



# The Glasgow Prognostic Score (GPS) May Serve as a Prognostic Indicator in ST-Elevation Myocardial Infarction (STEMI) Patients Undergoing Emergency Coronary Artery Bypass Graft Surgery

Glasgow Prognostik Skoru (GPS) Acil Koroner Arter Bypass Greft Cerrahisi Geçiren ST-Yükselmeli Miyokard Enfarktüsü (STEMİ) Hastalarında Prognostik Bir Gösterge Olabilir

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## ABSTRACT

**Objective:** Ischemic heart disease remains a leading cause of death worldwide. Emergency coronary artery bypass grafting (CABG) is life-saving for ST-elevation myocardial infarction (STEMI) patients unsuitable for percutaneous coronary intervention. This study aimed to evaluate the Glasgow prognostic score (GPS) as a predictor of in-hospital mortality in STEMI patients undergoing emergency CABG. GPS, calculated from serum C-reactive protein (CRP) and albumin levels, reflects systemic inflammation and nutritional status.

**Methods:** A retrospective analysis included 112 STEMI patients who underwent emergency CABG within 6 hours of symptom onset (2010-2023). Patients were stratified into survivors (n=99)

## ÖZ

**Amaç:** İskemik kalp hastalığı dünyada önde gelen ölüm nedenidir. ST-yükselmeli miyokard enfarktüsü (STEMİ) hastalarında acil koroner arter bypass greft cerrahisi (CABG), perkütan koroner girişim (PCI) uygun olmayan anatomili veya mekanik komplikasyonlu olgularda hayat kurtarıcıdır. Bu çalışmanın amacı, acil CABG uygulanan STEMI hastalarında Glasgow prognostik skorunun (GPS) hastane içi mortaliteyi öngörmedeki rolünü değerlendirmektir. GPS, serum CRP ve albümin düzeyleriyle hesaplanan, enflamasyon ve nutrisyonel durumu yansıtan basit bir prognostik göstergedir.

**Yöntemler:** 2010-2023 yılları arasında acil serviste STEMI tanısı alan, PCI için uygun olmayan ve semptom başlangıcından 6

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**ABSTRACT**

and non-survivors (n=13) based on in-hospital mortality. GPS was categorized (0-2) using albumin (<3.5 g/dL) and CRP (>10 mg/L). Statistical analyses were performed using SPSS 26.0.

**Results:** Non-survivors had significantly higher GPS  $\geq 1$  (76.9% vs. 31.3%,  $p=0.001$ ). Multivariate analysis identified GPS as an independent predictor of mortality [hazard ratio (HR)=12.820,  $p=0.037$ ]. Other independent predictor: The Society of Thoracic Surgeons (STS) score (HR =1.565,  $p=0.041$ ). Non-survivors also exhibited: reduced left ventricular ejection fraction (34.6% vs. 45.5%,  $p<0.001$ ), elevated white blood cell (21.4 vs.  $12 \times 10^6/L$ ,  $p<0.001$ ), and hemodynamic instability (30.8% vs. 3%,  $p=0.003$ ).

**Conclusion:** GPS is a simple, accessible, and independent indicator of in-hospital mortality in STEMI patients requiring emergency CABG. Combining GPS with the STS score may enhance risk stratification and postoperative prognosis prediction. Validation in larger cohorts is warranted. They also had lower glomerular filtration rates ( $60.7 \pm 32.9$  vs.  $86.6 \pm 22.3$  mL/min/1.73 m<sup>2</sup>,  $p<0.001$ ).

**Keywords:** Emergency CABG, ST-elevation myocardial infarction, Glasgow prognostic score, in-hospital mortality, risk stratification

**ÖZ**

saat içinde acil CABG uygulanan 112 hasta retrospektif olarak incelendi. Hastalar, birincil sonlanım noktası (hastane içi mortalite) temelinde sağ kalanlar (n=99) ve sağ kalmayanlar (n=13) olarak iki gruba ayrıldı. GPS, serum albümin (<3,5 g/dL) ve CRP (>10 mg/L) düzeylerine göre kategorize edildi (GPS 0-2). İstatistiksel analizlerde SPSS 26.0 kullanıldı.

**Bulgular:** Hayatta kalmayan grubunda GPS  $\geq 1$  oranı anlamlı derecede yüksekti (%76,9 vs. %31,3,  $p=0,001$ ).

GPS, çok değişkenli analizde hastane içi mortalitenin bağımsız öngördürücüsü olarak saptandı [risk oranı (HR)=12,820,  $p=0,037$ ].

Diğer bağımsız prediktör: Göğüs Cerrahları Derneği (STS) skoru (HR =1,565,  $p=0,041$ ). Hayatta kalmayan grubunda ayrıca: düşük sol ventrikül ejeksiyon fraksiyonu (%34,6 vs. %45,5,  $p<0,001$ ), yüksek beyaz kan hücresi ( $21,4$  vs.  $12 \times 10^6/L$ ,  $p<0,001$ ) ve hemodinamik instabilite (%30,8 vs. %3,  $p=0,003$ ) görüldü.

**Sonuç:** GPS, acil CABG gerektiren STEMI hastalarında hastane içi mortalitenin basit, erişilebilir ve bağımsız bir belirtecidir. Klinikte risk stratifikasyonu için GPS ve STS skorunun birlikte kullanımı, postoperatif prognozu öngörmeye değerli bir araç olabilir. Bu bulguların daha geniş kohortlarda doğrulanması önerilir. Ayrıca glomerüler filtrasyon hızları daha düşüktü ( $60,7 \pm 32,9$  vs.  $86,6 \pm 22,3$  mL/dk/1,73 m<sup>2</sup>,  $p<0,001$ ).

**Anahtar Kelimeler:** Acil koroner arter bypass cerrahisi, ST-yükselmeli miyokard enfarktüsü, Glasgow prognostik skoru, hastane içi mortalite, prognostik belirteç

**Introduction**

Despite advances in the diagnosis and invasive treatments of ischemic heart disease, it remains the leading cause of death worldwide. Most of these deaths stem from acute ST-segment elevation myocardial infarction (STEMI) and its complications. While primary percutaneous coronary intervention (PCI) is the recommended alternative treatment for acute STEMI, emergency coronary artery bypass graft (CABG) surgery is indicated for patients with anatomy unsuitable for PCI, particularly those with life-threatening myocardial infarction involving complex arterial systems (such as left main disease or multivessel disease) or mechanical complications (1).

Although various studies have evaluated prognostic factors, risk scores, and clinical outcomes in STEMI patients undergoing emergency CABG, most have predominantly focused on anatomical factors. Clinical parameters such as age, creatinine clearance, and left ventricular ejection fraction (LVEF), combined with the angiographic SYNTAX score in the logistic clinical SYNTAX score (log CSS), are known mortality predictors in this population (2).

The Glasgow prognostic score (GPS), a calculated index based on serum C-reactive protein (CRP) and albumin levels, reflects systemic inflammatory activity and nutritional status. It has proven to be a valuable prognostic indicator widely used to determine prognosis in various diseases and surgical interventions

(3). Numerous studies have confirmed its utility in terminal malignancy and the postoperative period (4).

Opportunities exist to explore the association between clinical data at the time of emergency department presentation (beyond individual risk parameters) and persistent independent outcome following emergency revascularization with CABG. This study enables the assessment of the relationship between patients' systemic inflammatory profile and nutritional status at presentation and in-hospital mortality.

**Methods**

Between 2010 and 2023, a total of 124 patients who presented to the emergency department with STEMI, had the diagnosis confirmed by electrocardiogram (ECG), underwent emergency angiography, and subsequently underwent emergency CABG within 6 hours due to anatomy unsuitable for PCI, were retrospectively analyzed. After excluding patients with mechanical complications of STEMI or those requiring concomitant significant valve surgery, 112 patients were included.

Patient demographic information, established risk factors (age, family history, smoking status, hyperlipidemia, hypertension, diabetes), and admission laboratory results were obtained through systematic retrospective review of hospital records. The study protocol was approved by the Local Ethics Committee Scientific Research Ethics Committee of University of Health Sciences

Türkiye, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (decision no: 2025.04-27, date: 27.06.2025) and was conducted in accordance with the Helsinki Declaration, good practice guidelines, and International Council for Harmonisation guidelines.

STEMI ECG criteria (5): new ST-segment elevation at the J-point in  $\geq 2$  contiguous leads with cut-off points of:

- >0.1 mV in all leads except V2-V3
- >0.2 mV in men  $\geq 40$  years (V2-V3)
- >0.25 mV in men <40 years (V2-V3)
- >0.15 mV in women (V2-V3)

Cardiogenic shock was defined as (6): cardiac arrest, or systolic blood pressure <90 mmHg (persisting despite adequate fluid resuscitation) requiring vasopressors, PLUS signs of end-organ hypoperfusion (altered mental status, oliguria/anuria, elevated serum lactate). The primary end point was in-hospital mortality. Patients were stratified into two groups (survivors vs. non-survivors) and compared for: in the differential diagnosis process, acute pulmonary embolism was systematically excluded in line with the 2019 European Society of Cardiology pulmonary embolism guideline recommendations (4).

- Demographic characteristics
- Cardiovascular risk factors
- Intraoperative parameters
- GPS

GPS calculation (7): the GPS is a prognostic marker reflecting cumulative inflammatory/nutritional status via serum CRP and albumin levels. The cut-off values used - albumin  $\leq 3.5$  g/dL (hypoalbuminemia) and CRP  $\geq 10$  mg/L (significant systemic inflammation) - are standard values derived from the original definition of GPS and widely accepted in the literature for various clinical prognoses (5).

- **Cut-off values:** Albumin  $\leq 3.5$  g/dL; CRP  $\geq 10$  mg/L
- **GPS 0:** Normal albumin + normal CRP
- **GPS 1:** Normal albumin + elevated CRP **or** low albumin + normal CRP
- **GPS 2:** Low albumin + elevated CRP

### Statistical Analysis

The statistical analysis of the research was performed using Statistical Package for the Social Sciences version 26.0 (SPSS Inc., Chicago, Illinois, USA). To assess the normal distribution of variables, visual methods such as histograms and probability plots were employed alongside the Kolmogorov-Smirnov test. Numerical variables following a normal distribution were presented as mean  $\pm$  standard deviation, while those not following a normal distribution were presented as median (interquartile

range). Categorical variables were expressed as percentages (%). Numerical variables were compared between two groups using the unpaired Student's t-test and Mann-Whitney U test based on the distribution. Categorical variables were compared using the chi-square or Fisher's exact test. To identify determinants of in-hospital mortality, we employed both univariate and multivariate Cox proportional hazards regression models, calculating hazard ratios (HR) and 95% confidence intervals (95% CI). The time-to-event was defined as the duration from the emergency CABG surgery to either in-hospital death (event) or hospital discharge (censored). A significance level of less than 0.05 was considered throughout the study.

### Results

A total of 112 patients were included in the study, comprising 99 survivors and 13 non-survivors. The mean age of the study cohort was  $57.6 \pm 12$  years, with a male predominance (68.8%). Demographic characteristics and comorbidities [hypertension, peripheral artery disease (PAD), etc.] were similarly distributed between the two groups (all  $p > 0.05$ ). However, the non-survivor group had significantly higher rates of hemodynamic instability (30.8% vs. 3%,  $p = 0.003$ ) and failed PCI (46.2% vs. 18.2%,  $p = 0.021$ ).

Regarding laboratory findings, non-survivors exhibited significantly elevated white blood cell (WBC) counts and glucose levels ( $p < 0.001$  for both). Additionally, non-survivors had lower glomerular filtration rates (GFR) ( $60.7 \pm 32.9$  vs.  $86.6 \pm 22.3$  mL/min/1.73 m<sup>2</sup>,  $p < 0.001$ ) and significantly reduced LVEF ( $34.6\% \pm 4.3\%$  vs.  $45.5\% \pm 6.9\%$ ,  $p < 0.001$ ).

Comorbidities such as hypertension, PAD, and chronic obstructive pulmonary disease and the baseline demographics, clinical and laboratory characteristics of the study groups are summarized in Table 1.

Table 2 shows the distribution of culprit lesions and intraoperative and postoperative characteristics of the study groups. Regarding the intraoperative data, the average aortic cross-clamp time was significantly shorter in the non-survivor group ( $36.2 \pm 15.9$  min vs.  $48 \pm 18.4$  min.,  $p = 0.030$ ). There was no significant difference in cardiopulmonary bypass (CPB) time between the two groups. Non-survivors required more intra-aortic balloon pump support (69.2% vs. 34.3%,  $p = 0.015$ ) and had a longer intensive care unit stay (6 days vs. 2 days,  $p = 0.027$ ). Ventilation time was also significantly longer in the non-survivor group (28 hours vs. 9 hours,  $p < 0.001$ ). The postoperative drainage volume and hospital stay duration were similar between the groups.

In the univariate Cox regression analysis, low LVEF, low GFR, high Killip class, high GPS, and high Society of Thoracic Surgeons (STS) score were significant predictors of in-hospital mortality. However, in the multivariate Cox regression model, only high GPS (HR = 12.820,  $p = 0.037$ ) and high STS score (HR = 1.565,  $p = 0.041$ ) remained as persistent and independent predictors of mortality (Table 3). The distribution of the GPS in hospital survivors and non-survivors is shown in Figure 1.

**Table 1.** The baseline demographics, clinical and laboratory characteristics of the study groups

|                                                      | All patients<br>(n=112) | Survivors<br>(n=99) | Non-survivors (n=13) | p-value          |
|------------------------------------------------------|-------------------------|---------------------|----------------------|------------------|
| Age, years (mean $\pm$ SD)                           | 57.6 $\pm$ 12           | 57.6 $\pm$ 11.6     | 57 $\pm$ 15.2        | 0.858            |
| Gender (male), n (%)                                 | 77 (68.8)               | 68 (68.7)           | 9 (69.2)             | 0.968            |
| BMI (mean $\pm$ SD)                                  | 26.1 $\pm$ 3.5          | 26.1 $\pm$ 3.5      | 26.5 $\pm$ 3.5       | 0.650            |
| Hypertension, n (%)                                  | 33 (29.5)               | 28 (28.3)           | 5 (38.5)             | 0.449            |
| PAD, n (%)                                           | 17 (15.2)               | 14 (14.1)           | 3 (23.1)             | 0.399            |
| CVD, n (%)                                           | 9 (8)                   | 8 (8.1)             | 1 (7.7)              | 1                |
| COPD, n (%)                                          | 16 (14.3)               | 14 (14.1)           | 2 (15.4)             | 0.904            |
| Atrial fibrillation, n (%)                           | 9 (8)                   | 8 (8.1)             | 1 (7.7)              | 0.961            |
| Smoking, n (%)                                       | 32 (28.6)               | 29 (29.3)           | 3 (23.1)             | 0.641            |
| WBC, 10 <sup>6</sup> /L (mean $\pm$ SD)              | 13.1 $\pm$ 6.6          | 12 $\pm$ 4.2        | 21.4 $\pm$ 13.1      | <b>&lt;0.001</b> |
| Hemoglobin, g/dL (mean $\pm$ SD)                     | 12.3 $\pm$ 2.6          | 12.5 $\pm$ 2.7      | 11.1 $\pm$ 1.4       | 0.066            |
| Platelets, 10 <sup>3</sup> / $\mu$ L (mean $\pm$ SD) | 239 $\pm$ 85.4          | 235.1 $\pm$ 82.5    | 269.1 $\pm$ 103.9    | 0.179            |
| Albumin, g/dL (mean $\pm$ SD)                        | 3.82 $\pm$ 0.58         | 3.86 $\pm$ 0.58     | 3.53 $\pm$ 0.52      | 0.061            |
| CRP, mg/L [median (IQR)]                             | 7.6 (3.6-9.8)           | 7.1 (3.4-9.3)       | 11.5 (4.4-53.9)      | 0.072            |
| Glucose, mg/dL (mean $\pm$ SD)                       | 176.2 $\pm$ 67.9        | 168 $\pm$ 57.9      | 238.4 $\pm$ 102.9    | <b>&lt;0.001</b> |
| Total cholesterol, mg/dL (mean $\pm$ SD)             | 189.1 $\pm$ 37.5        | 189.4 $\pm$ 39.3    | 186.5 $\pm$ 19.1     | 0.789            |
| LDL-C, mg/dL (mean $\pm$ SD)                         | 126.3 $\pm$ 32          | 126.8 $\pm$ 33.5    | 122.5 $\pm$ 16.8     | 0.653            |
| HDL-C, mg/dL (mean $\pm$ SD)                         | 38.3 $\pm$ 8            | 38 $\pm$ 8.1        | 40.7 $\pm$ 7.1       | 0.254            |
| Triglyceride, mg/dL (mean $\pm$ SD)                  | 173.2 $\pm$ 88.2        | 174.2 $\pm$ 91.5    | 165.2 $\pm$ 60.1     | 0.729            |
| Troponin, ng/mL [median (IQR)]                       | 0.13 (0.04-0.35)        | 0.12 (0.04-0.27)    | 0.38 (0.14-0.6)      | <b>0.011</b>     |
| GFR, mL/min/1.73 m <sup>2</sup> (mean $\pm$ SD)      | 83.6 $\pm$ 25           | 86.6 $\pm$ 22.3     | 60.7 $\pm$ 32.9      | <b>&lt;0.001</b> |
| LVEF, % (mean $\pm$ SD)                              | 44.2 $\pm$ 7.5          | 45.5 $\pm$ 6.9      | 34.6 $\pm$ 4.3       | <b>&lt;0.001</b> |
| Q wave on ECG                                        | 27 (24.1)               | 20 (20.2)           | 7 (53.8)             | <b>0.008</b>     |
| PR duration, ms (mean $\pm$ SD)                      | 149.9 $\pm$ 26.3        | 149.4 $\pm$ 26.1    | 153.5 $\pm$ 29.4     | 0.605            |
| QRS duration, ms (mean $\pm$ SD)                     | 90.7 $\pm$ 15.5         | 88.9 $\pm$ 14.6     | 104.4 $\pm$ 16       | <b>0.011</b>     |
| Heart rate, beats/min (mean $\pm$ SD)                | 84.7 $\pm$ 15.5         | 82.2 $\pm$ 14.5     | 103.5 $\pm$ 9.4      | <b>&lt;0.001</b> |
| Corrected QT duration, ms (mean $\pm$ SD)            | 441.3 $\pm$ 38.1        | 439.6 $\pm$ 37      | 453.9 $\pm$ 45       | 0.205            |
| Previous PCI, n (%)                                  | 18 (16.1)               | 15 (15.2)           | 3 (23.1)             | 0.436            |
| Failed PCI, n (%)                                    | 24 (21.4)               | 18 (18.2)           | 6 (46.2)             | <b>0.021</b>     |
| Previous stent thrombosis, n (%)                     | 17 (15.2)               | 16 (16.2)           | 1 (7.7)              | 0.687            |
| CPR before surgery, n (%)                            | 5 (4.5)                 | 2 (2)               | 3 (23.1)             | <b>0.011</b>     |
| Killip class, n (%)                                  |                         |                     |                      | <b>&lt;0.001</b> |
| I                                                    | 93 (83)                 | 90 (90.9)           | 3 (23.1)             |                  |
| II                                                   | 6 (5.4)                 | 3 (3)               | 3 (23.1)             |                  |
| $\geq$ III                                           | 13 (11.6)               | 6 (6.1)             | 7 (53.8)             |                  |
| CAD                                                  |                         |                     |                      | 0.074            |
| 1 vessel                                             | 12 (10.7)               | 8 (8.1)             | 4 (30.8)             |                  |
| 2 vessels                                            | 37 (33)                 | 35 (35.4)           | 2 (15.4)             |                  |
| 3 vessels                                            | 37 (33)                 | 33 (33.3)           | 4 (30.8)             |                  |
| $\geq$ 4 vessels                                     | 26 (23.2)               | 23 (23.2)           | 3 (23.1)             |                  |
| Cardiogenic shock, n (%)                             | 7 (6.3)                 | 3 (3)               | 4 (30.8)             | <b>0.003</b>     |
| STS score (mean $\pm$ SD)                            | 6.3 $\pm$ 2.3           | 6.1 $\pm$ 2.2       | 7.6 $\pm$ 2.7        | <b>0.024</b>     |
| GPS                                                  |                         |                     |                      | <b>0.003</b>     |
| 0                                                    | 71 (63.4)               | 68 (68.7)           | 3 (23.1)             |                  |
| 1                                                    | 28 (25)                 | 20 (20.2)           | 8 (61.5)             |                  |
| 2                                                    | 13 (11.6)               | 11 (11.1)           | 2 (15.4)             |                  |
| Glasgow prognostic score, n (%)                      |                         |                     |                      | <b>0.001</b>     |
| GPS=0                                                | 71 (63.4)               | 68 (68.7)           | 3 (23.1)             |                  |
| GPS $\geq$ 1                                         | 41 (36.6)               | 31 (31.3)           | 10 (76.9)            |                  |

Data are expressed as percentage, mean  $\pm$  SD, or median (interquartile range)

SD: Standard deviation, BMI: Body mass index, IQR: Interquartile range, CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease, CRP: C-reactive protein, CPR: Cardiopulmonary resuscitation, CVD: Cerebrovascular disease, ECG: Electrocardiogram, GFR: Glomerular filtration rate, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein cholesterol, LVEF: Left ventricular ejection fraction, PAD: Peripheral artery disease, PCI: Percutaneous coronary intervention, STS: Society of Thoracic Surgeons, GPS: Glasgow prognostic score, WBC: White blood cell

**Table 2.** The distribution of culprit lesion, intraoperative and postoperative characteristics of study groups

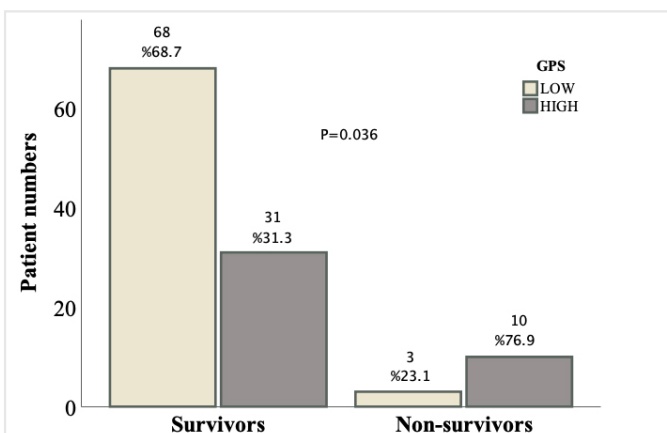
|                                     | All patients<br>(n=112) | Survivors<br>(n=99) | Non-survivors<br>(n=13) | p-value |
|-------------------------------------|-------------------------|---------------------|-------------------------|---------|
| Culprit lesion                      |                         |                     |                         | 0.678   |
| LMCA                                | 33 (29.5)               | 28 (28.3)           | 5 (38.5)                |         |
| LAD                                 | 77 (68.8)               | 69 (69.7)           | 8 (61.5)                |         |
| LCX                                 | 2 (1.8)                 | 2 (2)               | 0 (0)                   |         |
| RCA                                 | 0 (0)                   | 0 (0)               | 0 (0)                   |         |
| Intraoperative characteristics      |                         |                     |                         |         |
| ACC time (min.) (mean ± SD)         | 46.6±18.5               | 48±18.4             | 36.2±15.9               | 0.030   |
| CPB time (min.) (mean ± SD)         | 85.8±35.9               | 84.3±35.1           | 99.1±41                 | 0.231   |
| Grafts per patient (n) (mean ± SD)  | 2.72±1.02               | 2.76±0.99           | 2.46±1.2                | 0.325   |
| Postoperative characteristics       |                         |                     |                         |         |
| Drainage (mL) (mean ± SD)           | 641.3±160.7             | 633±157.5           | 704.6±177               | 0.132   |
| Hospital stay (days) (mean ± SD)    | 7.6±4                   | 7.5±3.6             | 7.9±6.9                 | 0.740   |
| IABP support                        | 43 (38.4)               | 34 (34.3)           | 9 (69.2)                | 0.015   |
| ICU stay (days) [median (IQR)]      | 2 (1-4)                 | 2 (1-4)             | 6 (1-15)                | 0.027   |
| Ventilation time (h) [median (IQR)] | 9 (7-17.3)              | 9 (6-12)            | 28 (22-105)             | <0.001  |

SD: Standard deviation, IQR: Interquartile range, ACC: Aortic cross-clamp, CPB: Cardiopulmonary bypass, IABP: Intra-aortic balloon pump, ICU: Intensive care unit, LAD: Left anterior descending artery, LCX: Left circumflex artery, LMCA: Left main coronary artery, RCA: right coronary artery

**Table 3.** Univariate and multivariate Cox proportional hazards regression analyses for predictors of in-hospital mortality

|                       | Univariate analysis |                         |         | Multivariate analysis |                         |         |
|-----------------------|---------------------|-------------------------|---------|-----------------------|-------------------------|---------|
|                       | HR                  | 95% CI<br>(lower-upper) | p-value | HR                    | 95% CI<br>(lower-upper) | p-value |
| LVEF                  | 0.750               | 0.652-0.862             | <0.001  | 0.831                 | 0.682-1.013             | 0.066   |
| GFR                   | 0.954               | 0.928-0.982             | 0.001   | 0.984                 | 0.943-1.026             | 0.453   |
| ICU stay              | 1.442               | 1.179-1.764             | <0.001  | 1.260                 | 0.890-1.784             | 0.192   |
| Killip class ≥III     | 18.083              | 4.606-71                | <0.001  | 7.812                 | 0.429-142.106           | 0.155   |
| High GPS              | 7.312               | 1.880-28.441            | 0.004   | 12.820                | 1.172-140.257           | 0.037   |
| STS score (mean ± SD) | 1.236               | 1.014-1.507             | 0.036   | 1.565                 | 1.020-2.402             | 0.041   |

SD: Standard deviation, HR: Hazard ratio, ICU: Intensive care unit, CI: Confidence interval, GFR: Glomerular filtration rate, GPS: Glasgow prognostic score, LVEF: Left ventricular ejection fraction, STS: Society of Thoracic Surgeons



**Figure 1.** Distribution of the Glasgow prognostic score (GPS) among in-hospital survivors and non-survivors. Bars denote percentages for GPS=0 and GPS ≥1 in each group; group comparison by chi-square test, p=0.001

A higher proportion of non-survivors had a GPS ≥1 (76.9% vs. 31.3% in survivors, p=0.001). Furthermore, the incidence of GPS =0 was significantly higher in survivors (68.7% vs. 23.1% in non-survivors).

## Discussion

Our study is among the first to demonstrate that the GPS is a strong and independent predictor of in-hospital mortality in a high-risk cohort such as STEMI patients undergoing emergency CABG. Our multivariate Cox regression analysis results showed that GPS independently predicted mortality (HR =12.820, p=0.037), alongside the STS score a comprehensive risk assessment tool. This finding underscores that risk models based solely on anatomical and standard clinical factors overlook the critical role of systemic inflammation and nutritional derangements in these patients' prognoses.

This prognostic value of GPS can be explained by its underlying biological mechanisms. STEMI and subsequent emergency CABG trigger a massive systemic inflammatory reaction. The significantly elevated WBC counts and blood glucose levels we observed in non-survivors are concrete manifestations of this inflammatory and metabolic stress. Elevated CRP levels reflect an exaggerated inflammatory response to extensive tissue injury. Conversely, hypoalbuminemia (low albumin levels) is not only a marker of poor nutritional status but also reflects impaired synthesis of this negative acute-phase reactant. Low albumin levels directly contribute to reduced oncotic pressure, impaired wound healing, increased capillary leakage, and heightened infection susceptibility. Thus, a high GPS represents a patient profile with diminished capacity to withstand surgical stress and depleted physiological reserves, making increased mortality risk biologically plausible.

Our findings align with other studies in the literature. As expected, the STS score remained a significant predictor of mortality. However, purely anatomical scores like the SYNTAX score are known to be inadequate for predicting prognosis after emergency CABG (8). Dynamic scores incorporating systemic status, like GPS, hold significant potential to fill this gap.

### Clinical Implications and Future Research

These results offer important insights for clinical practice. GPS is a cost-effective tool easily calculated from routinely measured CRP and albumin values. Targeted strategies could be developed for high-GPS patients ( $\text{GPS} \geq 1$ ), including closer postoperative monitoring, aggressive nutritional support protocols, and proactive screening for potential infection foci. This score may also aid in optimizing intensive care utilization. Future studies should validate our findings in larger, multicenter cohorts. Prospective investigations are needed to comparatively evaluate GPS against established prognostic scores like EuroSCORE II and test its discriminatory power using receiver operating characteristic curve analyses.

### Study Limitations

Our study has important limitations. First, its retrospective, single-center design carries inherent risks of selection bias. Second, the low event rate in the non-survivor group ( $n=13$ ) limits the robustness of our multivariate analyses and may affect generalizability. Third, the study spans a 13-year period (2010-2023). Evolving standards in CPB techniques, anesthesia management, and postoperative care during this timeframe represent a potential confounding factor. Finally, the prognostic value of GPS was not directly compared against other established risk scores like EuroSCORE II.

### Conclusion

In our study GPS emerged as an independent predictor of in-hospital mortality in STEMI patients undergoing emergency CABG. This finding demonstrates that GPS may offer potential utility for risk assessment in this high-risk cohort.

Incorporating scoring systems like GPS—which evaluate inflammation and nutritional status—into clinical decision-making could enhance prognosis prediction and postoperative management in emergency CABG patients. Clinically, GPS could be pragmatically integrated with existing anatomical and clinical risk scores (such as the STS score) to provide a more comprehensive risk profile. Patients with high GPS may benefit from intensified postoperative monitoring, nutritional support, and proactive complication management strategies. However, broader validation in larger cohorts and diverse subgroups is needed to fully establish GPS's clinical applicability.

### Ethics

**Ethics Committee Approval:** The study protocol was approved by the Local Ethics Committee Scientific Research Ethics Committee of University of Health Sciences Türkiye, Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (decision no: 2025.04-27, date: 27.06.2025).

**Informed Consent:** Retrospective study.

### Footnotes

### Authorship Contributions

Surgical and Medical Practices: M.Y.S., M.Y., S.A., Concept: N.U., A.S., S.A., Design: N.U., A.S., R.G., N.M., Data Collection or Processing: M.Y.S., R.G., Analysis or Interpretation: M.Y., S.A., N.M., Literature Search: M.Y.S., M.Y., N.M., Writing: N.U., A.S., R.G.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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