Prospective Comparison of the 3 Most Commonly Used Scoring Systems in Patients with Gastrointestinal Bleeding

Tufan ALATLI [1], Salih KOCAOĞLU [1]

[1] Balıkesir University, Faculty of Medicine, Department of Emergency Medicine

ABSTRACT

Objective: This study aimed to determine the most appropriate scoring system for the emergency department to facilitate the management of patients with gastrointestinal bleeding. **Materials and Methods:** Data were collected prospectively September'21-March'22 in the emergency department (ED). 117 adult patients were included. Endoscopic intervention, rebleeding, admission to the intensive care unit, and in-hospital death were recorded. **Results:** The patients median age was 75 years and 58.1% (n=68) of them were male. Of the patients, 21 were hospitalized in the intensive care unit and 85 in the ward (17.94-72.64%). All three scoring systems can determine the hospitalization place or discharge of patients with GI bleeding. A positive and significant correlation was found between Glasgow-Blatchford, AIMS-65 and length of hospitalization (p<0.05). In-hospital mortality developed in 15 (12.82%) of the patients. Rockall, Glasgow-Blatchford, and AIMS-65 scoring systems were found to be significant for mortality prediction (AUC= 0.745 - 0.777 - 0.851). Seventy-one (60.68%) of patients received ES transfusion, and the Rockall, Glasgow-Blatchford, and AIMS-65 scoring systems were found to be significant for the prediction of ES transfusion (AUC= 0.624 - 0.826 - 0.653). Rebleeding developed in 16 (13.67%) patients. Glasgow-Blatchford and AIMS-65 scoring systems were found to be significant for rebleeding (p= 0.03-0.04). The Rockall classification was found to be insignificant (p=0.57). **Conclusion:** All scoring systems were successful in terms of management of patients with GI bleeding and survey estimation. The AIMS-65 scoring system stands out only in terms of rebleeding prediction. For this reason and it is more practical, we recommend the AIMS-65 scoring system for the emergency department.

Keywords: Gastrointestinal Bleeding, Scoring Systems, Emergency Department, Complications.

Gastrointestinal Sistem Kanamalı Hastalarda En Sık Kullanılan 3 Skorlama Sisteminin Prospektif Karşılaştırılması

ÖZ

Amaç: Bu çalışmanın amacı gastrointestinal kanamalı hasta yönetimini kolaylaştırmak için acil servise en uygun skorlama sistemini saptamaktır. **Gereç ve Yöntem:** Veriler, acil serviste 6 aylık (22.09.2021-31.03.2022) bir süre boyunca ileriye dönük olarak toplandı. GI kanaması olan yetişkin 117 hasta dahil edildi. Bileşik klinik sonuçlar, cerrahi veya endoskopik müdahale ihtiyacı, tekrar kanama, yoğun bakım ünitesine yatış veya hastane içi ölümden oluşuyordu. **Bulgular:** Hastaların ortanca yaşı 75 olup, %58.1'i (n=68) erkekti. Hastaların 21'i yoğun bakım, 85'i servise yatırıldı (% 17.94-72.64). Her üç skorlama sistemide hastalarının yatış yeri veya taburculuğunu belirleyebilmektedir. Glasgow-Blatchford ve AIMS-65 ile yatış süresi arasında pozitif anlamlı bir ilişki bulunmuştur (p<0.05). Hastaların 15'inde (%12.82) hastane içi mortalite gelişmiştir, Rockall, Glasgow-Blatchford, AIMS-65 skorlama sistemleri mortalite tahmini yönünden anlamlı bulunmuştur (AUC= 0.745 – 0.777 – 0,851). Hastaların 71'ine (%60.68) ES transfüzyonu yapılmıştır ve Rockall, Glasgow-Blatchford, AIMS-65 skorlama sistemleri ES transfüzyonu tahmini açısından anlamlı saptanmıştır (AUC=0.624 – 0.826 – 0.653). Hastalardan 16'sında (%13.67) yeniden kanama gelişmiştir. Glasgow-Blatchford ve AIMS-65 skorlamaları yeniden kanama için anlamlı (p=0.03-0.04), Rockall sınıflaması ise anlamsız saptanmıştır (p=0,57). **Sonuç:** Tüm skorlama sistemleri GIS kanama hastalarının yönetimi ve survey tahmini açısından başarılıdır. Sadece yeniden kanama tahmini açısından AIMS-65 ön plana çıkmaktadır. Bu sebepten ve daha pratik olduğundan AS için biz AIMS-65 skorlama sistemini önermekteyiz.

Anahtar Kelimeler: Gastrointestinal Kanama, Skorlama Sistemi, Acil Servis, Komplikasyonlar.

Sorumlu Yazar / Corresponding Author: Tufan ALATLI, Balıkesir University, Faculty of Medicine, Department of Emergency Medicine, Balıkesir, Türkiye.
E-mail: drtufanalatli@gmail.com

INTRODUCTION

Patients with Gastrointestinal System Bleeding (GSB) are one of the groups with high morbidity and mortality in emergency service (ED) admissions if they are not intervened rapidly. Depending on the severity of the bleeding, it can end with a wide variety of clinics and outcomes. The annual incidence of the disorder is 50-170/100000 people (Park et al., 2016; Atkinson & Hurlstone, 2008). Although its mortality varies between 3-and 15%, this rate is even higher in patients with hemodynamic instability (Tang et al., 2018). While bleeding caused by erosive gastritis and peptic ulcer can sometimes be controlled with acid-suppressing drugs, severe bleeding, hemorrhagic shock, and even mortality may occur in conditions, such as esophageal or gastric variceal bleeding, a peptic ulcer caused by large arterial erosion, Dieulafoy's disease, and gastrointestinal tumors (Zhong et al., 2016). Therefore, determining the severity of GSB is important for optimizing patient care and efficient use of resources. Although endoscopy-based triage has been recommended to reduce the length of hospital stay and costs, the possibility of continuous endoscopy in ED is limited. Various risk scoring systems have been developed to predict the need for intervention or the probability of death and to develop an optimal management strategy. Scoring systems are important in terms of choosing the appropriate treatment method, reducing medical costs, and improving prognosis (Çay & Çetinkaya, 2022). AGA (American Gastroenterological Association) recommends early classification for the management of patients with GSB (Abougergi et al., 2016). Various scoring systems have been developed to predict risks, such as mortality, rebleeding, timing of endoscopy, time of discharge, and level of care, and to help decision-making (Zhong et al., 2016). Although there are many scoring systems, the most commonly used ones are AIMS65, Glasgow-Blatchford Bleeding Score (GBS), and pre-endoscopic Rockall Score. Risk scores will be useful for emergency physicians in situations where emergency endoscopy cannot be performed. In our study, we aimed to investigate which of these scores was more useful in ED and superior in predicting clinical outcomes.

MATERIALS AND METHODS

Study type

This descriptive study was conducted with Balıkesir University Medical Faculty Emergency Department patients from September 22, 2021- March 31, 2022.

Study group

The research universe consisted of were collected prospectively over 6 months (September 22, 2021- March 31, 2022) in the ED of a university hospital. Balıkesir University is located in Balıkesir province, at the northern west coast of Turkey. The sample size was not calculated as the researchers attempted to reach the maximum study size. Participation in this research was voluntary, patients who did not agree to participate in the study were excluded and the study was conducted with 117 patients.

Dependent and independent variables

The independent variables of this research are age, gender, comorbidities, clinic, endoscopic diagnosis, hospitalization (ICU, ward etc.), length-of-stay, in-hospital mortality, ES transfusion, rebleeding. The dependent variables are Glasgow-Blatchford, AIMS-65 and pre-endoscopic Rockall score.

Procedures

Blood counts were tested by Beckman Coulter Hematology Analyzer LH780. All serum biochemical parameters were tested by Beckman Coulter Chemistry Analyzer AU680. Blood transfusion was applied to patients with shock, hypotension, clinical deterioration or hemoglobin below 7 g/dl. Scoring systems were filled out by the patient's physician with the data obtained at the time of admission to the ED. Data about patients who developed mortality, their re-bleeding status, endoscopic intervention report, and length of hospital stay were obtained from epicrisis report and hospital management software.

Statistical analysis

Skewness and kurtosis coefficients were examined for the assumption of normality. Since these values were in the range of ±1, the assumption of normality was met. Continuous variables with normal distribution were expressed as mean ± standard deviation values, and comparisons between independent groups were performed with the independent t-test and one-way ANOVA test. ROC curve analysis was performed to evaluate and compare the performances of diagnostic markers. Youden J index was used to obtain the optimal cut-off value, and related sensitivity, specificity, positive predictive, and negative predictive values were presented. The significance level was taken as $\alpha = 0.05$. Statistical analyses were performed on IBM SPSS Statistics version 22.0 (IBM Corp., USA).

Ethical considerations

The study was approved by Clinical Research Ethics Committee with the decision number 2021/192. An 'informed consent form' was obtained from each patient participating in the study.

RESULTS

117 patients were included in the study. The median age of the patients was 75 (min-max: 18-97) years, and 58.1% (n=68) of them were male. The most common diagnosis of the patients in ED was melena (64.10%, n=75). When the patients were evaluated in terms of comorbidities, the most common ones were hypertension, diabetes mellitus type 2, and coronary artery diseases. The frequencies of comorbidities and bleeding patterns are shown in Table 1.

Table 1. The frequencies of comorbidities and bleeding patterns.

Comorbidity	n	%
Hypertension	37	31.62
Diabetes Mellitus type 2	27	23.07
Coronary Artery Disease	22	18.80
CVD	10	8.54
Congestive Heart Failure	9	7.69
Atrial Fibrillation	8	6.83
Chronic renal failure	8	6.83
COPD	6	5.12
Cirrhosis	6	5.12
Covid-19	2	1.70
Other	34	29.05
No Comorbidity	30	25.64
Total	**117**	**100**
Clinic	**n**	**%**
Hematemesis	29	24.79
Hematochezia	21	17.95
Melena	75	64.10
Hemoptysis	1	0.85
No clinic	3	2.56
Total	**117**	**100**

CVD: Cardiovascular Disease, **COPD:** Cronic Obstructive Pulmonary Disease.

Of the patients diagnosed with GI bleeding in ED, 21 were hospitalized in the intensive care unit (ICU) and 85 were hospitalized in the ward. While 9 patients were discharged, 2 patients refused treatment (17.94%-72.64%-7.69%-1.70%). The scores of the scoring systems in terms of predicting ICU admission, ward admission, and discharge were found significant as follows, respectively: pre-endoscopic Rockall, 4.19-3.15-2.89 (2.112=3.66, p<0.05); Glasgow-Blatchford 13.86-8.96-5.11 (2.112=18.21, p=0.00); AIMS-65, 2.90-1.32-0.67 (2.112=25.47, p=0.00). All three scoring systems can determine the hospitalization place or discharge of patients with GI bleeding during ED admission. This situation is shown in Table 2.

Pre-endoscopic Rockall, Glasgow-Blatchford, and AIMS-65 scoring systems were found to be significant in determining whether patients with a diagnosis of GI bleeding needed hospitalization and, if they did, whether they would be admitted to the ICU or ward (p=0.039-0.00-0.00). An intra-group analysis of hospitalized patients was carried out in terms of the relationship between the scoring systems and length of stay. Accordingly, a positive and significant correlation was found between Glasgow-Blatchford and AIMS-65 and length of hospital stay (r=0.22, p<0.05, r=0.22, p<0.05), but there was no significant relationship between pre-endoscopic Rockall Score and length of hospital stay (r=-0.01, p=0.93). This is shown in Table 3.

Table 2. Ability of scoring systems to determine hospitalization.

Scoring System	Conclusion	n	Mean	Std. Deviation	95% Confidence Interval for Mean		F	p
					Lower Bound	Upper Bound		
Rockall	ICU Hosp.	21	4.19	1.692	3.42	4.96		
	Ward Hosp.	85	3.15	1.562	2.82	3.49	3.66	**0.029***
	Discharged	9	2.89	2.315	1.11	4.67		
	Total	115	3.32	1.689	3.01	3.63		
Glasgow - Blatchford	ICU Hosp.	21	13.86	3.678	12.18	15.53		
	Ward Hosp.	85	8.96	3.983	8.11	9.82	18.21	**0.000***
	Discharged	9	5.11	5.349	1.00	9.22		
	Total	115	9.56	4.615	8.70	10.41		
AIMS-65	ICU Hosp.	21	2.90	1.375	2.28	3.53		
	Ward Hosp.	85	1.32	0.916	1.12	1.52	25.47	**0.000***
	Discharged	9	0.67	0.500	0.28	1.05		
	Total	115	1.56	1.186	1.34	1.78		

ICU: Intensive Care Unit, **Hosp.:** Hospitalization.
One-way-ANOVA, *p<0.05.

Table 3. Relationship between scoring systems and length of stay.

Scoring System	Length of Stay	
	r	p
Rockall	-0.01	0.93
Glasgow-Blatchford	0.22	0.01*
AIMS-65	0.22	0.01*

r: Pearson correlation test, ***** p< 0.05

66 patients received an endoscopic intervention after the diagnosis of GI bleeding (56.41%). Bleeding patterns were classified according to the Forrest classification. Accordingly, Forrest 2C type bleeding was the most frequently observed one. The classification of endoscopy results is shown in Table 4.

Table 4. Diagnoses after endoscopic intervention.

| Endoscopy Diagnosis	n	%
No Active Bleeding	1	1.52
Mallory Weiss Syndrome	1	1.52
Forrest 1 A	5	7.58
Forrest 1 B	9	13.64
Forrest 2 A	6	9.09
Forrest 2 B	5	7.58
Forrest 2 C	21	31.82
Forrest 3	13	19.70
Lower GIS Bleeding	2	3.03
Crohn's Disease	2	3.03
Ulcerative Colitis	1	1.52
Total	66	100

Discriptive statistics

17 (14.52%) patients diagnosed with GI bleeding in ED were referred to another center. In-hospital mortality developed in 15 (12.82%) of all patients. Pre-endoscpic Rockall, Glasgow-Blatchford and AIMS-65 scoring systems were compared with ROC analysis for in-hospital mortality prediction, and all scoring systems were found to be significant in terms of mortality prediction (AUC= 0.745 - 0.777 - 0.851, p=0.002 - 0.001 - 0.000) (Table 5 and Figure 1).

Table 5. ROC curve analysis results on mortality estimation of scoring systems.

Accuracy index	Rockall	Glasgow-Blatchford	AIMS-65
AUC	0.745	0.777	0.851
p-value	**0.002**	**0.001**	**0.000**
Cut-off value	2.5	13.5	1.5
Youden J index	0.22	0.52	0.57
Sensitivity (95% CI)	28.4	85.3	63.7
Specificity (95% CI)	93.3	66.7	93.3

AUC: Area Under the Curve
ROC Curve Analysis, p< 0.05
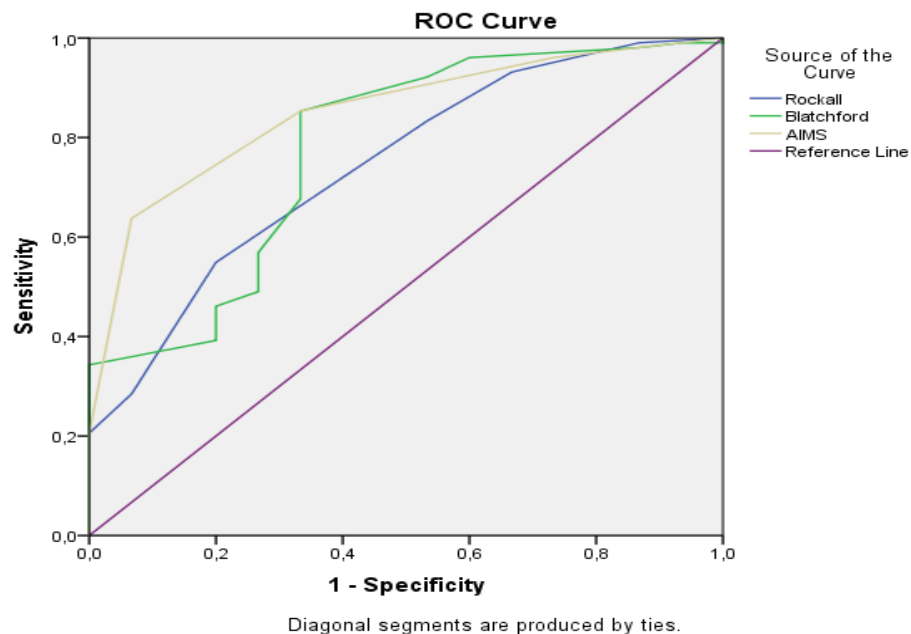
Figure 1. ROC curve analysis chart of scoring systems in terms of in-hospital mortality.

71 (60.68%) patients diagnosed with GI bleeding in ED received erythrocyte suspension (ES) transfusion. When pre-endoscpic Rockall, Glasgow-Blatchford,

and AIMS-65 scoring systems were compared in terms of ES transfusion prediction, all three scoring systems were found to be significant. AUC= 0.624 - 0.826 - 0.653, p=0.023-0.000-0.005 (Table 6 and Figure 2).

Table 6. ROC curve analysis results on estimation of ES transfusion by scoring systems.

Accuracy index	Rockall	Glasgow- Blatchford	AIMS-65
AUC	0.624	0.826	0.653
p-value	**0.023**	**0.000**	**0.005**
Cut-off value	4.50	15.50	2.5
Youden J index	0.19	0.1	0.17
Sensitivity (95% CI)	28.2	12.7	28.2
Specificity (95% CI)	91.3	97.8	89.1

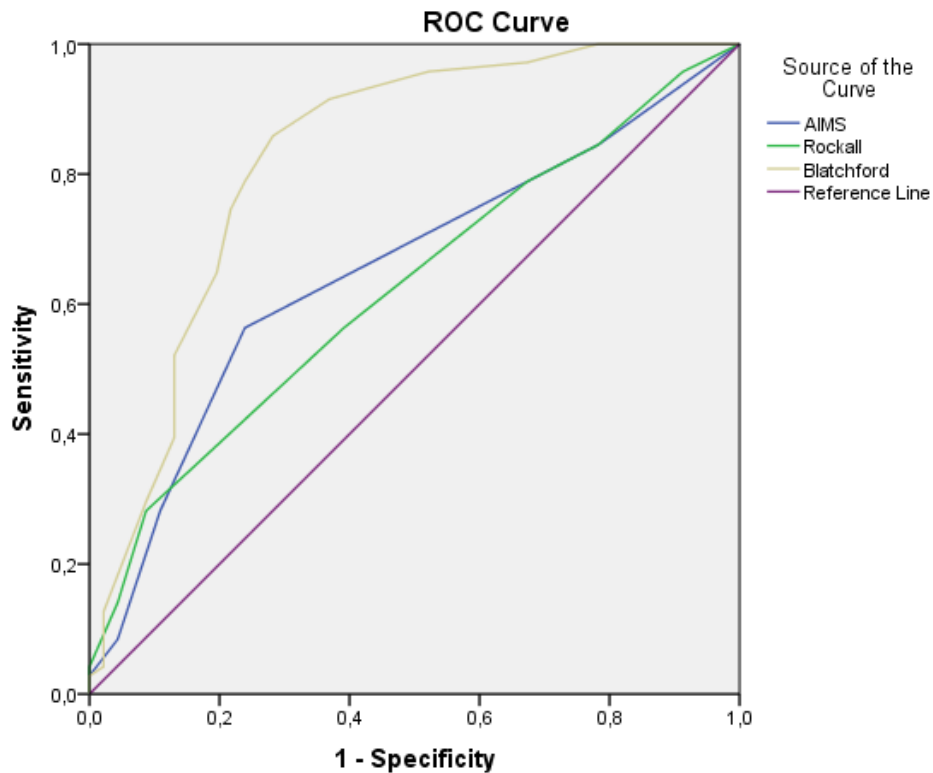**AUC:** Area Under the Curve
ROC Curve Analysis, *p < 0.05

Figure 2. ROC curve analysis plot on estimation of ES transfusion by scoring systems.

Rebleeding developed in 16 (13.67%) patients diagnosed with GI bleeding in ED. When pre-endoscpic Rockall, Glasgow-Blatchford, and AIMS-65 scoring systems were compared in terms of rebleeding prediction, they were found to be significant. AUC= 0.544 - 0.669 - 0.661, p=0.571-0.030-0.040 (Table 7 and Figure 3).

Table 7. ROC curve analysis results on rebleeding estimation of scoring systems.

Accuracy index	Rockall	Glasgow- Blatchford	AIMS-65
AUC	0.544	0.669	0.661
p-value	0.571	**0.030**	**0.40***
Cut-off value	3.50	9.50	4.5
Youden J index	0.08	0.39	0.05
Sensitivity (95% CI)	56.3	87.5	6.3
Specificity (95% CI)	51.5	51.5	99

AUC: Area Under the Curve, ROC Curve Analysis, *$p < 0.05$.
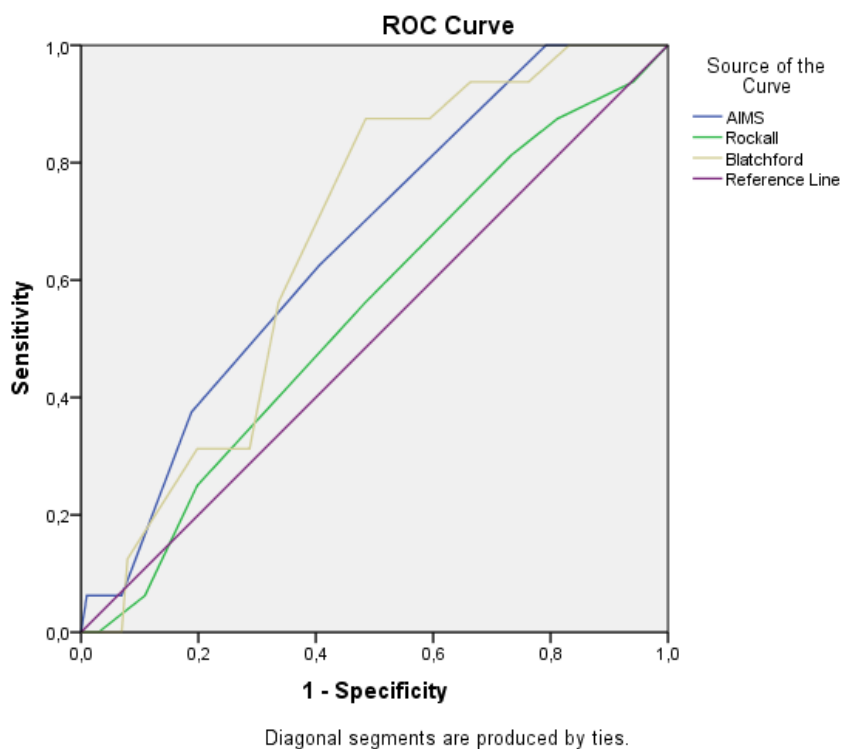

Figure 3. ROC curve analysis chart on rebleeding estimation of scoring systems.

DISCUSSION

The majority of patients diagnosed with GI bleeding in the ED are male (71.9%, 70.6%, 76.6%, 68.4%) and their mean age has been reported as approximately 60 years (64, 57.4, 61.3 years) (Kim et al., 2019; Lewis et al., 2002; Gu et al., 2018; Jung et al., 2019). In our study results, similar to the literature, the majority of them were male and the mean age was 75 years. The most common clinical presentation of patients has been reported as melena (27.5%-74.2%) (Kim et al., 2019; Lewis et al., 2002). According to our study results, the most common clinical presentation was melena, too. The most common comorbidities in patients have been reported as DM type2 (38%) and HT (22.1%) (Jung et al., 2019), and HT and DM type2 were found to be the most common ones in our study, as well.

During the admission of 16.8% of patients to the ICU, the scoring systems have been reported to be successful in identifying patients who will be admitted to the ICU (The AUC values for predicted admission were: AIMS65=0.73 (95% CI, 0.69–0.77), PRS = 0.70 (95% CI, 0.66-0.74), and GBS=0.71 (95% CI, 0.67–0.75) (Kim et al., 2019). Consistent with the literature, we found that all three scoring systems were significant in determining ICU admissions. Regarding the relationship between the length of stay and scoring systems, it has been stated that the AIMS-65 score is superior (Abougergi et al., 2016). Consistent with the literature, in addition to the AIMS-65 score, we found the Glasgow-Blatchford score correlated in our study.

According to the literature, most patients (86%) diagnosed with GI bleeding do not need endoscopic

intervention (Stanley et al., 2011), but the majority of the patients in our study underwent endoscopic intervention. We think that the approach of the gastroenterology clinic was effective in this result. In addition, our hospital had the only active gastroenterology clinic in the province during this period, which may also be effective. In line with the classifications of patients undergoing endoscopy, the most common etiology has been reported as gastric ulcer (Kim et al., 2019; Lewis et al., 2002; Jung et al., 2019). In our study, as we made the endoscopic classification based on Forrest classification, the most common etiology was 'pigmented lesion on ulcer', which is class 2C. This finding was consistent with the literature.

Although there is no study in the literature regarding the referral rate of patients diagnosed with GI bleeding, the high referral rate in our study is striking. The first reason for this is that the clinical responses of gastroenterolgy were periodically shared with different hospitals in the province. In addition, the lack of beds due to patient density may have played a role. It has been reported in the literature that mortality rates vary between 3 and 7% (Stanley et al., 2017; Shafaghi et al., 2019). AIMS-65 Score was found to be more successful in predicting in-hospital mortality than GBS and pre-endoscopic Rockall (AIMS65=0.84, PRS=0.74, and GBS=0.72) (Abougergi et al., 2016; Kim et al., 2019). In a study, it was reported that all three scoring systems were able to predict mortality with similar rates (AIMS65, GBS, and RS; AUC:0.76 - 0.78 - 0.78) (Martínez-Cara et al., 2016). In our study results, similar to the literature, we determined that all three scoring systems were significant in terms of mortality prediction, and similarly, we found that the AIMS-65 score was superior to GBS and pre-endoscopic Rockall in predicting mortality.

The need for urgent ES transfusion for patients with GI bleeding has been reported at rates ranging from 40% to 77% in the literature. GBS has been found to be superior to other scoring systems in determining the need for ES transfusion in many studies (Kim et al., 2019; Lewis et al., 2002; Stanley et al., 2011; Stanley et al., 2017). In our study, all three scoring systems were found to be successful in terms of ES transfusion prediction, and similar to the literature, GBS came to the fore as the best predictive scoring system. According to the results of the current studies in the literature, rebleeding has been detected in 2.5% of patients (Park et al., 2016; Lewis et al., 2002). In many studies, scoring systems have not been found to be superior to each other, but they are still successful in estimating rebleeding (Martínez-Cara et al., 2016; Wang et al., 2013). In addition, there are studies indicating that pre-endoscopic Rockall and GBS are better predictors than AIMS-65 (8,13). In our study, similar to the literature, AIMS-65 and GBS scoring systems were successful in predicting rebleeding, but the pre-endoscopic Rockall score was found to be

insignificant in terms of rebleeding. AIMS-65 and Glasgow-Blatchford scoring systems were not found superior to each other, either.

CONCLUSION

Gastrointestinal bleeding is one of the leading diseases with high morbidity and mortality rates in patients that present to the ED. It is recommended that scoring systems be used for patient management and survey estimation. The most commonly used scoring systems, namely pre-endoscopic Rockall, Glasgow-Blatchford and AIMS-65 yielded similar results in terms of serious outcomes, such as mortality, ES transfusion, and ICU hospitalization. However, AIMS-65 and Glasgow-Blatchford scoring systems were found to be more successful in terms of rebleeding. For this reason, we recommend the AIMS-65 scoring system as more practical for emergency services due to easier applicability and calculation for all possible serious outcomes.

Conflict of Interest
The author declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Author Contributions
Plan, design: TA; **Material, methods and data collection:** TA, SK; **Data analysis and comments:** TA, SK; **Writing and corrections:** TA, SK.

REFERENCES

Abougergi, M.S., Charpentier, J.P., Bethea, E., Rupawala, A., Kheder, J., Nompleggi, D., Liang, P., Travis, A.C., & Saltzman, J.R. (2016). A prospective, multicenter study of the AIMS65 score compared with the Glasgow-Blatchford score in predicting upper gastrointestinal hemorrhage outcomes. *Journal of Clinical Gastroenteroloji, 50*(6):464-9.

Atkinson, R.J., & Hurlstone, D.P. (2008). Usefulness of prognostic indices in upper gastrointestinal bleeding. *Best Practice & Research Clinical Gastroenterology, 22*(2):233–42

Çay, F., & Çetinkaya, H.B. (2022). The usability of shock index and lactate in predicting mortality in multitrauma patients presenting to the emergency department. *Anatolian Current Medical Journal, 4*(2): 185-189

Gu, L., Xu, F., & Yuan, J. (2018). Comparison of AIMS65, Glasgow-Blatchford and Rockall scoring approaches in predicting the risk of in-hospital death among emergency hospitalized patients with upper gastrointestinal bleeding: a retrospective observational study in Nanjing, China. *BMC Gastroenterol, 18*(1):98. https://doi.org/10.1186/s12876-018-0828-5.

Jung, D.H., Ko, B.S., Kim, Y.J., & Kim, W.Y. (2019). Comparison of risk scores and shock index in hemodynamically stable patients presenting to the emergency department with nonvariceal upper gastrointestinal bleeding. *European Journal of Gastroenterology & Hepatology, 31*(7):781-785.

Kim, M.S., Choi, J., & Shin, W.C. (2019). AIMS65 scoring system is comparable to Glasgow-Blatchford score or Rockall score for prediction of clinical outcomes for non-variceal upper gastrointestinal bleeding. *BMC Gastroentero, 26;19*(1):136.

Lewis, J.D., Bilker, W.B., Brensinger, C., Farrar, J.T., & Strom, B.L. (2002). Hospitalization and mortality rates from peptic ulcer disease and GI bleeding in the 1990s: relationship to sales of nonsteroidal antiinflammatory drugs and acid suppression medicationsAmerican Journal of Gastroenterology, *97*:2540-2549.

Martínez-Cara, J.G., Jiménez-Rosales, R., Úbeda-Muñoz, M., de Hierro, M.L., de Teresa, J., & Redondo-Cerezo, E. (2016). Comparison of AIMS65, Glasgow-Blatchford score, and Rockall score in a European series of patients with upper gastrointestinal bleeding: performance when predicting in-hospital and delayed mortality. *United European Gastroenterology Journal, 4*(3):371-379. https://doi.org/10.1177/2050640615604779

Park, S.M., Yeum, S.C., Kim, B.W., Kim, J.S., Kim, J.H., Sim, E.H., Ji, J.S., & Choi, H. (2016). Comparison of AIMS65 Score and other scoring systems for predicting clinical outcomes in Koreans with nonvariceal upper gastrointestinal bleeding. *Gut and Liver, 10*(4): 526-531

Shafaghi, A., Gharibpoor, F., Mahdipour, Z., & Samadani, A.A. (2019). Comparison of three risk scores to predict outcomes in upper gastrointestinal bleeding; modifying Glasgow-Blatchford with albumin. *Romanian Journal of Internal Medicine, 57*(4):322-333. https://doi.org/10.2478

Stanley, A.J., Dalton, H.R., Glasgow-Blatchford, O., Ashley, D., Mowat, C., Cahill, A., Gaya, D.R., Thompson, E., Warshow, U., Hare, N., Groome, M., Benson, & G., Murray, W. (2011). Multicentre comparison of the Glasgow-Blatchford and Rockall Scores in the prediction of clinical end-points after upper gastrointestinal haemorrhage. *Aliment Pharmacol Ther, 34*(4):470–5.

Stanley, A.J., Laine, L., Dalton, H.R., Ngu, J.H., Schultz, M., Abazi, R., Zakko, L., Thornton, S., Wilkinson, K., Khor, C.J., Murray, I.A., Laursen, S.B. (2017). International Gastrointestinal Bleeding Consortium. Comparison of risk scoring systems for patients presenting with upper gastrointestinal bleeding: international multicentre prospective study. *BMJ, 4;*356:i6432. https://doi.org/10.1136/bmj.i6432.

Tang, Y., Shen, J., Zhang, F., Zhou, X., Tang, Z., & You, T. (2018). Comparison of four scoring systems used to predict mortality in patients with acute upper gastrointestinal bleeding in the emergency room. *Journal of Emergency Medicine, 36*(1):27-32. https://doi.org/10.1016/j.ajem.2017.06.053

Wang, C.H., Chen, Y.W., Young, Y.R., Young, C.J., & Chem, J.C. (2013). A prospective comparison of 3 scoring systems in upper gastrointestinal bleeding. *American Journal of Emergency Medicine 31*: 775–778

Zhong, M., Chen, W.J., Lu, X.Y., Qian, J., Zhu, C.Q. (2016). Comparison of three scoring systems in predicting clinical outcomes in patients with acute upper gastrointestinal bleeding: a prospective observational study. *Journal of Digestive Diseases, 17*(12):820-828. https://doi.org/10.1111/1751-2980.12433.