ~1% mortality; ABC 4–7: ~7%; ABC ≥8: ~25%), supporting the clinical interpretation of our optimal cut-off of approximately ≥8.5 as a threshold that concentrates high-risk patients at initial assessment. Regarding AIMS65, our

AUC=0.882 is comparable with the published observations that this score often has very good ability to predict a fatal outcome. Hyett et al. showed that AIMS65 outperforms GBS for predicting in-hospital mortality (AUROC 0.93 versus 0.68), while GBS remains stronger for transfusion. Similar results were reported by Abougergi et al., who in a prospective series reported better discrimination of AIMS65 compared to GBS for in-hospital mortality (AUROC 0.85 versus 0.66). This corresponds to our data – AIMS65 is a clinically useful "rapid" score for early assessment, although in our cohort it is inferior in AUC to PNED and ABC. In variceal bleeding, our results should be interpreted with caution due to the small subgroup of patients. Nevertheless, it is noteworthy that in our cohort the highest AUC values belong to MAP(ASH), AIMS65, PNED, and ABC. The literature demonstrates heterogeneity in the performance of scores in variceal bleeding, and firm conclusions from statistically non-significant ROC models should be avoided.

In our study, all scores demonstrated statistically significant discrimination for **rebleeding** in non-variceal bleeding, but with clear variability in performance (from high to moderate). Post-endoscopic scoring systems performed expectedly better in predicting rebleeding, as they include endoscopic parameters that directly reflect the morphology of the lesion (e.g., stigmata of active and/or recent bleeding) and the need for endoscopic hemostasis. In this context, the leadership of PNED in our cohort (AUC=0.894; cut-off ≥6.5 with very high sensitivity) is compatible with the evidence that PNED is a complex instrument that objectively captures the clinical severity of bleeding and therefore performs consistently not only in predicting mortality, but also unfavorable evolution, including rebleeding. The high "screening" profile (very high sensitivity at moderate specificity) is clinically applicable when the goal is to minimize missed cases and early referral to more intensive monitoring for at-risk patients. Our data are in good agreement with the international multicenter prospective study of Stanley et al., which compared GBS, AIMS65, both variants of Rockall, and PNED in 3012 patients with upper GI bleeding. In that study, PNED was the best predictor of rebleeding (AUROC 0.85), and AIMS65 and PNED were leading for 30-day mortality (AUROC 0.77). This corresponds to our observations, in which PNED demonstrated the highest prognostic performance for rebleeding (non-variceal AUROC=0.894; variceal AUROC=0.958) and is among the strongest predictors of mortality. In parallel, in the study of Stanley et al., GBS was the best score for predicting the need for blood transfusion or intervention, while for rebleeding and mortality it lagged behind PNED and AIMS65. This tendency is consistent with our results, where GBS shows more limited discrimination for rebleeding and mortality. The second score in our cohort, CSMCPI (AUC=0.854), demonstrated a better balance between sensitivity and specificity, which is a practical advantage in daily clinical decisions. On the other hand, the more modest performance of GBS and AIMS65 for rebleeding in our analysis is in line with the way these scores were originally validated – GBS is strongest for transfusion and/or intervention, and AIMS65 – more often for mortality. In variceal bleeding, our analysis is based on a small subgroup, which inevitably leads to wider confidence intervals and the risk of unstable thresholds. Nevertheless, three of the scoring systems showed good performance – PNED, CSMCPI, and MAP(ASH) – with very high AUC and specificity reaching 100% at optimal thresholds, i.e., a distinct rule-in profile for high risk of rebleeding. As a clinical interpretation, this is plausible, as in cirrhosis rebleeding is often a function of the severity of portal hypertension, hepatic dysfunction, and systemic complications.

In our cohort, all nine scoring systems demonstrated statistically significant prognostic value for the **need for endoscopic hemostasis** in non-variceal bleeding, but with moderate discrimination (AUC 0.636–0.804). Expectedly, post-endoscopic scores performed better, as they include endoscopic morphology of the bleeding lesion, which is precisely what determines the decision for hemostasis. In this regard, ESGE emphasizes the need for systematic endoscopic description (e.g., Forrest classification for peptic ulcer) specifically for the purpose of distinguishing low- and high-risk stigmata that dictate the need for endoscopic therapy. In our analysis, CSMCPI has the highest AUC (0.804) and very high sensitivity at threshold ≥5.5 (93.4%), positioning it as a useful triage tool for early identification of patients in whom the probability of therapeutic endoscopy is high. A similar profile is observed for complete Rockall (high sensitivity but low specificity), which is explained by the addition of endoscopic components compared to the pre-endoscopic variant. The third post-endoscopic score in the analysis – PNED (AUC 0.769) – performs well and offers a better balance between sensitivity and specificity. Published data from Chang et al. support that prediction of endoscopic intervention is an endpoint with limited accuracy for pre-endoscopic scores and that their performance varies by bleeding subtype: in non-variceal bleeding, all three scores in their study (AIMS65, GBS, Rockall) are significant, but Rockall performs relatively better than AIMS65 for endoscopic intervention, while in variceal bleeding none of the three is reliable. Similar heterogeneity is noted in more recent studies. Khatana et al. reported that in non-variceal bleeding, GBS and Rockall predict the need for endoscopic intervention, while in variceal bleeding the predictive value of these scores is limited. In this context, our result of moderate AUC values without a perfect predictor is fully consistent with the data from the literature. The study of Khatana also confirms our conclusion that in variceal bleeding, comparison by need for hemostasis is methodologically limited, since almost all patients receive therapy, while in non-variceal bleeding the models are significant but their accuracy is moderate and highly dependent on the endoscopic findings.

In our cohort, predicting the **need for surgical treatment or interventional radiology therapy (TAE)** in non-variceal bleeding is possible, but discrimination remains moderate (the leading models reach AUC≈0.72). This is expected for several reasons. First, surgical intervention is a rare outcome in our study and often occurs as a last step after failure of endoscopic therapy. On the other hand, the decision for surgery is strongly dependent on local practice and available resources (e.g., access to interventional radiology). Additionally, a large proportion of the scores have been validated with a focus on mortality or resource needs, rather than specifically on the need for surgical intervention. This explains why in various series the surgical endpoint is often predicted less reliably and with lower AUC compared to blood transfusion or other composite outcomes. The leading scores in our cohort, PNED (AUC=0.722) and MAP(ASH) (AUC=0.720), have high sensitivity but limited specificity, i.e., they have more of a triage profile suitable for early identification of patients in whom the probability of treatment escalation is higher. In the international multicenter study of Stanley et al., surgical treatment and transarterial embolization are included as part of the interventional endpoints, and the authors showed that as a pre-endoscopic tool, GBS best predicts the need for intervention overall (composite outcome “intervention or death”, AUROC 0.86). In our cohort, GBS remains statistically significant, but with more modest discrimination (AUC=0.662) and low Youden. In the prospective series of Khatana et al., in non-variceal bleeding, only GBS predicted the need for surgical/radiological intervention (the authors report a significantly higher AUROC for this endpoint compared to AIMS65 and Rockall). This difference likely reflects cohort-specific

characteristics (event frequency, treatment algorithm, and access to interventional radiology). In the variceal bleeding group in our cohort, surgical intervention is extremely rare (1 case), making ROC comparisons methodologically inappropriate.

All scoring systems examined by us demonstrated statistically significant discrimination for **the need for blood transfusion**, with GBS standing out as the strongest predictor (AUC=0.890; cut-off ≥9.5 with sensitivity 92% and specificity 60%). This result is logical, as GBS includes variables closely related to the administration of blood transfusion (Hb, urea, hemodynamics, clinical signs). Our observation is analogous to that from other series. Hyett et al. showed that GBS outperforms AIMS65 for predicting the need for blood transfusion (AUC 0.85 versus 0.65; $p<0.01$). A similar tendency is confirmed in the prospective study of Chang et al., where in non-variceal bleeding GBS has the best prognostic accuracy for transfusion, while in variceal bleeding the behavior of the scores changes. Data in the same direction are available from other Asian cohorts (e.g., Kim et al.), where GBS is the strongest for predicting blood transfusion (AUC approximately 0.87, with cut-off GBS >8). In this context, the higher optimal threshold in our cohort (GBS ≥9.5) is clinically plausible and likely reflects differences in patient profile and local transfusion practice. In the variceal bleeding group, blood transfusion is a very frequent event (17 of 19 patients received a transfusion), which creates a strongly imbalanced endpoint and inevitably increases the instability of ROC estimates. Nevertheless, in our analysis MAP(ASH) and AIMS65 showed exceptionally high AUC (≈0.98) with specificity 100% at optimal thresholds, which can be interpreted as a strong "rule-in" profile for very high risk, but with the clear caveat that the small sample increases the likelihood of effect overestimation. Published data support that in variceal bleeding, the behavior of scores differs from that in non-variceal bleeding. In the series of Chang et al., AIMS65 is the only score that reliably predicts the need for blood transfusion in variceal bleeding, while in non-variceal bleeding GBS remains the leader. In summary, our analysis showed that in non-variceal bleeding, the leading predictors by AUC are distributed according to clinical outcome as follows – PNED stands out as the strongest model for in-hospital mortality and rebleeding, CSMCPI – for the need for endoscopic hemostasis, and GBS – for the need for blood transfusion, while for surgical/radiological treatment discrimination remains moderate and the highest AUC again belongs to PNED. In variceal bleeding, comparative conclusions are more limited (e.g., for the need for endoscopic hemostasis and surgery), but high prognostic value of certain scores for clinically key outcomes is preserved, including dominance of MAP(ASH) for mortality and blood transfusion and of PNED for rebleeding. The practical applicability of this comparative analysis lies at the foundation of creating a risk stratification algorithm at initial assessment: the choice of score can be purposefully oriented toward the specific clinical need (e.g., PNED for identification of patients with high risk for fatal outcome/rebleeding, CSMCPI for early referral to endoscopy, GBS for predicting the need for blood transfusion), which allows structured therapeutic decision-making at the emergency department level.

Table 97. Most effective score for each endpoint in non-variceal and variceal bleeding.

Endpoint	**Non-variceal – highest AUC**	**Variceal – highest AUC**
In-hospital mortality	PNED (AUC=0.923)	MAP(ASH) (AUC=0.950)
Rebleeding	PNED (AUC=0.894)	PNED (AUC=0.958)

Endpoint	Non-variceal – highest AUC	Variceal – highest AUC
Need for endoscopic hemostasis	Cedars–Sinai (CSMCPI) (AUC=0.804)	No valid ranking
Need for surgical treatment	PNED (AUC=0.722)	No valid ranking
Need for blood transfusion	GBS (AUC=0.890)	MAP(ASH) (AUC=0.984)

6. Rebleeding during hospitalization.

6.1. Frequency and temporal characteristics of rebleeding.

During the hospital stay, rebleeding represents one of the most serious complications in patients with acute upper gastrointestinal bleeding, as it is associated with an increased need for interventions, blood transfusions, and an unfavorable clinical outcome. Rebleeding during hospitalization was identified in 60 of 209 patients (28.7%). The mean time to rebleeding was 35.33 ± 56.24 hours, with a median of 21.5 hours and the most frequently observed value of 24 hours, indicating that most rebleeding events occur within the first 24–40 hours after initial control of the hemorrhage. The minimum time to rebleeding was 2 hours and the maximum was 336 hours (≈14 days), with late rebleeding events being isolated and confirming the need for strict monitoring during the first 24–48 hours.

Table 98. Frequency and temporal characteristics of rebleeding

Parameter	Value
Total number of patients	209
Patients with rebleeding	60 (28.7%)
Patients without rebleeding	149 (71.3%)
Mean time to rebleeding (hours)	35.33 ± 56.24
Median time to rebleeding (hours)	21.5
Most frequent time to rebleeding (mode)	24 hours
Minimum time to rebleeding	2 hours
Maximum time to rebleeding	336 hours (≈14 days)
Patients with rebleeding ≤24 hours	48 (80.0% of all with rebleeding)

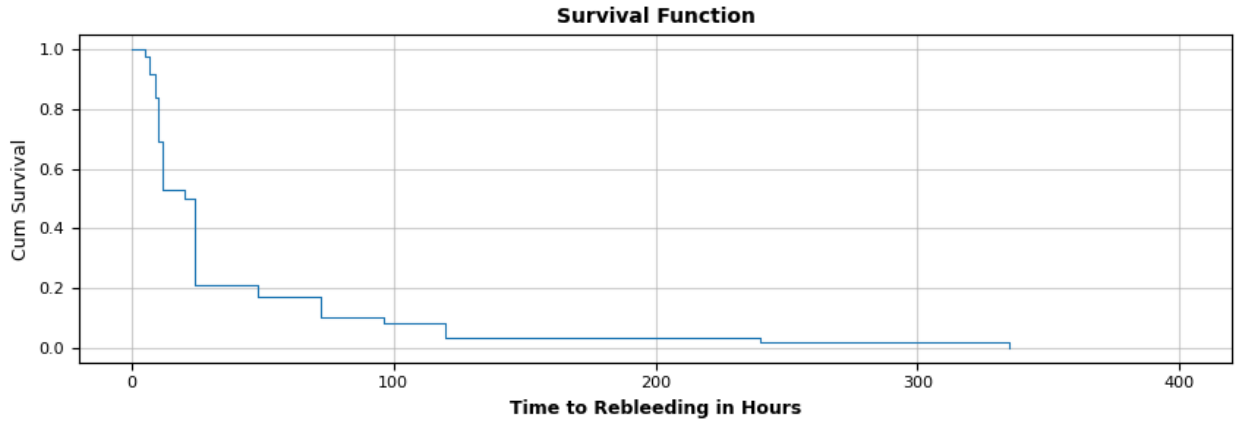
Table 99. Temporal distribution of rebleeding

Time to rebleeding (hours)	Number of patients (n)	Percentage of rebleeding (%)	Cumulative percentage (%)
≤6	10	16.7	16.7
7–12	18	30.0	46.7
13–24	20	33.3	80.0
25–72	6	10.0	90.0
>72	6	10.0	100.0

6.2. Analysis of time to rebleeding.

In order to assess the temporal dynamics until the occurrence of rebleeding, a *Kaplan–Meier analysis* was performed in patients who developed recurrent hemorrhage during the hospital stay. The analysis included all 60 patients with registered rebleeding, with time to event defined as the interval (in hours) from initial control of the bleeding to the occurrence of rebleeding. The rebleeding-free survival curve shows a steep decline in the early hours after the initial event, reflecting a high frequency of early rebleeding events. The median time to rebleeding is 19.0 hours (95% CI: 15.2–22.8 hours), meaning that in 50% of patients, rebleeding occurs within the first 24 hours of hospitalization. The mean time to rebleeding is 35.33 hours (95% CI: 21.10–49.56 hours), with the higher value of the mean compared to the median reflecting the presence of late but rare rebleeding events. The graphical representation of the Kaplan–Meier curve demonstrates a clearly expressed asymmetry with a “long tail” toward later time intervals, with the majority of rebleeding events concentrated in the first 24–40 hours after initial control of the hemorrhage. After the first 48 hours, the curve flattens, indicating a significant reduction in the risk of late rebleeding. The Kaplan–Meier analysis confirms that rebleeding is predominantly an early event in the course of hospitalization.

Figure 13. Cumulative probability of rebleeding-free survival (Kaplan–Meier analysis)



6.3. Factors associated with rebleeding.

6.3.1. Clinical parameters at admission.

Analysis of admission parameters showed that patients with rebleeding were younger (62.5 versus 67.5 years; p=0.026) and more often male (80.0% versus 60.4%; p=0.007). They presented with more pronounced hemodynamic instability – higher shock index (1.185 versus 0.962; p<0.001), more frequent anemia (95.0% versus 82.6%; p=0.019), and more frequent need for blood transfusion (90.0% versus 69.1%; p=0.002), reflecting more severe initial blood loss with a more unfavorable clinical course.

Table 100. Clinical parameters at admission according to the presence of rebleeding

Parameter	Rebleeding (n=60)	No rebleeding (n=149)	p-value
Age (years, mean)	62.52	67.46	0.026

Parameter	Rebleeding (n=60)	No rebleeding (n=149)	p-value
Sex (male/female)	48 (80%) / 12 (20%)	90 (60.4%) / 59 (39.6%)	0.007
Shock index (mean value)	1.185	0.962	<0.001
Anemia (n)	57 (95%)	123 (82.6%) 0	.019
Need for blood transfusion	54 (90%)	103 (69.1%) 0	.002

Note: Quantitative variables were compared using Student's t-test for independent samples or the Mann–Whitney U test, and categorical variables using the χ^2-test or Fisher's exact test. Statistical significance was accepted at $p < 0.05$.

6.3.2. Laboratory findings in patients with and without rebleeding.

Patients with rebleeding had a more severe laboratory profile already at admission. They exhibited lower hemoglobin values (79.7 vs. 90.4 g/L; p=0.028), hematocrit (0.24 vs. 0.27; p=0.039), and platelets (213.5 vs. 261.2 $\times 10^9$/L; p=0.012), as well as lower fibrinogen (2.87 vs. 3.49 g/L; p=0.003) and significantly lower albumin (30.26 vs. 34.81 g/L; p<0.001), while INR, renal parameters, CRP, ESR, and liver enzymes did not differ substantially between the groups.

Table 101. Laboratory parameters and association with rebleeding

Parameter	Rebleeding (n=60)	No rebleeding (n=149)	p-value
Hemoglobin (g/L)	79.70	90.36	0.028
Hematocrit	0.24	0.27	0.039
Platelets ($\times 10^9$/L)	213.52	261.20	0.012
INR	1.44	1.62	0.154
Fibrinogen (g/L)	2.87	3.49	0.003
Albumin (g/L)	30.26	34.81	<0.001
Creatinine (µmol/L)	134.86	155.43	0.369
Urea (mmol/L)	15.08	16.22	0.511
eGFR (ml/min)	70.05	62.03	0.115
CRP (mg/L)	41.87	48.76	0.541
ALAT (U/L)	33.19	43.58	0.567
ASAT (U/L)	52.29	65.32	0.715
Total bilirubin (µmol/L)	21.87	22.86	0.917
Direct bilirubin (µmol/L)	13.39	15.90	0.757

Note: Data are presented as mean values. Comparison between the two independent groups was performed using Student's t-test for independent samples or the Mann–Whitney U test, according to data distribution. Statistical significance was accepted at $p < 0.05$.

6.3.3. Comorbidities and their association with rebleeding

Patients with rebleeding had higher comorbidity compared to those without recurrence. Arterial hypertension was more frequent in the rebleeding group (p=0.023), while other cardiovascular diseases and diabetes mellitus did not differ substantially between the groups. Liver cirrhosis, a history of varices, and prior endoscopic band ligation were significantly more common in patients with rebleeding (p<0.01), underscoring the role of portal hypertension and advanced liver disease. Among pulmonary conditions, pneumonia and respiratory failure showed a strong association with rebleeding (p=0.023 and p<0.001), while COPD, asthma, and COVID-19 showed no significant differences. A history of prior upper GI bleeding and recent surgical intervention (within 1 month) were also more common in patients with rebleeding (p=0.018 and p=0.006).

Table 102. Comorbidities in patients with rebleeding.

Comorbidity	With rebleeding (n=60)	No rebleeding (n=149)	p-value
Hypertensive disease	38 (63.3%)	117 (78.5%)	0.023
Heart failure	17 (28.3%)	55 (36.9%)	0.238
Ischemic heart disease	21 (35.0%)	71 (47.7%)	0.096
Status post percutaneous intervention	2 (3.3%)	20 (13.4%)	0.032
Rhythm disorders	10 (16.7%)	44 (29.5%)	0.055
Diabetes mellitus	18 (30.0%)	42 (28.2%)	0.793
Pneumonia	12 (20.0%)	13 (8.7%)	0.023
Respiratory failure	42 (70.0%)	39 (26.2%)	<0.001
Chronic kidney disease	9 (15.0%)	33 (22.1%)	0.243
Liver cirrhosis	23 (38.3%)	18 (12.1%)	<0.001
Recent surgical intervention	13 (21.7%)	12 (8.1%)	0.006
Oncological disease	11 (18.3%)	35 (23.5%)	0.416
History of prior UGIB	32 (53.3%)	53 (35.6%)	0.018

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

6.3.4. Risk-associated medications and their relationship with rebleeding

Use of NSAIDs, antiplatelet agents, and anticoagulants showed no statistically significant association with rebleeding, despite some quantitative differences between groups (e.g., more frequent use of NSAIDs and dual antiplatelet therapy in patients without rebleeding). Other investigated medications (glucocorticosteroids, SSRIs, cyclooxygenase and phosphodiesterase inhibitors, prior therapy with PPIs or H_2-blockers) were also not associated with a significant risk of recurrent bleeding. This supports the conclusion that rebleeding is primarily determined by the endoscopic findings, clinical severity, and comorbidity, and that an individualized approach and careful interpretation are required in patients on antiplatelet/anticoagulant therapy.

Table 103. Risk-associated medications and rebleeding

Medication	With rebleeding (n=60)	No rebleeding (n=149)	p-value
NSAIDs	5 (8.3%)	22 (14.8%)	0.210
Glucocorticosteroids	2 (3.3%)	8 (5.4%)	0.533
Antiplatelet agents	13 (21.7%)	41 (27.5%)	0.382
Dual antiplatelet therapy	0 (0%)	8 (5.4%)	0.067
Anticoagulants	16 (26.7%)	56 (37.6%)	0.133
NOACs	5 (8.3%)	30 (20.1%)	0.699
Vitamin K antagonists	4 (6.7%)	15 (10.1%)	0.439
Parenteral anticoagulants	8 (13.3%)	15 (10.1%)	0.495
SSRIs	0 (0%)	3 (2.0%)	0.268
PPIs / H2-blockers	11 (18.3%)	22 (14.8%)	0.522

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

6.3.5. Endoscopic findings and their association with rebleeding.

Endoscopic findings showed that the morphological characteristics of the bleeding source are closely associated with the risk of rebleeding. Active bleeding at index endoscopy, need for endoscopic hemostasis, and failure of initial hemostasis were significantly more common in patients with rebleeding ($p<0.001$), as were high-risk stigmata of bleeding (visible vessel, adherent clot, large amount of fresh blood, and hematin). Regarding the type of hemorrhage, rebleeding was observed in 45 patients with non-variceal and 15 with variceal bleeding, and the proportion of rebleeding was considerably higher in the variceal group. Bivariate analysis revealed a moderate but statistically significant association between variceal bleeding and rebleeding ($r=0.331$; $p<0.001$), which likely reflects the influence of portal hypertension, coagulopathy, and the greater difficulty in achieving stable hemostasis.

Table 104. Endoscopic findings and rebleeding.

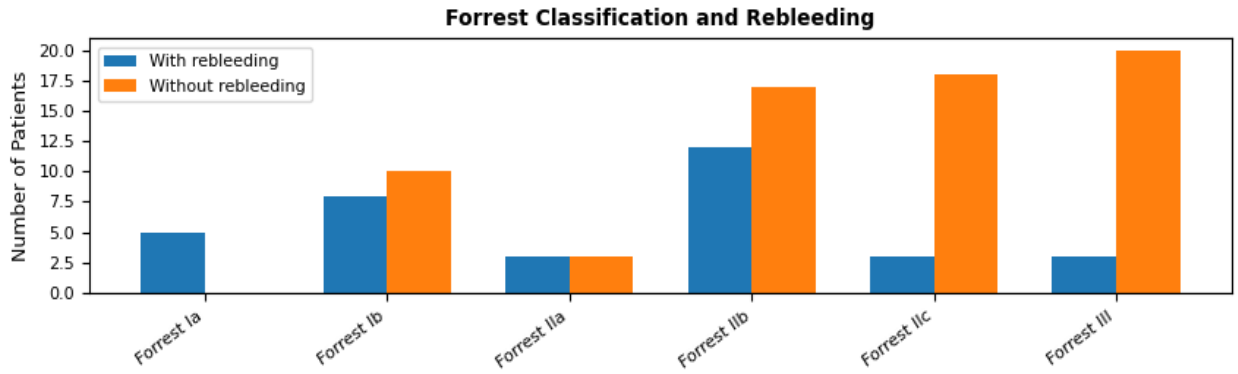
Endoscopic parameter	Rebleeding (n=60)	No rebleeding (n=149)	p-value
Presence of active bleeding	31 (51.7%)	12 (8.1%)	<0.001
High-risk stigmata of bleeding	58 (96.7%)	92 (61.7%)	<0.001
Need for endoscopic hemostasis	46 (76.7%)	33 (22.1%)	<0.001
Failure of initial hemostasis	15 (25.0%)	0 (0.0%)	<0.001

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

Forrest classification and association with rebleeding

In non-variceal bleeding, the Forrest classification demonstrated a clear relationship between endoscopic stigmata and the risk of rebleeding. In patients without rebleeding, low-risk lesions Forrest III and IIc predominated, whereas in those with rebleeding, high-risk classes Forrest Ib and IIb were significantly more common, and Forrest Ia was observed exclusively in the rebleeding group. Bivariate analysis established a moderate but statistically significant correlation between higher Forrest class and recurrent bleeding (r=0.407; p=0.001), confirming that the degree of endoscopic activity is a strong predictor of rebleeding during hospitalization.

Figure 14. Distribution by Forrest class in patients with and without rebleeding



Location of the ulcer lesion and rebleeding

In patients with peptic ulcer disease, an additional analysis was performed to assess the significance of ulcer location. Among patients with rebleeding, antral ulcers predominated and accounted for the largest proportion of recurrent hemorrhages, while ulcers in the fundus and along the greater curvature were rare and represented by isolated cases. In contrast, corpus ulcers along the lesser curvature and pyloric ulcers were more common in patients without rebleeding; such locations were not observed in the rebleeding group. Despite the noted tendencies, the

differences in location distribution did not reach statistical significance (p = 0.081, Fisher's exact test), likely due to the limited number of patients with ulcer disease and rebleeding.

6.3.7. Independent risk factors for rebleeding.

To identify independent predictors of rebleeding during hospitalization, a logistic regression model was constructed in which the dependent variable was the presence of rebleeding. Due to the limited number of patients with rebleeding (n = 60; 28.7%) and the risk of overfitting, only quantitative parameters that showed statistical significance in univariate analysis were included in the model: age, shock index, hemoglobin, hematocrit, platelets, fibrinogen, and serum albumin. The model demonstrated very good fit to the data (Hosmer–Lemeshow $\chi^2 = 8.580$; p = 0.379) and an overall classification accuracy of 75.0%, correctly classifying 90.7% of patients without rebleeding and 39.5% of those with rebleeding. The only statistically significant independent predictor was ***shock index*** (B = 2.748; p = 0.001; OR = 15.613), emphasizing the role of hemodynamic instability at admission. ***Serum albumin*** showed borderline significance (p = 0.051; OR = 0.934), with lower values being associated with an increased risk of rebleeding. The remaining parameters did not retain independent statistical significance in the multivariate analysis. The results show that acute hemodynamic instability at admission, reflected by the shock index, is the strongest independent predictor of rebleeding. At the same time, the limited number of patients with rebleeding and the large number of potential risk factors restrict the ability to build a more robust multivariate model. Therefore, these results should be interpreted with caution and as a guide for future studies with a larger sample size.

Table 105. Logistic regression model for rebleeding.

Variable	B	SE	p-value	OR (Exp(B))	Interpretation
Age	-0.001	0.017	0.961	0.999	No significant association
Shock index	2.748	0.840	0.001	15.613	Strong independent predictor
Hemoglobin	0.006	0.040	0.883	1.006	No significant association
Hematocrit	-3.417	14.088	0.808	0.033	No significant association
Platelets	-0.003	0.002	0.170	0.997	No significant association
Fibrinogen	-0.226	0.196	0.249	0.798	No significant association
Albumin	-0.069	0.035	0.051	0.934	Borderline significance

6.4. Discussion.

Our data show that patients with rebleeding had a more severe clinical profile already at admission – a higher shock index, more pronounced anemia, and a greater need for blood transfusion, and in the multivariate regression analysis the shock index remained the only independent predictor of recurrent bleeding (OR 15.6; p=0.001). Our results are consistent with those of Parveen et al., who reported that a significant proportion of patients with rebleeding in their study were in shock at presentation and required more blood transfusions. In our cohort, patients with rebleeding had lower hemoglobin values at admission compared to those without rebleeding (79.70 vs. 90.36 g/L; p=0.028). This observation is in agreement with the results of Suk et al., who found that an initial hemoglobin ≤90 g/L is an independent predictor of rebleeding after endoscopic therapy for non-variceal upper gastrointestinal bleeding. These data support the concept that hemodynamic instability and the severity of the initial blood loss are key determinants of a recurrent bleeding episode. Additional analysis of the endoscopic characteristics in our cohort revealed a clearly pronounced predominance of active bleeding and high-risk stigmata among patients who experienced rebleeding. This was manifested through a higher frequency of lesions classified as Forrest I–IIb, as well as an almost universal presence of high-risk endoscopic signs in this subgroup. The results are consistent with the observations of Parveen et al., who reported that high-risk Forrest stigmata and a larger ulcer size were statistically significantly associated with rebleeding. The exclusive presence of Forrest Ia only in patients with rebleeding in our study is particularly indicative and is supported by specific quantitative data in the literature. In the study by de Groot et al., Forrest classification retained its predictive value for rebleeding, and the authors reported the highest risk of recurrent bleeding for Forrest Ia (approximately 59%). This is fully consistent with ESGE recommendations that the Forrest classification should be used routinely to distinguish low- and high-risk stigmata for the purpose of deciding on endoscopic therapy. Data from our cohort show that patients with rebleeding were characterized by higher comorbidity, which is consistent with the observations of Suk et al. In their study, comorbidities – specifically liver cirrhosis and chronic kidney disease – emerged as independent predictors of rebleeding, which also supports our findings regarding the role of comorbidities in unfavorable outcomes. Particularly noteworthy in our study is the strong association between rebleeding and liver cirrhosis, as well as the more frequent history of varices and prior endoscopic band ligation, which further underscores the significance of portal hypertension and impaired hemostatic balance as predisposing factors for recurrent hemorrhage. Although renal parameters in our cohort did not demonstrate statistically significant differences, this does not contradict the conclusions of Suk et al., but rather likely reflects differences in the population structure and prevalence of renal dysfunction.

7. In-hospital mortality and factors associated with fatal outcome.

In-hospital mortality represents one of the most significant adverse clinical outcomes in patients with acute upper gastrointestinal bleeding and reflects both the severity of the initial condition and the effectiveness of the diagnostic and therapeutic approach during hospitalization. In the present study, the analysis of in-hospital mortality is aimed at identifying clinical, laboratory, and endoscopic factors associated with fatal outcome. For this purpose, a comparative analysis was performed between patients who survived the hospital stay and patients with fatal outcome.

7.1. Incidence of in-hospital mortality.

In the present study, of all 209 patients with acute bleeding, a fatal outcome was recorded in 59 patients, corresponding to 28.2% of all included patients. This relatively high proportion of in-hospital mortality underscores the severity of acute upper gastrointestinal bleeding as an acute and potentially life-threatening condition, particularly in the context of advanced age, pronounced comorbidity, and the presence of systemic organ dysfunction in a significant proportion of patients. This justifies the need for a thorough analysis of the clinical, laboratory, endoscopic, and therapeutic factors associated with mortality, presented in the following subsections.

Table 106. Incidence of in-hospital mortality.

Mortality	Number of patients (n)	Percentage (%)
Deceased	59	28.2
Survivors	150	71.8
Total	209	100.0

7.2. Factors associated with in-hospital mortality.

7.2.1. Demographic characteristics.

Age and sex showed no statistically significant association with in-hospital mortality in the studied cohort. Mean age was similar in deceased and surviving patients (66.86 vs. 65.72 years; p=0.610), and males predominated in both groups with no significant difference in sex distribution (p=0.507).

Table 107. Demographic characteristics and in-hospital mortality.

Parameter	Deceased (n=59)	Survivors (n=150)	p-value
Age (mean)	66.86 yrs.	65.72 yrs.	0.610
Sex – male	41 (69.5%)	97 (64.7%)	0.507
Sex – female	18 (30.5%)	53 (35.3%)	0.507

Note: Quantitative variables were compared using Student's t-test for independent samples or the Mann–Whitney U test, and categorical variables using the χ^2-test or Fisher's exact test. Statistical significance was accepted at $p < 0.05$.

7.2.2. Clinical parameters at admission.

Deceased patients presented at admission with clearly pronounced hemodynamic instability compared to survivors. They had lower systolic blood pressure (91.02 vs. 105.87 mmHg; p<0.001), higher heart rate (106.10 vs. 95.59 beats/min; p<0.001), and a higher shock index (1.24 vs. 0.94; p<0.001). The type of clinical presentation (hematemesis, melena, hematochezia) was not associated with mortality, but respiratory failure at admission was strongly associated with fatal outcome (86.4% of deceased vs. 20.0% of survivors; p<0.001). Additionally, in a large proportion of the deceased, bleeding had been recorded during hospitalization for another reason (27 vs. 30 cases, p < 0.001). This confirms that newly

developed in-hospital bleeding represents a severe complication with unfavorable prognostic significance.

Table 108. Clinical parameters at admission and in-hospital mortality.

Parameter	Deceased (n=59)	Survivors (n=150)	p-value
Systolic BP (mmHg)	91.02	105.87	<0.001
Heart rate (beats/min)	106.10	95.59	<0.001
Shock index	1.24	0.94	<0.001
Hematemesis	29 (49.2%)	59 (39.3%)	0.196
Melena	52 (88.1%)	128 (85.3%)	0.598
Rectorrhagia/ Hematochezia	9 (15.3%)	16 (10.7%)	0.358
Respiratory failure	51 (86.4%)	30 (20.0%)	<0.001
Newly developed in-hospital bleeding	27 (45.8%)	30 (20.0%)	<0.001

Note: Data are presented as mean values for quantitative variables and as n (%) for categorical variables. Comparison between quantitative variables was performed using Student's t-test for independent samples or the Mann–Whitney U test, according to data distribution, and between categorical variables using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

7.2.3. Laboratory parameters and in-hospital mortality.

Deceased patients exhibited more severe laboratory abnormalities already at admission. They had lower hemoglobin (78.34 vs. 90.83 g/L; p=0.009) and hematocrit (0.24 vs. 0.27; p=0.012), as well as a higher frequency of anemia (94.9% vs. 82.7%; p=0.021), combined with a higher white blood cell count (15.37 vs. 11.23 $\times 10^9$/L; p=0.015), indicating greater blood loss and a pronounced systemic inflammatory/stress response. In deceased patients, more pronounced impairment of renal function was observed – higher urea (18.36 vs. 14.93 mmol/L; p=0.046) and lower eGFR (56.97 vs. 67.21 ml/min/1.73 m²; p=0.044), as well as lower total protein (57.67 vs. 63.72 g/L; p=0.001) and albumin (28.78 vs. 35.29 g/L; p<0.001). Liver enzymes did not differ significantly between the groups, but coagulation disturbances were more frequent in the deceased – lower prothrombin index (53.85% vs. 68.97%; p<0.001) and higher INR (1.82 vs. 1.47; p=0.030), with a trend toward prolonged aPTT and lower fibrinogen.

Table 109. Laboratory parameters at admission and in-hospital mortality.

Parameter	Deceased (n=59)	Survivors (n=150)	p-value
Hemoglobin (g/L)	78.34	90.83	0.009
Hematocrit	0.24	0.27	0.012
Platelets ($\times 10^9$/L)	232.93	253.25	0.291
ESR (mm/h)	38.10	37.52	0.930

Parameter	Deceased (n=59)	Survivors (n=150)	p-value
Leukocytes (×10⁹/L)	15.37	11.23	0.015
ALAT (U/L)	51.60	36.02	0.393
ASAT (U/L)	113.56	40.30	0.178
Total bilirubin (μmol/L)	30.23	19.69	0.282
Direct bilirubin (μmol/L)	20.88	12.88	0.348
GGT (U/L)	138.89	122.22	0.742
ALP (U/L)	161.09	108.97	0.075
Creatinine (μmol/L)	160.93	145.11	0.489
Urea (μmol/L)	18.36	14.93	0.046
eGFR (ml/min/1.73m²)	56.97	67.21	0.044
CRP (mg/L)	53.06	43.98	0.430
Sodium (mmol/L)	137.27	137.75	0.632
Potassium (mmol/L)	4.32	4.35	0.757
Chloride (mmol/L)	101.49	102.34	0.442
Total protein (g/L)	57.67	63.72	0.001
Albumin (g/L)	28.78	35.29	<0.001
PI (%)	53.85	68.97	<0.001
INR	1.82	1.47	0.030
aPTT (sec)	33.77	30.91	0.063
Fibrinogen (g/L)	3.04	3.39	0.139
LDH (U/L)	1021.24	494.52	0.070

Note: Data are presented as mean values. Comparison between the two independent groups was performed using Student's t-test for independent samples or the Mann–Whitney U test, according to data distribution. Statistical significance was accepted at $p < 0.05$.

7.2.4. Comorbidities associated with in-hospital mortality.

Comorbidities significantly influenced in-hospital mortality, but only some of them showed a clear association with fatal outcome. Among cardiovascular diseases, neither hypertension, nor heart failure, ischemic heart disease, or rhythm disorders were associated with mortality, whereas status post percutaneous coronary intervention was more common in survivors, likely with a protective effect (p=0.035). Pulmonary thromboembolism and chronic arterial insufficiency of the extremities were significantly more frequent in the deceased (p=0.006 and p=0.034), and pneumonia, active COVID-19 infection, and particularly respiratory failure showed the strongest association with fatal outcome (p<0.001 for pneumonia and ARF; p=0.009 for COVID-19). Chronic kidney disease, oncological and rheumatological diseases did not reach statistical significance, despite a trend toward more frequent CKD in the deceased, while recent surgical intervention (within 1 month) was significantly more common in patients

with fatal outcome (p=0.005), underscoring the role of postoperative stress and coagulation disorders as aggravating factors.

Table 110. Comorbidities and in-hospital mortality

Comorbidity	Deceased (n=59)	Survivors (n=150)	p-value
Hypertensive disease	43 (72.9%)	112 (74.7%)	0.791
Heart failure	25 (42.4%)	47 (31.3%)	0.131
Ischemic heart disease	26 (44.1%)	66 (44.0%)	0.993
Status post percutaneous intervention	2 (3.4%)	20 (13.3%)	0.035
Valve replacement	1 (1.7%)	5 (3.3%)	0.534
Status post CABG	2 (3.4%)	2 (1.3%)	0.329
Rhythm disorders	19 (32.2%)	35 (23.3%)	0.187
Status post AMI	6 (10.2%)	9 (6.0%)	0.293
Status post PTE	8 (13.6%)	5 (3.3%)	0.006
Cerebrovascular disease	16 (27.1%)	34 (22.7%)	0.497
Status post IS	10 (16.9%)	30 (20.0%)	0.614
Diabetes mellitus	21 (35.6%)	39 (26.0%)	0.168
CALI	14 (23.7%)	18 (12.0%)	0.034
DVT	8 (13.6%)	12 (8.0%)	0.219
Thyroid diseases	3 (5.1%)	5 (3.3%)	0.553
COVID-19	6 (10.2%)	3 (2.0%)	0.009
Pneumonia	18 (30.5%)	7 (4.7%)	<0.001
Respiratory failure	51 (86.4%)	30 (20.0%)	<0.001
COPD	3 (5.1%)	7 (4.7%)	0.899
Bronchial asthma	0 (0.0%)	4 (2.7%)	0.205
Rheumatological disease	3 (5.1%)	15 (10.0%)	0.254
Oncological disease	14 (23.7%)	32 (21.3%)	0.707
Recent surgical intervention	13 (22.0%)	12 (8.0%)	0.005
Chronic kidney disease	15 (25.4%)	27 (18.0%)	0.228
Coagulation disorders	2 (3.4%)	1 (0.7%)	0.136
Liver cirrhosis	18 (30.5%)	23 (15.3%)	0.013

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

Liver cirrhosis emerged as one of the most significant clinical factors associated with in-hospital mortality in upper GI bleeding. Cirrhosis was found in 30.5% of deceased vs. 15.3% of survivors (p=0.013), indicating an approximately twofold higher proportion and substantially elevated risk of fatal outcome in advanced chronic liver disease. Distribution by Child–Pugh classification showed that decompensated forms of cirrhosis (Child–Pugh class C) were significantly more common among patients with fatal outcome. No patients in class A were observed in the deceased group, while class C predominated (11 patients, p=0.018), in contrast to survivors, in whom classes A and B were more frequently encountered. The MELD score was also significantly higher in deceased patients compared to survivors (20.80 vs. 16.22; p=0.044), reflecting more severe systemic involvement (including renal dysfunction and coagulopathy). In contrast, historical data related to portal hypertension and variceal bleeding prophylaxis (known varices in the past, prophylaxis with NSBB, prior ligation) did not differ between the two groups (p>0.05). In summary, the results clearly demonstrate that liver cirrhosis, particularly in advanced stage, is an independent marker of increased risk of in-hospital mortality in patients with upper gastrointestinal bleeding. The severity of hepatic decompensation, reflected by the Child–Pugh and MELD scores, has key prognostic significance and should be an integral part of early risk stratification and clinical management in this patient subgroup.

Table 111. Liver cirrhosis and in-hospital mortality.

Parameter	Deceased (n=59)	Survivors (n=150)	p-value
Presence of cirrhosis	18 (30.5%)	23 (15.3%)	0.013
Child–Pugh A	0 (0.0%)	4 (2.7%)	0.130
Child–Pugh B	5 (8.5%)	13 (8.7%)	0.192
Child–Pugh C	11 (18.6%)	6 (4.0%)	0.018
MELD (mean)	20.80	16.22	0.044
Known varices in the past	11 (18.6%)	13 (8.7%)	0.767
Prophylaxis with NSBB	5 (8.5%)	7 (4.7%)	0.853
Prior ligation	6 (10.2%)	8 (5.3%)	0.923

Note: Data are presented as n (%) for categorical variables and as mean value for MELD. Comparison between categorical variables was performed using the χ^2-test or Fisher's exact test, where applicable, and for MELD using Student's t-test for independent samples. Statistical significance was accepted at $p < 0.05$.

7.2.5. Risk-associated medications.

In the assessment of medications, it was found that direct anticoagulants for parenteral administration (including LMWH) were significantly more frequently used in deceased patients compared to survivors (11 vs. 12 patients; p=0.027). Use of vitamin K antagonists showed a trend toward higher mortality (9 vs. 10 patients; p=0.052), but without reaching conventional

statistical significance. Prior therapy with proton pump inhibitors or H_2-blockers was more common in patients with fatal outcome (p=0.017), likely as an indirect marker of underlying chronic gastrointestinal disease and/or combined antithrombotic therapy, rather than a direct risk factor. Platelet antiplatelet agents, dual antiplatelet therapy, NSAIDs, glucocorticoids, DOACs as a subgroup, and SSRIs showed no statistically significant differences between deceased and surviving patients (p>0.05 for all).

Table 112. Risk-associated medications and in-hospital mortality.

Medication	Deceased (n=59)	Survivors (n=150)	p-value
NSAIDs	9 (15.3%)	18 (12.0%)	0.528
Glucocorticoids	1 (1.7%)	9 (6.0%)	0.189
Antiplatelet agents	17 (28.8%)	37 (24.7%)	0.538
Dual antiplatelet therapy	1 (1.7%)	7 (4.7%)	0.314
Direct parenteral anticoagulants	11 (18.6%)	12 (8.0%)	0.027
Vitamin K antagonists	9 (15.3%)	10 (6.7%)	0.052
NOACs	7 (11.9%)	28 (18.7%)	0.676
SSRIs	0 (0.0%)	3 (2.0%)	0.274
PPIs / H2- blockers	15 (25.4%)	18 (12.0%)	0.017

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

7.2.6. Endoscopic findings associated with fatal outcome.

Endoscopic assessment showed that the severity of findings and the need for therapeutic interventions are closely associated with in-hospital mortality. Time to urgent EGD did not differ significantly between deceased and surviving patients (3.68 vs. 4.19 hours; p=0.479), but active bleeding was more frequently identified in the deceased (33.9% vs. 15.3%; p=0.003) along with a need for endoscopic hemostasis (54.2% vs. 31.3%; p=0.002), with a significantly lower rate of successful initial hemostasis (30.5% vs. 66.7%; p<0.001). High-risk stigmata of bleeding were present in all patients with fatal outcome versus 60.7% of survivors (p<0.001), confirming the prognostic significance of endoscopic assessment of lesion morphology. Variceal bleeding was more frequent in the group with fatal outcome (15.3% vs. 6.7%; p=0.052), while the frequency of peptic ulcer, erosive gastritis, esophagitis, Mallory–Weiss, Cameron ulcer, and portal hypertensive gastropathy did not reach statistical significance between the groups. In the analysis of Forrest classification, no statistically significant differences in the distribution of categories between patients with and without in-hospital mortality were found (p = 0.598).

Table 113. Endoscopic findings and in-hospital mortality.

Endoscopic variable	Deceased (n=59)	Survivors (n=150)	p-value
Active bleeding	20 (33.9%)	23 (15.3%)	0.003
High-risk stigmata	59 (100.0%)	91 (60.7%)	<0.001
Need for endoscopic hemostasis	32 (54.2%)	47 (31.3%)	0.002
Success of initial hemostasis	18 (30.5%)	47 (31.3%)	<0.001
Variceal bleeding	9 (15.3%)	10 (6.7%)	0.052
Erosive gastritis	38 (64.4%)	97 (64.7%)	0.972
Mallory–Weiss	0 (0.0%)	7 (4.7%)	0.091
Cameron ulcer	2 (3.4%)	15 (10.0%)	0.116
Neoplasm of upper GI tract	5 (8.5%)	4 (2.7%)	0.063
Portal hypertensive gastropathy	14 (23.7%)	21 (14.0%)	0.090
Forrest high-risk (Ia–IIb)	20 (33.9%)	31 (20.7%)	0.598

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

7.2.7. Clinical course and other risk factors associated with in-hospital mortality.

Patients with fatal outcome more frequently required blood transfusion and had a higher incidence of rebleeding. Blood transfusion was administered in 88.1% of deceased patients vs. 70.0% of survivors (p=0.006), and rebleeding was recorded in 39 of 59 deceased patients compared to 21 of 150 survivors (p<0.001), identifying recurrent hemorrhage as one of the strongest markers of in-hospital mortality. The need for surgical intervention was more common in the deceased, but without statistical significance (7 vs. 8 patients; p=0.100).

Table 114. Clinical course and other risk factors associated with fatal outcome.

Parameter	Deceased	Survivors	Total	p-value
Need for blood transfusion	52 (88.1%)	105 (70.0%)	157 (75.1%)	0.006
Need for surgical intervention	7 (11.9%)	8 (5.3%)	15 (7.2%)	0.100
Rebleeding	39 (66.1%)	21 (14.0%)	60 (28.7%)	<0.001

Note: Data are presented as n (%). Comparison between groups was performed using the χ^2-test or Fisher's exact test, where applicable. Statistical significance was accepted at $p < 0.05$.

7.2.8. Independent risk factors for in-hospital mortality.

To identify independent predictors of in-hospital mortality, a logistic regression analysis was performed, in which the dependent variable was fatal outcome during hospitalization. Due to the limited number of patients with fatal outcome (n = 59; 28.2%) and the large number of potential clinical, laboratory, and endoscopic predictors, several separate models were constructed, evaluating the influence of different groups of variables. The first model included only quantitative parameters at admission: age, systolic blood pressure, shock index, platelets, hemoglobin, INR, creatinine, albumin, sodium, and MELD score. The model showed good fit to the data according to the Hosmer–Lemeshow test ($\chi^2 = 9.406$; $p = 0.309$) and a high overall accuracy of 89.5%, correctly classifying 95.7% of survivors and 80.0% of deceased patients. Of the included predictors, only *shock index* showed a statistically significant independent association with mortality ($p = 0.040$), with its increase being associated with a sharp rise in the probability of fatal outcome. The remaining parameters did not reach statistical significance within this model, although platelets showed a borderline trend ($p = 0.075$).

Table 115. Model 1: Logistic regression model (quantitative variables)

Variable	B	SE	Wald	p-value	OR (Exp(B))
Age	0.095	0.088	1.159	0.282	1.099
Systolic BP	-0.017	0.046	0.142	0.707	0.983
Shock index	14.780	7.205	4.208	0.040	2623012.5
Platelets	0.021	0.012	3.160	0.075	1.021
Hemoglobin	-0.004	0.037	0.012	0.912	0.996
INR	-0.449	0.957	0.220	0.639	0.638
Creatinine	-0.017	0.013	1.632	0.201	0.983
Albumin	-0.126	0.127	0.987	0.321	0.881
Sodium	0.187	0.155	1.453	0.228	1.206
MELD score	0.325	0.198	2.701	0.100	1.384

Model 2 included only qualitative clinical and endoscopic variables – sex, Child–Pugh score, presence of active bleeding at endoscopy, and success of initial endoscopic hemostasis. The model showed very good fit to the data (Hosmer–Lemeshow $\chi^2 = 0.936$; $p = 0.988$) and an overall classification accuracy of 83.3%, correctly classifying 81.8% of patients without fatal outcome and 84.6% of those with in-hospital mortality. Of the included predictors, *Child–Pugh score* emerged as the strongest factor with borderline statistical significance ($p = 0.056$), with an increase of one class being associated with an approximately 12.7-fold increase in the probability of in-hospital mortality. The remaining variables showed no statistically significant association with mortality during hospitalization.

Table 116. Logistic regression model 2 – qualitative predictors of in-hospital mortality

Variable	B	SE	Wald	p-value	OR (Exp(B))
Sex	-0.81	2.054	0.156	0.693	0.445

Variable	B	SE	Wald	p-value	OR (Exp(B))
Child–Pugh score	2.538	1.331	3.638	0.056	12.653
Active bleeding	-1.319	1.594	0.685	0.408	0.267
Success of hemostasis	-22.223	14076.976	0.0	0.999	0.0

Model 3 is an extended logistic regression model including quantitative parameters with potential prognostic value: heart rate, systolic blood pressure, shock index, hematocrit, hemoglobin, leukocytes, urea, eGFR, total protein, albumin, prothrombin index, and INR. The model showed good statistical fit to the data according to the Hosmer–Lemeshow test ($p > 0.05$) and satisfactory overall prognostic accuracy (76.7%), classifying surviving patients better than fatal cases. Of all included variables, only *serum albumin* reached statistical significance ($p = 0.019$), with lower values being associated with a significantly increased risk of in-hospital mortality. The remaining parameters showed no independent statistically significant association.

Table 117. Model 3 - extended logistic regression model with quantitative parameters

Variable	B	SE	Wald	p	OR (Exp(B))	95% CI for OR
Albumin	-0.105	0.045	5.547	0.019	0.900	0.825 – 0.983
Heart rate	0.012	0.028	0.204	0.651	1.013	0.959 – 1.069
Systolic BP	0.003	0.027	0.012	0.912	1.003	0.951 – 1.058
Shock index	1.592	2.249	0.501	0.479	4.913	0.060 – 403.531
Hemoglobin	0.013	0.033	0.149	0.699	1.013	0.949 – 1.081
Hematocrit	-1.888	11.122	0.029	0.865	0.151	—
Leukocytes	0.033	0.029	1.256	0.262	1.033	0.976 – 1.094
Urea	0.011	0.022	0.265	0.607	1.011	0.969 – 1.055
eGFR	-0.012	0.009	2.073	0.150	0.988	0.971 – 1.004
Total protein	-0.039	0.027	2.081	0.149	0.962	0.912 – 1.014
PI %	-0.025	0.018	2.082	0.149	0.975	0.942 – 1.009

Variable	B	SE	Wald	p	OR (Exp(B))	95% CI for OR
INR	-0.416	0.389	1.145	0.285	0.660	0.308 – 1.414

7.3. Discussion.

Our data show that initial hemodynamic instability is one of the strongest early predictors of in-hospital mortality in acute upper gastrointestinal bleeding. Deceased patients in our cohort were admitted with significantly lower systolic blood pressure, higher heart rate, and a higher shock index (1.24 vs. 0.94; $p < 0.001$), which is consistent with data in the literature. A meta-analysis by Tari et al. showed that hemodynamic instability at admission is associated with a significantly increased risk of both mortality and rebleeding in acute gastrointestinal hemorrhage. Our results are also supported by the study of Doğru et al., who found that the shock index, measured already at admission, has good prognostic value for mortality in elderly patients with upper GI bleeding and may surpass some of the traditional scoring systems. These observations are further confirmed by the results of our logistic regression analysis. In the model including quantitative parameters at admission, the shock index emerged as the only independent predictor of in-hospital mortality ($p = 0.040$). The positive regression coefficient and the exceptionally high value of the odds ratio (OR ≈ 2,623,012) indicate that an increase in the shock index is associated with a sharp rise in the probability of fatal outcome. Although the wide confidence interval reflects some instability in the estimate due to the limited number of events, the direction of the effect remains clearly expressed and clinically plausible. Particularly noteworthy is also the fact that in a significant proportion of deceased patients, bleeding had occurred during hospitalization for another reason. This finding is comparable to data from Haddad et al., who showed that newly developed in-hospital bleeding is associated with higher mortality (20%) and more unfavorable clinical outcomes (longer hospital stay, greater need for vasopressor agents and blood transfusion) compared to bleeding that led to the initial hospital admission. The authors attributed this to the higher comorbidity and more severe general condition of these patients. Our results show that patients with fatal outcome during hospitalization were characterized by more pronounced laboratory abnormalities already at admission. The most marked difference was observed with respect to hemoglobin (78.34 g/L vs. 90.83 g/L, $p = 0.009$) and hematocrit (0.24 vs. 0.27, $p = 0.012$), which were significantly lower in deceased patients. This likely reflects greater initial blood loss and more severe anemia. Particularly important are the established differences in renal function parameters. In our cohort, patients with fatal outcome had higher urea values (18.36 vs. 14.93 mmol/L; $p = 0.046$) and lower estimated glomerular filtration rate (eGFR 56.97 vs. 67.21 ml/min/1.73 m²; $p = 0.044$), suggesting more frequent renal dysfunction in this group. This observation is consistent with numerous studies showing that renal failure is an independent risk factor for unfavorable outcome in upper gastrointestinal bleeding. In a large population-based study, Sood et al. showed that both chronic kidney disease and end-stage renal disease are associated with higher in-hospital mortality in upper GI hemorrhage. In patients with chronic kidney disease the risk of mortality was increased with OR 1.47 (95% CI 1.21–1.78), and in those with end-stage renal disease it reached OR 3.02 (95% CI 2.23–4.10) (261). The elevated urea in our cohort likely reflects not only renal hypoperfusion and prerenal azotemia in the context of hemodynamic instability, but also more severe blood loss, since in upper gastrointestinal bleeding an elevated urea is traditionally regarded as an indirect indicator of the severity of blood loss. For this reason, urea as a

laboratory component is included in many of the widely used risk stratification scores, including the Glasgow-Blatchford Score (GBS). Our results show that patients with fatal outcome had significantly lower serum albumin values (28.78 vs. 35.29 g/L; $p < 0.001$). Furthermore, in the extended logistic regression model including hemodynamic, hematological, renal, and coagulation parameters, serum albumin remained the only independent quantitative predictor of in-hospital mortality (OR = 0.900; 95% CI 0.825–0.983; $p = 0.019$). Our observations are comparable to the results of Cheng et al., who in a prospective study of patients with peptic ulcer bleeding found that hypoalbuminemia is an independent predictor of both mortality and rebleeding. The authors showed that the frequency of fatal outcome increases progressively with lower albumin values, and that patients with severe hypoalbuminemia have a significantly higher risk of unfavorable clinical outcome. The strong association established in our cohort between pneumonia, COVID-19 infection, respiratory failure, and in-hospital mortality supports the understanding that unfavorable outcome in acute upper gastrointestinal bleeding is often determined not only by the bleeding itself, but also by the severity of concurrent diseases. Data from the prospective study by Sung et al. show that a significant proportion of deaths in patients with peptic ulcer bleeding are attributable to cardiopulmonary complications and multiorgan failure, rather than to the bleeding itself. A similar interpretation is supported by the analysis of Lanas, according to which in patients with upper GI hemorrhage mortality is frequently the result of decompensation of concurrent conditions, especially cardiopulmonary. The higher prevalence of liver cirrhosis among patients with in-hospital mortality observed in our cohort (30.5% vs. 15.3%; $p=0.013$) supports the understanding that cirrhosis is an important prognostic marker for unfavorable outcome in upper gastrointestinal bleeding. Even more indicative is the fact that among deceased patients Child–Pugh class C significantly predominated ($p=0.018$), while earlier stages were more frequently encountered in survivors. Our logistic regression model supported the central role of hepatic decompensation in prognosis – Child–Pugh score emerged as the strongest predictor, reaching borderline statistical significance ($p=0.056$), with an increase of one class being associated with an approximately 12.7-fold increase in the probability of in-hospital mortality (OR=12.65). Additionally, the calculated MELD in our cohort was significantly higher in deceased patients (20.80 vs. 16.22; $p=0.044$). These observations are consistent with data in the literature, according to which the severity of hepatic dysfunction, rather than merely the presence of cirrhosis, is the key determinant of prognosis in acute upper GI bleeding. Peng et al. showed that both Child–Pugh and MELD have good discriminatory ability for predicting in-hospital mortality in cirrhotic patients with acute upper GI bleeding. Our results show that the endoscopic severity of the bleeding source is closely associated with in-hospital mortality, with the most unfavorable profile seen in patients with active bleeding and high-risk stigmata. Particularly noteworthy is the fact that the need for endoscopic hemostasis was significantly more frequent in deceased patients (54.2% vs. 31.3%, $p = 0.002$), and the success of initial hemostasis was substantially lower in this group (30.5% vs. 66.7%, $p < 0.001$). In a large prospective analysis by Sung et al. comprising 10,428 cases of non-variceal bleeding, a significant proportion of deaths occurred precisely in the setting of failed bleeding control during index endoscopy or in the early period after endoscopic treatment. Our data clearly demonstrate that rebleeding is one of the strongest clinical markers associated with in-hospital mortality ($p < 0.001$). This observation is in very good agreement with the results of Laursen et al., who in a national cohort study of 19,258 patients with peptic ulcer hemorrhage found that rebleeding was associated with an approximately twofold increase in 30-day mortality. In summary, in-hospital mortality in patients with bleeding is the result of a complex interaction between the severity of

the endoscopic lesion, the presence of rebleeding, hemodynamic instability, and underlying organ decompensation, which underscores the need for early identification of high-risk patients and timely intensive therapeutic management.

VI Conclusion

Acute upper gastrointestinal bleeding remains one of the most serious and clinically significant emergencies in contemporary gastroenterological practice, due to its clinical heterogeneity and potentially severe course. Despite advances in diagnostic and therapeutic capabilities, early risk assessment and timely identification of patients with an increased probability of rebleeding, need for intervention, and fatal outcome continue to be decisive for the success of treatment. The conducted study enabled a comprehensive characterization of patients with acute upper gastrointestinal bleeding in the real-world hospital setting. The analysis showed that this is a population predominantly comprising elderly patients with a high comorbidity burden, with a significant proportion taking medications associated with increased hemorrhagic risk. At admission, hemodynamic instability, pronounced anemia, and laboratory abnormalities pointing to systemic involvement are frequently identified. The results obtained confirm that the clinical outcome in these patients is not determined solely by the local severity of the bleeding lesion, but is the result of a complex interaction between the etiology of bleeding, the general condition of the patient, comorbidities, and the degree of organ dysfunction. A substantial focus of the study was placed on the evaluation of the prognostic value of established scoring systems. The results show that these instruments have an undeniable clinical role, but their effectiveness is not uniform for all endpoints. There is no universal score with optimal applicability for every clinical outcome in upper gastrointestinal bleeding. We demonstrated that the prognostic power of individual systems depends both on the specific event being assessed and on the etiology of bleeding. This necessitates an individualized and clinically justified approach in their application in practice. The data obtained support the need for an integrated approach based on clinical, laboratory, and endoscopic parameters, with the aim of achieving more accurate risk stratification and optimizing therapeutic decision-making in patients with upper gastrointestinal bleeding.

VII Summary of Findings

1. Patients with acute upper gastrointestinal bleeding in the studied cohort are predominantly elderly, with a high prevalence of comorbidities and clinical signs of hemodynamic instability, thus delineating a population at increased risk of unfavorable in-hospital outcome.

2. The severe course of non-variceal bleeding is associated with a complex interaction between the endoscopic severity of the lesion, pronounced laboratory abnormalities, and comorbidity, with some of these factors having independent prognostic value.

3. In patients with chronic liver disease, variceal bleeding is closely associated with clinical, laboratory, and endoscopic signs of advanced portal hypertension, underscoring the leading role of the hemodynamic consequences of cirrhosis in its occurrence.

4. Established clinical scoring systems demonstrate varying prognostic effectiveness with respect to the main clinical events and outcomes in acute upper gastrointestinal bleeding, with their

discriminatory ability depending both on the specific endpoint and on the etiology of bleeding, indicating that there is no universal score with optimal applicability for every clinical outcome.

5. Direct comparison between established scoring systems revealed substantial differences in their discriminatory ability for predicting rebleeding, mortality, and need for intervention, confirming that the choice of the most appropriate prognostic tool should be tailored to the specific clinical scenario.

6. Analysis of time to rebleeding showed that the recurrent bleeding episode is predominantly an early event during hospitalization and is closely associated with the severity of the patient's initial clinical condition, with hemodynamic instability, reflected by the shock index, emerging as the principal independent predictor of recurrent bleeding.

7. In-hospital mortality in patients with acute upper gastrointestinal bleeding is determined by a complex interaction between hemodynamic instability, the severity of blood loss, concurrent organ dysfunction, unfavorable endoscopic findings, and rebleeding.

8. Endoscopic characteristics of the bleeding source, including active bleeding, high-risk stigmata, and failed initial hemostasis, are of substantial importance for short-term prognosis and are closely associated with an increased risk of rebleeding and mortality.

9. Early risk stratification through the combination of clinical, laboratory, endoscopic parameters, and established scoring systems is of substantial importance for optimizing triage, therapeutic management, and follow-up of patients with acute upper gastrointestinal bleeding.

VIII Contributions

1. A comprehensive and complex characterization of patients with acute upper gastrointestinal bleeding in real-world hospital practice has been performed, thereby delineating the profile of the studied population as a foundation for subsequent analysis of risk factors and prognostic models.

2. Independent clinical, endoscopic, and laboratory predictors of severe course of non-variceal bleeding have been identified, enabling more precise early recognition of high-risk patients in clinical practice.

3. Factors associated with the occurrence of variceal bleeding in patients with chronic liver disease have been investigated, enabling better definition of the risk profile in this population.

4. For the first time in a Bulgarian cohort, the differentiated prognostic value of the Glasgow–Blatchford score (GBS), AIMS65, ABC, CANUKA, MAP(ASH), Rockall (pre-endoscopic and full), PNED, and CSMCPI has been evaluated with respect to the main clinical endpoints: in-hospital mortality, rebleeding, and need for intervention.

5. For the first time in a Bulgarian clinical cohort, a comprehensive comparative analysis of nine prognostic scoring systems has been performed in real-world hospital practice, thereby determining their relative advantages and limitations in predicting main adverse outcomes and the need for therapeutic intervention in patients with upper gastrointestinal bleeding.

6. It has been established that individual scoring systems have varying prognostic effectiveness according to the specific adverse outcome, which argues for a targeted rather than a universal approach in their use.

7. The temporal dynamics of rebleeding have been evaluated and factors associated with recurrent bleeding during the hospital stay have been investigated.

8. A comprehensive analysis of the frequency, associated factors, and independent predictors of in-hospital mortality in patients with acute upper gastrointestinal bleeding has been performed, thereby clarifying the risk profile of patients with the most unfavorable clinical course.

9. The practical value of early risk stratification already at patient admission has been confirmed for optimizing therapeutic management and for identifying patients at high risk of complications and death.

10. The results obtained have scientific and applied significance and can be used to refine local clinical management algorithms for patients with upper gastrointestinal bleeding.

IX Publications and Participation in Scientific Forums related to the topic of the dissertation.

1. Yordanov A. **Prognostic Scores for Risk Stratification in Patients with Acute Upper Gastrointestinal Bleeding.** *Scripta Scientifica Medica.* 2026;
2. Yordanov A. **Management Algorithm in Variceal Upper Gastrointestinal Bleeding.** *Scripta Scientifica Medica.* 2026;
3. Yordanov A. **Esophageal and Gastric Varices – Pathogenesis, Screening, and Primary Prophylaxis.** *Varna Medical Forum.* 2026;
4. Yordanov A. **Epidemiology and Risk Factors for Non-Variceal Upper Gastrointestinal Bleeding: A Literature Review.** *Varna Medical Forum.* 2025;
5. Yordanov A. **Endoscopic Therapy in Non-Variceal Upper Gastrointestinal Bleeding.** *Varna Medical Forum.* 2025;
6. Interest Club Internal Medicine, Union of scientists- Varna - participation with presentation of an independent paper “Approach to acute upper gastrointestinal nonvariceal bleeding in adults.”
7. Conference on Internal Medicine, organized by the Interest Club “Internal Medicine” of the Union of Scientists – Varna – participation with presentation of an independent paper “Management Algorithm for Variceal Bleeding”