

ORIGINAL RESEARCH



Hemoglobin, albumin, lymphocyte and platelet (HALP) score effectiveness in peptic ulcer perforation

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Abstract

Background: Peptic ulcer perforation (PUP) has mortality rates up to 30%. This study aims to determine whether the “hemoglobin, albumin, lymphocyte and platelet” (HALP) score is effective in predicting morbidity and mortality of PUP cases. **Methods:** This retrospective study was conducted from January 2019 to September 2023, at the General Surgery Clinic of Isparta City Hospital. Patients included in this research underwent surgery after being diagnosed with PUP. Demographic data and HALP score were collected. To analyze the HALP score’s prognostic significance, Receiver Operating Characteristic (ROC) Curve analysis was performed, and a ROC curve was created. Sample size was calculated using G*Power program. **Results:** The study included 141 patients (112 males, 29 females), 55.97 ± 21.51 (18–97) years old. Patients with complications and mortality had lower HALP scores in comparison to patients without complications and mortality ($p < 0.001$). **Conclusions:** The HALP score is calculated with simple laboratory data and is a cheap and easy scoring system to predict post-surgical complications and mortalities in PUP patients.

Keywords

HALP score; Mortality; Morbidity; Surgery; Emergency; Peptic ulcer perforation

1. Introduction

Peptic ulcers (PU) are the duodenal or gastric mucosa’s erosions which extend into muscularis mucosa [1]. This pathology has conventionally been associated with acid hypersecretion, dietary factors, and stress [2, 3]. Nowadays, the increase in alcohol and cigarette use, the extensive usage of non-steroid anti-inflammation drugs, and the increasing incidence of *Helicobacter pylori* infections have changed the epidemiology of this disease [4]. Although there has been a significant decrease in the hospitalization and mortality rates in the last 30 years, complications are still encountered in 20–50% of these patients [5, 6].

Complications associated with PU disease (PUD) include gastric outlet obstruction, perforation, and bleeding [7]. PU perforation (PUP) has been a surgical emergency and linked with the morbidity rates of ~5–16% and mortality rates of 8.5–30% [6, 8–10].

PUP has been surgically treated since the late 1800s [11]. Surgical procedures involve the open or laparoscopic techniques [12]. Moreover, it is also suggested to employ scoring systems for predicting morbidity and mortality in PUP cases [7, 13].

HALP score being an immune-nutrient marker is employed in predicting prognosis of various malignant diseases. Chen et al. developed the HALP Score to prognose gastric cancer cases. The calculations are made by dividing the number of

hemoglobin (g/L), albumin (g/L) and lymphocyte (/L) by the number of platelet (/L) [14]. HALP score prognoses the malignant diseases. Studies also show that it is used to predict benign acute ischemic stroke, antineutrophil cytoplasmic antibody related vasculitis, acute heart failure and sleeve gastrectomy surgeries [15–18]. The immune nutrition status is an important parameter in PUP disease as is the case in cancer patients.

This work aims to explore if HALP score at the hospitalization is effective in predicting mortality and complications in patients operated because of PUP.

2. Materials and methods

2.1 Patients' selection

The data of 141 patients who underwent surgery alongside PUP diagnosis at the General Surgery Clinic of Isparta City Hospital between January 2019 and September 2023 had been investigated via the single-center retrospective cross-sectional study design. The size of sample was calculated as 134 patients employing the G*power program (version 3.1, Heinrich-Heine University of Dusseldorf, Dusseldorf, NRW, Germany), wherein the effect size value was taken as 0.3, α err probe as 0.05 and the power size as 0.95. Preoperative blood tests of the patients were performed. The study included the patients that had undergone primary closure because of PUP and had complete data available. Patients having perforation due to malignancy, multiple comorbidities, undergone combined sur-

gical procedures, without data, atypically located perforations such as jejunum ileum, gastrectomy and vagotomy, treated conservatively, and below 18 years age had been excluded from the current work.

2.2 Collecting data

Demographic data (gender, age), hospital stay duration, postoperative complications, preoperative findings (abscess, *etc.*), surgery techniques (laparoscopic, open), preoperative HALP scores and whether mortalities occurred, had been documented for patients involved in the study.

2.3 Study design

The HALP scores were calculated for all the patients. HALP score's cut-off value had been found as per the postoperative mortality and complications.

2.4 HALP scoring

HALP values were recorded from preoperative laboratory examinations. HALP scores were determined by hemoglobin (g/L) $\times$ albumin (g/L) levels $\times$ lymphocyte count (/L)/platelet count (/L). HALP scores' cut-off values were found based on the postoperative mortality and complications. HALP scores' cut-off values were determined by generating receiver operating characteristic (ROC) curve and ROC analysis.

2.5 Statistical analysis

Statistical analyses were performed by employing SPSS (SPSS Inc., Chicago, IL, USA) (version 20). The quantitative parameters' normal distribution was tested by Kolmogorov Smirnov test. In comparing the groups that survived and did not survive, with and without complications, the Mann Whitney-U test was employed for data not complying with normality, while the Independent Samples *T* test for data complying with normality. HALP scores' predictive function regarding mortality and complications was addressed by creating ROC curves. The statistical significance was set as $p < 0.05$.

3. Results

The study included 141 patients with average age 55.97 ± 21.51 (18–97) years, wherein 112 (79.4%) were men and 29 (20.6%) women. They were hospitalized for 8.99 (1–45) days on average. Pneumoperitoneum had been found in 100% patients in plain radiography, posterior-anterior chest radiography and/or Computed Tomography (CT). All patients underwent emergency surgery on the first day of their hospitalization after diagnosis. Laparoscopic surgery was performed on 36 patients and open surgery on 105 patients. All cases underwent Graham's omental patch repair. No patient had malignancy, chronic liver disease or active Acquired Immune Deficiency Syndrome (AIDS). In the postoperative period, mortality occurred in 16 (11.3%) patients, either in 30 days or during the same admission period. Patients undergone mortality included 5 women and 11 men. The average age of mortality patients was 73.38 ± 16 years. The highest prevalence among postoperative complications was the wound infection and detected

in 22 patients. Additionally, lung complications were detected in 8 patients, intra-abdominal abscess in 4, ileus in 3 and eventration in 8. Two of these patients were re-operated (1 ileus, 1 repair leak) (Table 1).

The median HALP score had no significant difference in its distribution according to gender groups. However, HALP score distribution had significant difference according to complication groups. HALP scores had been significantly lower in patients having complications compared to patients without complications. Moreover, the HALP score had a significant relationship with hospital mortality. Significantly lower HALP scores had been detected for patients having hospital mortality in comparison to the patients without hospital mortality (Table 2).

HALP score's cut-off value was found as per the mortality and postoperative complications. The HALP score cut-off value was ≤ 0.1375 in those who led to mortality and ≤ 0.1605 who developed complications (Table 3, Figs. 1,2).

4. Discussion

The current study evaluates HALP score's prognostic value in patients operated because of PUP. The obtained data demonstrate that the HALP score is linked to both postoperative complications and mortality.

The PUD prevalence is around 1500–3000 per 100,000 individuals, and lifetime probability of PUD development is ~5% [19]. There has been a decrease in PU surgery due to the use of proton pump inhibitors. However, the perforation rate in PUD remains at an high level of 7% per year [20]. PUP is prevalent in the fourth and fifth decades. The average age of patients in this study is 55.97, which is in accordance with the literature. This study is male-dominated like those in the literature, and male to female proportion is 3.86/1.0.

There are many systems of scoring employed for predicting mortality and morbidity in PUP patients. Thorsen et al. have conducted the meta-analysis to compare 10 scoring systems (Boey score, Hacettepe score, Jabalpur score, PUP score, American Society of Anesthesiologists (ASA) score, Charlson comorbidity index, Sepsis score, Mannheim Peritonitis Index (MPI), Acute physiology and chronic health evaluation II (APACHE II), Simplified acute physiology score II (SAPS II), Mortality probability models II (MPM II), Physiological and operative severity score for the enumeration of mortality and morbidity physical sub-score (POSSUM-phys score). The rates of morbidity and mortality vary from 0.63–0.98 as evaluated from the area under the curve (AUC) values. However, many of these scoring systems are difficult to implement and the scoring system is complex [21]. In this study, the AUC values for mortality and morbidity are 0.8 and 0.78, respectively. The study herein shows that postoperative morbidity and mortality can be predicted by HALP score.

The postoperative mortality rate for PUP varies between 4% and 30%, and the morbidity rate between 20% and 50% [22]. Factors affecting mortality and morbidity in PUP have been determined in several studies. The most common are being over 65 years age, male gender, PUD, smoking, delayed presentation, presence of shock findings and the size of perforation [23–25]. There are contradictory results in the studies

TABLE 1. Patients' clinical and demographic data.

Variables	Data
Age, year, mean $\pm$ SD, distribution	55.97 $\pm$ 21.51 (18–97)
Gender, n (%)	
Male	112 (79.4%)
Female	29 (20.6%)
Hgb, g/dL, mean $\pm$ SD, distribution	13.61 $\pm$ 2.44 (6.7–18.9)
Albumin, g/dL, mean $\pm$ SD, distribution	3.64 $\pm$ 0.76 (1.70–4.90)
Lymphocyte, $10^3/\mu\text{L}$, mean $\pm$ SD, distribution	1.50 $\pm$ 1.18 (0.14–7.62)
Platelet, $10^3/\mu\text{L}$, mean $\pm$ SD, distribution	295.87 $\pm$ 122.92 (52–722)
HALP Score, mean $\pm$ SD, distribution	0.32 $\pm$ 0.35 (0.01–2.63)
Complication, n (%)	
No	103 (73%)
Yes	38 (27%)
Hospital mortality, n (%)	
No	125 (88.7%)
Yes	16 (11.3%)
Hospitalization, days, mean $\pm$ SD, distribution	8.99 $\pm$ 7.04 (1–45)
Surgical technique	
Open	106
Laparoscopic	35

SD: standard deviation; HALP: Hemoglobin, albumin, lymphocyte, and platelet.

TABLE 2. Distribution of clinico-pathologic factors according to HALP scoring system.

Clinico-pathologic factors	HALP score, median, range	<i>p</i> value
Gender, n (%)		
Male	0.22 (0.02–2.63)	0.491 ^U
Female	0.25 (0.01–2.09)	
Complication, n (%)		
No	0.26 (0.02–2.63)	<0.001 ^U
Yes	0.10 (0.01–0.43)	
Hospital mortality, n (%)		
No	0.25 (0.01–2.63)	<0.001 ^U
Yes	0.05 (0.02–0.89)	

^U: Mann Whitney U test. HALP: Hemoglobin, albumin, lymphocyte, and platelet.

TABLE 3. HALP score cut-off values to detect postoperative mortality and complications.

	AUC (95% CI)	Cut-off	Sensitivity (%)	Specificity (%)	<i>p</i> value
Mortality	0.80 (0.66–0.94)	0.1375	71.4	74.2	<0.001
Complications	0.78 (0.70–0.85)	0.1605	71.1	71.8	<0.001

AUC: Area under the curve; CI: Confidence interval.

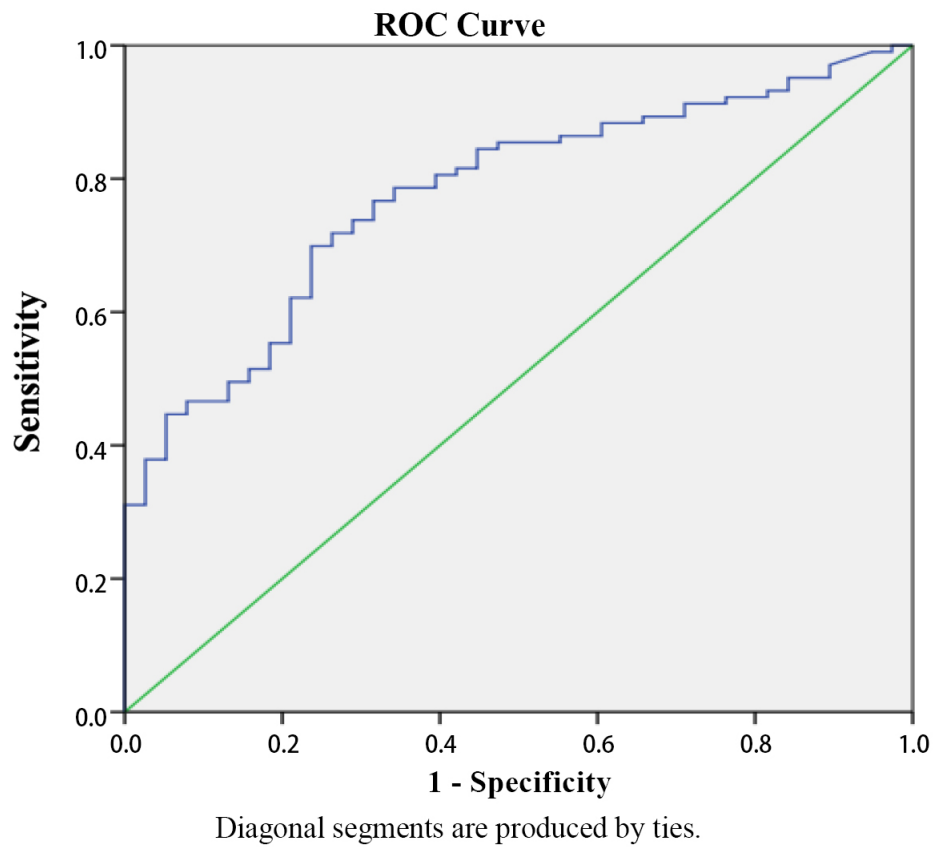


FIGURE 1. ROC curve due to complications. ROC: receiver operating characteristic.

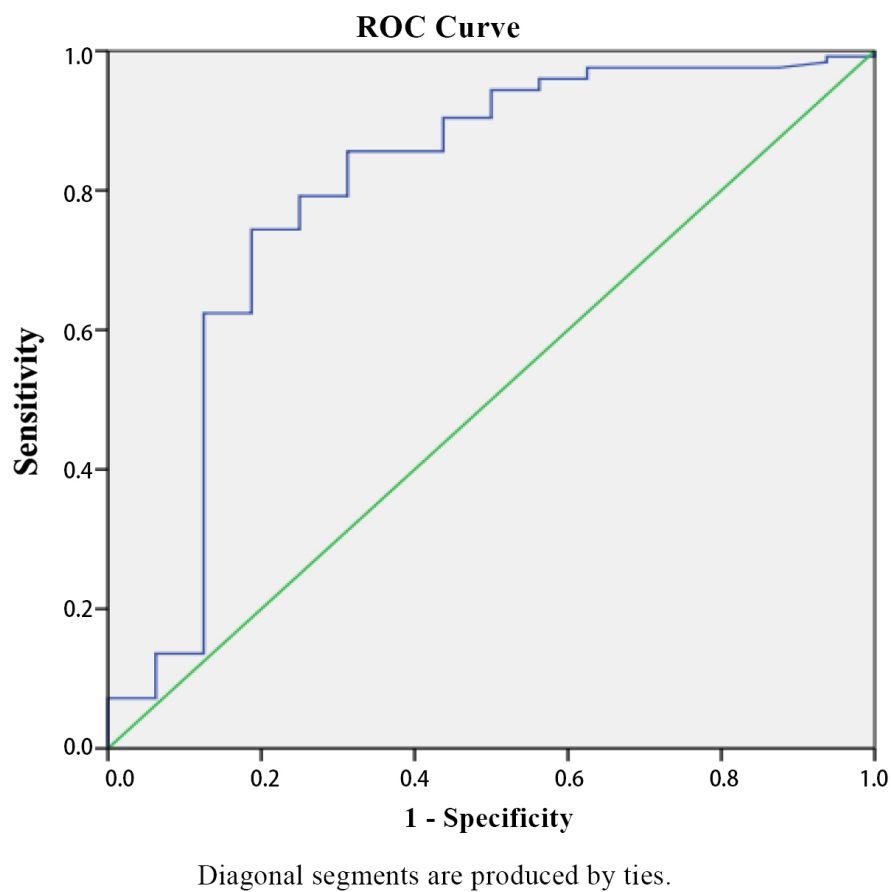


FIGURE 2. ROC curve due to mortality. ROC: receiver operating characteristic.

on relationship between age and HALP, which are among the most important factors affecting mortality in PUP. Eight studies have found significant differences between HALP and age. Five articles have shown that HALP score decreases with the increase in age. Two articles have reported opposite results. No statistically significant difference is shown regarding age in 15 articles [26]. Although there is a difference in the HALP score for gender, however the current results show that this does not significantly affect the utility of HALP as a biomarker [26]. The HALP score of smoking as another prognostic factor is higher than that of non-smokers. They attributed this to the increase in hemoglobin values [27]. Smoking is excluded in this study due to lack of retrospective data. Delayed perforation time, perforation size, and presence of shock findings are the indicators of sepsis because of PUP. Li *et al.* [28] have shown the prognostic potential of HALP score in predicting the outcomes of sepsis patients. Similarly, the study herein has found that HALP score is compatible with the literature in terms of PUP prognosis. This is because of the possible sepsis findings in patients who developed morbidity and mortality. The mortality rate in this study is found as 11.3% and the morbidity rate as 27%. Patients' average age developing mortality is 73.38 and more common in male patients, which is consistent with the literature.

The current topics include postoperative results of patients operated for malignancy and the link between nutritional and inflammatory factors. HALP score is also a new indicator for measuring systemic inflammation and nutritional status [29]. Studies have begun in recent years to examine HALP score effectiveness in predicting complications and mortality due to benign diseases. Güler *et al.* [30] have stated that short-term mortalities in Acute Pancreatitis patients can be predicted by HALP score. Benli *et al.* [31] have determined that HALP score is inexpensive, easily applicable, and simple diagnostic method showing the extent of complications related to acute appendicitis. Scanning of literature reveals that this is the first study to evaluate its effectiveness in PUP patients. Outcomes show the potential of HALP score in predicting mortality and detect the possibility of complications. Mortality and morbidity rates increase significantly in the postoperative period in patients with low HALP scores calculated preoperatively (<0.14). Therefore, multimodal treatment methodology can be planned by creating high and low risk patient groups based on HALP scores. The possible mortality and morbidity rates can thus be reduced.

This study has several limitations. It includes a small number of patients and is designed as retrospective study at a single center. It cannot be evaluated in this work whether there is a relationship between HALP score and the size of perforation, which has been associated with morbidity and mortality in previous studies and the time to hospital admission after perforation. Another limitation is the methodology of operation. This may vary according to the surgeon's technical preference, experience, and perioperative patient management. The reason for selecting surgical technique cannot be revealed due to the retrospective nature of medical records. It is thus recommended that multicentered prospective studies should be designed and executed for larger patient population in future. This approach can assess the reliability and accuracy of asso-

ciation between HALP score and postoperative results in PUP treatment. According to literature, HALP score is the only study carried on peptic ulcer perforation as a benign disease.

5. Conclusions

Through this study, HALP score as a new biomarker is generated based on the data achieved from simplified laboratory values. It is a simple, inexpensive, and easy scoring system used to predict mortality and post-surgical complications in PUP patients. The HALP score can be used for the timely identification of PUP patients who may be at risk of mortality and morbidity and for the implementation of intensive therapeutic interventions.

ABBREVIATIONS

HALP Score, Hemoglobin, Albumin, Lymphocyte, And Platelet (HALP) Score; PUP, Peptic ulcer perforation; PUD, Peptic ulcer disease; PU, Peptic ulcer; CT, computed tomography; ASA score, American society of anesthesiologists score; ROC, Receiver operating characteristics curve; AUC, Area under the curve; MPI, Mannheim peritonitis index; APACHE II, Acute physiology and chronic health evaluation II; SAPS II, Simplified acute physiology score II; MPM II, Mortality probability models II; POSSUM-phys score, Physiological and operative severity score for the enumeration of mortality and morbidity phys score; AIDS, Acquired Immune Deficiency Syndrome; SD, Standard Deviation; CI, Confidence interval.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

OB—Manuscript editing; Quality control of data and algorithms; Study concepts and design; Manuscript review. GÇ—Statistical analysis and preparation; Study concepts and design.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was reviewed and approved by the Ethics Committee of the Süleyman Demirel University Faculty of Medicine (Approval No: 29.12.2023-318). Consent for participation was obtained from all subjects.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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