ORIGINAL ARTICLE
Turk J Surg

Pre-procedural predictors of in-hospital mortality in ICU patients undergoing endoscopic PEG placement

Mustafa Oruç[1], Eda Şahingöz[1], Ece Canpolat[1], Tezcan Akın[1], Serdar Gökay Terzioğlu[1], Erdinç Çetinkaya[2]

[1]Clinic of General Surgery, Ankara Bilkent City Hospital, Ankara, Türkiye
[2]Department of General Surgery, Hacettepe University Faculty of Medicine, Ankara, Türkiye

ABSTRACT

Objective: Percutaneous endoscopic gastrostomy (PEG) is widely used to provide long-term enteral nutrition in patients unable to maintain oral intake. However, PEG placement is already considered a high-risk intervention in the intensive care unit (ICU), where short-term mortality is substantial. This study aimed to identify predictors of in-hospital mortality in ICU patients undergoing PEG.

Material and Methods: A retrospective cohort study was conducted at a single tertiary center from 2019 to 2024, including all consecutive adult ICU patients who underwent endoscopic PEG. Demographic, clinical, laboratory, and procedural data were analyzed. The primary outcome was in-hospital mortality. Univariate and multivariate logistic regression analyses were used to identify independent predictors.

Results: A total of 364 ICU patients underwent PEG, of whom 125 (34.3%) died during the index hospitalization. Among non-survivors, 56 (44.8%) died within the first 14 days after PEG placement. Non-survivors showed lower albumin levels (24.4 vs. 28.2 g/L; p<0.001), higher urea concentrations (57.1 vs. 40.6 mg/dL; p<0.001), higher neutrophil-lymphocyte ratio (6.44 vs. 4.81; p=0.002), and more frequent infection at the time of PEG (88% vs. 58.6%; p<0.001). Prolonged mechanical ventilation (>14 days) was more common among non-survivors (23.2% vs. 11.7%; p=0.005). In the multivariate model, active infection [odds ratio (OR) 3.62; p<0.001], lower albumin (OR 0.90 per g/L; p<0.001), and higher urea (OR 1.02; p=0.05) independently predicted in-hospital mortality, whereas prolonged intubation showed a strong trend but did not reach significance (OR 1.85; p=0.06).

Conclusion: ICU patients with active infection, severe hypoalbuminemia, and elevated urea levels have a markedly increased risk of in-hospital mortality after PEG placement. Prolonged mechanical ventilation appears to characterize a clinically more fragile ICU population rather than serving as an independent predictor of mortality. Incorporating these objective markers into pre-procedural assessments may improve patient selection and support decision-making in the ICU.

Keywords: Gastrointestinal surgery, intensive care unit, percutaneous endoscopic gastrostomy

INTRODUCTION

Percutaneous endoscopic gastrostomy (PEG) is a commonly used procedure for providing long-term enteral nutrition to patients who cannot maintain adequate oral intake (1). In the critical care setting, PEG is frequently used for individuals with prolonged mechanical ventilation, severe neurologic impairment, or persistent dysphagia (2). Although the procedure is technically successful and often necessary for nutritional support, short-term mortality in critically ill patients remains high, with reported in-hospital mortality rates between ten and twenty five percent (3).

This substantial mortality risk raises critical clinical dilemmas. In some critically ill patients, PEG placement may occur during the advanced stages of systemic illness when the physiological reserve is severely compromised. In such cases, the procedure may not meaningfully alter the short-term clinical trajectory (4). This pattern underscores the need to better identify, prior to intervention, patients at particularly high risk of early in-hospital mortality following PEG placement.

This need is particularly urgent when PEG is performed late in the illness trajectory of high-risk intensive care unit (ICU) patients, such as those with multiorgan failure or ongoing systemic infection. Although several individual risk factors for poor outcomes in different populations have been identified, and ICU admission itself is associated with a twofold increase in mortality following PEG (5), comprehensive models integrating clinical and laboratory variables to stratify early mortality risk specifically within ICU populations remain limited (6).

Cite this article as: Oruç M, Şahingöz E, Canpolat E, Akın T, Terzioğlu SG, Çetinkaya E. Pre-procedural predictors of in-hospital mortality in ICU patients undergoing endoscopic PEG placement. *Turk J Surg.* [Epub Ahead of Print]

Corresponding Author
Mustafa Oruç

E-mail: mustafaorucmd@gmail.com
ORCID ID: orcid.org/0000-0002-7918-1689

Received: 29.12.2025
Accepted: 04.05.2026
Epub: 08.05.2026

DOI: 10.47717/turkjsurg.2026.2025-12-39

Available at **www.turkjsurg.com**

Therefore, the primary aim of this study was to identify pre-procedural clinical and laboratory markers associated with in-hospital mortality following PEG placement in ICU patients. By characterizing high-risk physiologic profiles, we sought to identify patients at substantial risk of death during index hospitalization, in whom the intended benefits of long-term enteral access may not be realized.

MATERIAL and METHODS

Study Design and Patient Population

This retrospective cohort study was conducted at a single tertiary care hospital between 2019 and 2024. All consecutive adult patients who underwent endoscopic PEG placement during ICU admission were evaluated. The majority of PEG placements occurred in patients admitted for non-surgical indications, predominantly severe neurologic conditions and prolonged ventilatory dependence; postoperative cases following major surgery were rare. Only PEG procedures performed by the general surgery department were included; gastrostomy procedures performed by other specialties or via radiologic or surgical techniques were excluded from the study. The primary outcome of the study was in-hospital mortality, defined as death from any cause during index hospitalization.

Patient Selection and Data Collection

Electronic medical records were reviewed to identify eligible patients. Demographic characteristics, body mass index (BMI), comorbidities, admission characteristics, indications for PEG, medication use (including antiplatelet and anticoagulant therapy), and prior surgeries were recorded. Laboratory parameters [hemoglobin, white blood cell count, platelets, neutrophil-to-lymphocyte ratio (NLR), albumin, liver enzymes, renal function markers, electrolytes, C-reactive protein (CRP), and international normalized ratio (INR)] were obtained from blood tests performed within 24 hours before the PEG procedure.

Definitions

Infection during PEG placement was defined as an active, culture-confirmed infection from any source (blood, sputum, urine, tracheal aspirate, or wound samples) requiring systemic antibiotic therapy at the time of PEG placement; infections with documented resolution or negative follow-up cultures before the procedure were not classified as active. Because standardized sepsis severity scores (e.g., SOFA or APACHE II) were not consistently available in this retrospective cohort, the infection status reflected treated infection rather than graded sepsis or septic shock. Prolonged mechanical ventilation or tracheostomy was defined as invasive mechanical ventilation or tracheostomy lasting >14 days, and this classification was used when prolonged ventilatory dependence was the primary indication for PEG. Multisystem disorder on admission referred to the presence of two or more acute organ dysfunctions at the time of hospital admission. In-hospital mortality was defined as death from any cause during index hospitalization.

Statistical Analysis

Statistical analyses were performed using R (version 4.1.1). Continuous variables were assessed for normality using the Shapiro-Wilk test and visual inspection of the distribution plots. Normally distributed variables are presented as mean ± standard deviation and compared between survivors and non-survivors using the independent samples t-test, while non-normally distributed data are reported as median and interquartile range and compared using the Mann-Whitney U test. Categorical variables were summarized as frequencies and percentages and analyzed using either the chi-square test or Fisher's exact test, depending on the expected cell counts.

Correlation analyses (Pearson or Spearman coefficients according to distribution) were performed to evaluate the relationships among continuous predictors and to assess potential collinearity before multivariable modeling. Variables with a p-value <0.10 in univariate comparisons, along with those considered clinically relevant, were entered into a binary logistic regression model to identify independent predictors of in-hospital mortality. The final multivariable model was derived using a backward stepwise elimination approach based on the lowest Akaike Information Criterion. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for each predictor. Multicollinearity was assessed using correlation matrices and variance inflation factors, and highly collinear variables were not included in the same model. The discriminative performance of the multivariate model was evaluated using receiver operating characteristic (ROC) analysis. All statistical tests were two-sided, and statistical significance was set at $p<0.05$.

Ethical Review

This retrospective study was conducted in accordance with the ethical standards of the Declaration of Helsinki. The study protocol was approved by the Institutional Review Board of the Ankara Bilkent City Hospital (number: 433, date: 07.08.2024). The requirement for informed consent was waived owing to the use of anonymized clinical data and the observational, retrospective design of the study.

Artificial Intelligence (AI) Use Statement

During the preparation of this manuscript, ChatGPT (OpenAI, GPT-5) was used solely for language editing and improvement of clarity. No AI tool was used for data collection, data analysis, interpretation of results, or generation of scientific conclusions.

All authors critically reviewed and verified the content and take full responsibility for the accuracy, integrity, and originality of the manuscript. The use of AI complied with ethical standards regarding confidentiality and data protection.

RESULTS

Study Population

A total of 364 patients underwent PEG placement, of whom 125 (34.3%) died during index hospitalization. Baseline demographics, including age and sex distribution, were similar between survivors and non-survivors. However, patients who died had a significantly higher BMI (25.15±4.79 vs. 26.76±4.73 kg/m^2; p=0.010) than those who survived. Several comorbid conditions were more frequent among non-survivors, including multisystem disorder on admission (61.2% vs. 45.4%; p=0.009), active chemotherapy (16.8% vs. 7.5%; p=0.01), diabetes mellitus (32.0% vs. 21.8%; p=0.030), heart failure (8.8% vs. 2.1%; p=0.003), and antiplatelet use (15.2% vs. 8.4%; p=0.045) (Table 1).

Laboratory Parameters

Non-survivors demonstrated a more severe inflammatory and metabolic profile than survivors. They had lower hemoglobin (9.0 vs. 9.7 g/dL; p<0.001), higher NLR (6.44 vs. 4.81; p=0.002), lower albumin (24.4 vs. 28.2 g/L; p<0.001), and higher urea (57.1 vs. 40.6 mg/dL; p<0.001) levels. INR and CRP levels were also significantly elevated in patients who died. ALP levels were higher in the mortality group (p=0.01) (Table 2).

PEG Related Characteristics

The indications for PEG differed between the groups. Patients who died were more likely to have prolonged intubation as the primary indication (23.2% vs. 11.7%, p=0.005), whereas survivors were more often referred for chronic oral intake disorders.

Table 1. Baseline demographics and comorbidities of PEG patients stratified by in-hospital mortality

Variable	Total (n=364)	Survived (n=239)	Exitus (n=125)	p-value
Age, years, mean ± SD	76±17	76±17	76±17	0.89
Male sex, n (%)	186 (51.1)	122 (51.0)	64 (51.2)	0.54
BMI, kg/m^2, mean ± SD	25.74±4.82	25.15±4.79	26.76±4.73	**0.01**
Glasgow Coma Scale <8, n (%)	110 (30.2)	75 (31.4)	35 (28.0)	0.50
Admission from emergency department, n (%)	308 (84.6)	205 (85.8)	103 (82.4)	0.39
Multisystem disorder on admission, n (%)	156 (50.6)	93 (45.4)	63 (61.2)	**0.009**
Cancer (any type), n (%)	66 (18.1)	39 (16.3)	27 (21.6)	0.21
Active chemotherapy, n (%)	39 (10.7)	18 (7.5)	21 (16.8)	**0.01**
Prior abdominal surgery, n (%)	36 (9.9)	20 (8.4)	16 (12.8)	0.17
Prior head/neck-esophageal surgery, n (%)	6 (1.6)	5 (2.1)	1 (0.8)	0.35
Previous PEG, n (%)	10 (2.7)	9 (3.8)	1 (0.8)	0.10
Hypertension, n (%)	180 (49.5)	113 (47.3)	67 (53.6)	0.25
Diabetes mellitus, n (%)	92 (25.3)	52 (21.8)	40 (32.0)	**0.030**
Coronary artery disease, n (%)	41 (11.3)	26 (10.9)	15 (12.0)	0.74
Prior stroke, n (%)	57 (15.7)	42 (17.6)	15 (12.0)	0.16
Atrial fibrillation, n (%)	21 (5.8)	13 (5.4)	8 (6.4)	0.70
COPD, n (%)	34 (9.3)	22 (9.2)	12 (9.6)	0.90
Heart failure, n (%)	16 (4.4)	5 (2.1)	11 (8.8)	**0.003**
Chronic kidney disease, n (%)	14 (3.8)	8 (3.3)	6 (4.8)	0.49
Dementia, n (%)	87 (23.9)	56 (23.4)	31 (24.8)	0.77
Parkinson's disease, n (%)	38 (10.4)	20 (8.4)	18 (14.4)	0.07
Epilepsy, n (%)	13 (3.6)	9 (3.8)	4 (3.2)	0.78
Hypothyroidism, n (%)	12 (3.3)	6 (2.5)	6 (4.8)	0.24
Anticoagulant use, n (%)	53 (14.6)	37 (15.5)	16 (12.8)	0.49
Antiplatelet use, n (%)	39 (10.7)	20 (8.4)	19 (15.2)	**0.04**
Steroid use, n (%)	5 (1.4)	3 (1.3)	2 (1.6)	0.56

BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, PEG: Percutaneous endoscopic gastrostomy, SD: Standard deviation.

Infection during PEG intervention was markedly more common in non-survivors than in survivors (88% vs. 58.6%; p<0.001). ICU length of stay was significantly longer among patients who died (median 45 vs. 40 days; p=0.03). The overall hospital stay did not differ significantly (Table 3). Among the 125 patients who died during the index hospitalization, 37 (29.6%) died within the first 7 days after PEG placement, 19 (15.2%) between days 8 and 14, and the remaining 69 (55.2%) after 14 days. When non-survivors were stratified according to time from PEG to death (≤14 days vs. >14 days), the prevalence of infection, as well as albumin and urea levels at the time of PEG placement, did not differ significantly between early and late deaths (all p>0.05).

Predictors of In-hospital Mortality

The univariate and multivariate analyses identifying predictors of in-hospital mortality among ICU patients undergoing PEG placement are summarized in Table 4. In univariate logistic regression, infection during PEG intervention showed one of the strongest associations, corresponding to a 5.18-fold increase in the mortality risk (p<0.001). Active chemotherapy (OR 4.08, p=0.010) and heart failure (OR 4.51, p=0.006) were also strongly associated with increased mortality rates. Prolonged intubation as an indication for PEG conferred a 2.71-fold increased risk of death (p<0.001). Diabetes mellitus (OR 1.69, p=0.030) and antiplatelet use (OR 1.96, p=0.040) were additional comorbidity-related predictors.

Laboratory variables demonstrated significant prognostic value: lower hemoglobin (OR 0.74 per g/dL), higher NLR (OR 1.03), reduced albumin (OR 0.88 per g/L), elevated urea (OR 1.02), higher INR (OR 13.2), and increased CRP levels (OR 1.01) were all associated with increased mortality in the univariate analysis.

In the multivariate model, three predictors remained significant. Lower albumin levels were strongly associated with mortality, with each 1 g/L decrease increasing the risk by approximately 10% (OR 0.90, p<0.001). Elevated urea level also independently predicted mortality (OR 1.02, p=0.05). Infection during the PEG procedure remained the most important independent predictor, increasing the odds of in-hospital death by more than three-fold (OR 3.62, p<0.001). Although prolonged intubation as an indication for PEG showed a trend toward significance, it did not retain statistical significance after adjustment (OR 1.85, p=0.06).

In the multivariate model, the area under the ROC curve was 0.761. Using a probability cut-off value of 0.50, the model demonstrated a sensitivity of 41.9% and specificity of 86.8% for predicting in-hospital mortality, with an overall classification accuracy of 71.3%.

DISCUSSION

This study of critically ill patients undergoing PEG in the ICU demonstrated a markedly high in-hospital mortality rate of 34.3 percent. This elevated rate likely reflects our study's specific

Table 2. Laboratory parameters in PEG patients stratified by in-hospital mortality

Variables	Total (n=364)	Survived (n=239)	Exitus (n=125)	p-value
Hemoglobin, g/dL, median (IQR)	9.3 (8.3-10.8)	9.7 (8.6-11.4)	9.0 (8-10)	**<0.001**
WBC, $\times10^9$/L, median (IQR)	8.07 (6.19-11)	7.8 (6.01-10.66)	8.6 (6.35-11.6)	0.12
Platelets, $\times10^9$/L, median (IQR)	274 (207-384)	283 (217-398)	261 (195-353)	0.06
NLR, median (IQR)	5.18 (3.08-9.07)	4.81 (2.8-8.6)	6.44 (3.75-10.89)	**0.002**
Albumin, g/L, median (IQR)	26.83 (22.55-31.20)	28.2 (24.48-33)	24.4 (21.75-28)	**<0.001**
ALT, U/L, median (IQR)	21 (14-35)	22 (14-36)	20 (13-33)	0.28
AST, U/L, median (IQR)	29 (19-42)	28 (18-42)	30 (19-42)	0.55
ALP, U/L, median (IQR)	96.5 (74-136)	93 (72-127)	106 (80-147)	**0.01**
GGT, U/L, median (IQR)	28.5 (17.5-57.5)	29 (18-55)	27 (16-61)	0.71
Creatinine, mg/dL, median (IQR)	0.60 (0.42-0.93)	0.59 (0.43-0.83)	0.62 (0.40-1.10)	0.15
Urea, mg/dL, median (IQR)	44.47 (29.96-68.48)	40.6 (25.6-59.9)	57.1 (36.3-98.4)	**<0.001**
INR, median (IQR)	1.20 (1.1-1.3)	1.18 (1.08-1.21)	1.20 (1.1-1.36)	**<0.001**
CRP, mg/L, median (IQR)	40 (10-90)	34 (10-70)	54 (15-119)	**0.003**
Sodium, mmol/L, mean ± SD	140.55±6.98	139.4±6.13	141.7±8.25	0.1
Potassium, mmol/L, mean ± SD	3.87±0.63	3.87±0.54	3.89±0.78	0.34
Chloride, mmol/L, mean ± SD	105.58±7.01	104.88±6.00	106.89±8.46	0.05
Magnesium, mg/dL, mean ± SD	1.72±0.32	1.74±0.31	1.69±0.33	0.19

ALP: Alkaline phosphatase, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, CRP: C-reactive protein, GGT: Gamma-glutamyl transferase, INR: International normalized ratio, IQR: Interquartile range, NLR: Neutrophil-to-lymphocyte ratio, SD: Standard deviation, WBC: White blood cell count.

focus on a high-risk inpatient cohort, as all patients were actively receiving ICU-level care at the time of the procedure, a population with greater baseline illness severity and physiological instability than those in other clinical settings. This rate significantly exceeds the previously reported ICU-specific mortality (30-day mortality of 14.8% in one surgical ICU cohort), likely reflecting differences in case mix, baseline illness severity, and the evaluation of in-hospital rather than 30-day mortality (7). While ICU status has already been described as "an indication to discourage physicians for PEG," our analysis identified a specific, higher-risk subgroup within this population (5). Non-survivors exhibited a distinct clinical profile characterized by a greater

Table 3. PEG procedure characteristics and clinical outcomes stratified by in-hospital mortality

Variables	Total (n=364)	Survived (n=239)	Exitus (n=125)	p-value
PEG indication, n (%) Neurological disorders Prolonged intubation Oral intake deficiency	 117 (32.1) 57 (15.7) 190 (52.2)	 74 (31) 28 (11.7) 137 (57.3)	 43 (34.4) 29 (23.2) 53 (42.4)	**0.005**
Infection during PEG intervention n (%)	250 (68.7)	140 (58.6)	110 (88)	**<0.001**
Time from admission to PEG, days, median (IQR)	25 (14-37)	23 (13-37)	26 (17-38)	0.18
Time from admission to PEG categorical, n (%) 0-15 days 15-30 days 31-45 days	 94 (25.8) 154 (42.3) 116 (31.9)	 67 (28) 101 (42.3) 71 (29.7)	 27 (21.6) 53 (42.4) 45 (36)	0.31
Peg to in hospital death, n (%) ≤7 days 8-14 days ≥15 days	 37 (10.2) 19 (5.2) 69 (19)		 37 (29.6) 19 (15.2) 69 (55.2)	
Multiple PEG attempt, n (%)	21 (5.8)	13 (5.4)	8 (6.4)	0.7
PEG complication, n, (%)	12 (3.3)	7 (2.9)	5 (4)	0.75
ICU stay, days, median (IQR)	43 (25-68)	40 (21-66)	45 (33-71)	**0.03**
Length of hospital stay, days, median (IQR)	45 (26-71)	41 (22-70)	46 (35-72)	0.08

ICU: Intensive care unit, IQR: Interquartile range, PEG: Percutaneous endoscopic gastrostomy.

Table 4. Univariate and multivariate logistic regression for in-hospital mortality after PEG placement

Variable	Univariate OR (95% CI)	p-value	Multivariate OR (95% CI)	p-value
Glasgow Coma Scale, <8	1.17 (0.70-1.89)	0.5	—	—
BMI, kg/m^2	1.07 (1.01-1.13)	**0.017**	—	—
Active chemotherapy	4.08 (1.35-12.3)	**0.010**	—	—
Diabetes mellitus	1.69 (1.04-2.75)	**0.030**	—	—
Heart failure	4.51 (1.53-13.3)	**0.006**	—	—
Antiplatelet use	1.96 (1.00-3.83)	**0.040**	—	—
Hemoglobin, g/dL	0.74 (0.65-0.85)	**<0.001**	—	—
NLR	1.03 (1.00-1.06)	**0.03**	—	—
Albumin, g/L	**0.88 (0.84-0.92)**	**<0.001**	**0.90 (0.86-0.95)**	**<0.001**
ALP, U/L	1.00 (1.00-1.00)	0.08	—	—
Urea, mg/dL	**1.02 (1.01-1.04)**	**<0.001**	**1.02 (1.01-1.03)**	**0.05**
INR	**13.2 (3.47-50.2)**	**<0.001**	—	—
CRP, mg/L	**1.01 (1.00-1.01)**	**<0.001**	—	—
Prolonged intubation	2.71 (1.48-4.94)	**<0.001**	1.85 (0.96-3.57)	0.06
Infection during PEG intervention	**5.18 (2.85-9.42)**	**<0.001**	**3.62 (1.93-6.80)**	**<0.001**

ALP: Alkaline phosphatase, BMI: Body mass index, CI: Confidence interval, CRP: C-reactive protein, GCS: Glasgow Coma Scale, INR: International normalized ratio, NLR: Neutrophil-to-lymphocyte ratio, OR: Odds ratio, PEG: Percutaneous endoscopic gastrostomy.

systemic illness burden, more pronounced inflammatory and metabolic derangements, and a significantly higher incidence of infection at the time of the procedure. These findings emphasize the importance of objective risk stratification when considering PEG placement in critically ill patients.

The presence of active infection during PEG intervention emerged as the most powerful independent predictor of in-hospital mortality in our cohort, increasing the odds of death by more than threefold. This finding is consistent with the previous literature, underscoring infection as a decisive prognostic marker. Studies have reported that aspiration pneumonia is associated with a 13.6-fold increase in 90-day mortality (8), while early PEG-site infection correlates with a 30-day mortality rate as high as 68% (9). This relationship is further quantified by inflammatory biomarkers; for instance, a CRP level ≥5 mg/dL is associated with a 3-fold increase in 30-day mortality (10). Our results confirm this evidence by demonstrating that any active systemic infection at the time of the procedure serves as a potent indicator of the severe underlying illness. Notably, when non-survivors were stratified according to the time from PEG to death, the infection rates did not differ significantly between early and late deaths, suggesting that infection does not merely identify patients undergoing PEG during imminent terminal deterioration. This suggests that performing an elective procedure, such as PEG, during a state of systemic inflammatory response may reflect the burden of acute physiological instability rather than a direct procedural effect. Consequently, active infection and systemic inflammation should prompt careful clinical reassessment of PEG timing and the overall goals of care.

Severe hypoalbuminemia emerged as a strong, independent predictor of in-hospital mortality in our cohort, reinforcing its role as a key prognostic marker. As an indicator of both nutritional status and systemic inflammation, albumin reflects the overall physiological reserve. Consistent with prior studies, levels below approximately 2.7 g/dL have been linked to more than double the 30 day mortality risk (9). Additionally, each 1 g/dL increase in albumin was associated with an 81 percent reduction in six-month mortality after PEG (8). This risk increases further when hypoalbuminemia is combined with systemic inflammation, such as elevated CRP levels, identifying patients with extreme frailty and catabolic stress (11). Mortality in such cases can exceed 70 percent, with a more than sevenfold increase in risk (9). In ICU patients, marked hypoalbuminemia, particularly when accompanied by infection or other signs of systemic illness, should be interpreted as a marker of increased mortality risk at the time of PEG decision-making and may warrant careful clinical consideration of the overall prognosis.

Elevated urea was also an important predictor of in-hospital mortality in our cohort, highlighting its prognostic role in patients with metabolic and renal dysfunction. This finding is consistent with previous studies in which elevated pre-procedural urea levels were independently associated with a four-fold increase in 30 day mortality (11,12). In critical illness, an elevated BUN concentration often reflects renal impairment, dehydration, and increased catabolic protein breakdown, all of which are indicative of severe physiological stress and multi-organ dysfunction (13). Consequently, a high urea level in a candidate for PEG may reflect reduced metabolic reserve at the time of decision-making. Together with the existing evidence, our results suggest that an elevated BUN level is associated with an increased risk of early mortality and warrants careful clinical consideration within the broader context of the patient's overall condition.

Our analysis identified several factors that were strongly associated with mortality in the univariate analysis but did not retain independent significance in the final model. For example, elevated CRP levels are well-established predictors of early mortality in many PEG studies (10,12). However, in our intensive care cohort, its effect was likely absorbed by the closely related presence of active infection and profound hypoalbuminemia, both of which are central components of the systemic inflammatory response. A prolonged INR, which marked the most critically ill patients in our sample, similarly reflects severe hepatic dysfunction or coagulopathy but did not provide additional prognostic information once the core markers of acute physiological derangement were included. The indication for PEG placement also played an important role; the need for prolonged mechanical ventilation demonstrated a strong unadjusted association with mortality and narrowly missed significance after adjustment, suggesting that the observed risk may be related to the concurrent burden of infection, organ failure, and malnutrition (14). This overall pattern, in which traditional risk factors, such as comorbidities, inflammatory markers, and coagulation abnormalities, lose their predictive strength once broader indicators of acute severity are considered, has been described in other critically ill populations (2,7). This reinforces that in the intensive care setting, the overall severity of illness driven by infection, poor nutrition, and metabolic stress may be more influential in predicting outcomes than any single diagnosis or laboratory value. Importantly, these findings should be interpreted as associations reflecting underlying vulnerability rather than evidence that PEG placement itself contributes causally to mortality.

Although our model demonstrated acceptable discrimination, its modest sensitivity indicates that it should be interpreted as identifying high-risk clinical profiles rather than excluding patients from PEG based solely on the predicted probability. Prior studies have attempted to define non-beneficial PEG placement using broad clinical categories such as advanced dementia, persistent vegetative state, or death within 30 days

of the procedure, identifying roughly ten percent of cases as potentially unnecessary in a general patient cohort (6,15). These observations highlight that clearer selection criteria can meaningfully improve outcomes, as demonstrated by the reduction in 30-day PEG mortality in England from 13.2 percent to 5.3 percent following the adoption of more refined national guidelines (16). Our study provides evidence that may help extend the principle of structured risk assessment to the high-risk ICU population. By incorporating the key variables identified in this study, clinicians may better recognize patients at a substantially increased risk of in-hospital mortality.

This study has several strengths, including a relatively large cohort focused exclusively on critically ill ICU patients undergoing endoscopic PEG. Detailed clinical, laboratory, and physiological data collected at the time of the procedure enabled a structured evaluation of factors independently associated with in-hospital mortality.

Study Limitations

Important limitations should be acknowledged. The retrospective single-center design introduces potential residual confounding and limits its generalizability. Although selected laboratory parameters were analyzed as proxies of physiological instability, standardized severity-of-illness scores were not consistently available, and we could not definitively distinguish between localized infection and septic shock at the time of PEG placement. Standardized nutritional risk assessments were not routinely documented. While the timing from ICU admission to PEG was evaluated, a detailed assessment of dynamic clinical stability at the time of procedural decision-making was not possible. Because only patients who ultimately underwent endoscopic PEG were included, selection bias related to institutional referral patterns and procedural thresholds cannot be excluded. Furthermore, the exclusion of surgical and radiologic gastrostomy cases limits the generalizability of these findings to endoscopic PEG. Finally, although the multivariable model demonstrated acceptable discrimination, it was not externally validated and should be interpreted as identifying high-risk clinical profiles rather than serving as a stand-alone prediction tool. Despite these limitations, this study identified objective markers associated with early in-hospital mortality and supports the need for structured risk stratification in critically ill patients considered for PEG. Prospective multicenter validation is required.

CONCLUSION

This study identified a distinct high-risk profile associated with in-hospital mortality among critically ill patients undergoing PEG, primarily characterized by active infection, severe hypoalbuminemia, and elevated urea levels, while prolonged intubation characterized a clinically more fragile subgroup. These objective markers may support structured risk stratification and more informed patient selection in intensive care settings.

Ethics

Ethics Committee Approval: The study protocol was approved by the Institutional Review Board of the Ankara Bilkent City Hospital (number: 433, date: 07.08.2024).

Informed Consent: The requirement for informed consent was waived owing to the use of anonymized clinical data and the observational, retrospective design of the study.

Footnotes

Author Contributions

Concept - M.O., E.Ç.; Design - M.O., E.Ç.; Data Collection or Processing - E.Ş., E.C.; Analysis or Interpretation - M.O., T.A., S.G.T.; Literature Search - M.O., E.Ş., E.C., E.Ç.; Writing - M.O., T.A., S.G.T., E.Ç.

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

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. *Rahnemai-Azar AA, Rahnemaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. World J Gastroenterol. 2014;20:7739-7751.*
2. *Wei M, Ho E, Hegde P. An overview of percutaneous endoscopic gastrostomy tube placement in the intensive care unit. J Thorac Dis. 2021;13:5277-5296.*
3. *Arora G, Rockey D, Gupta S. High In-hospital mortality after percutaneous endoscopic gastrostomy: results of a nationwide population-based study. Clin Gastroenterol Hepatol. 2013;11:1437-1444.e3.*
4. *Johnston SD, Tham TC, Mason M. Death after PEG: results of the national confidential enquiry into patient outcome and death. Gastrointest Endosc. 2008;68:223-227.*
5. *Lima DL, Miranda LEC, da Penha MRC, Lima RNCL, Dos Santos DC, Eufrânio MS, et al. Factors associated with 30-day mortality in patients after percutaneous endoscopic gastrostomy. JSLS. 2021;25:e2021.00040.*
6. *Holt DQ, McDonald JF, Murray ML, Hair C, Devonshire DA, Strauss BJ, et al. Clinical selection criteria can predict futile intervention in patients referred for percutaneous endoscopic gastrostomy insertion. Intern Med J. 2015;45:648-652.*
7. *Pih GY, Na HK, Hong SK, Ahn JY, Lee JH, Jung KW, et al. Clinical outcomes of percutaneous endoscopic gastrostomy in the surgical intensive care unit. Clin Endosc. 2020;53:705-716.*
8. *Seyhan S, Tosun Taşar P, Karaşahin Ö, Albayrak B, Sevinç C, Şahin S. Complications and factors associated with mortality in patients undergoing percutaneous endoscopic gastrostomy. Clin Sci Nutr. 2024;6:97-106.*
9. *Karasahin O, Tosun Tasar P, Timur O, Binici DN, Kiper Yilmaz T, Aslan A, et al. High C-reactive protein and low albumin levels predict high 30-day mortality in patients undergoing percutaneous endoscopic gastrotomy. Gastroenterol Res. 2017;10:172-176.*
10. *Pih GY, Na HK, Ahn JY, Jung KW, Kim DH, Lee JH, et al. Risk factors for complications and mortality of percutaneous endoscopic gastrostomy insertion. BMC Gastroenterol. 2018;18:101.*
11. *Duzenli T, Ketenci M, Akyol T, Koseoglu H, Tanoglu A, Kaplan M, et al. Predictive factors of complications and 30-day mortality in patients undergoing percutaneous endoscopic gastrostomy: the*

utility of C-reactive protein to albumin ratio. Acta Gastroenterol Belg. 2021;84:283-288.

12. *Barbosa M, Magalhaes J, Marinho C, Cotter J. Predictive factors of early mortality after percutaneous endoscopic gastrostomy placement: the importance of C-reactive protein. Clin Nutr ESPEN. 2016;14:19-23.*
13. *Feinfeld DA, Bargouthi H, Niaz Q, Carvounis CP. Massive and disproportionate elevation of blood urea nitrogen in acute azotemia. Int Urol Nephrol. 2002;34:143-145.*
14. *Keskinkılıç Yağız B, Yalaza M. Evaluating the factors affecting mortality and survival of the patients who underwent percutaneous endoscopic gastrostomy; the short-term and long-term results. J Cukurova Anesth Surg. 2024;7:153-157.*
15. *Welbank T, Kurien M. To PEG or not to PEG that is the question. Proc Nutr Soc. 2021;80:1-8.*
16. *Kamran U, Lee PC, Coupland B, Abbasi A, Steed H, Ispoglou S, et al. Improving 30-day mortality after PEG tube placement in England from 2007 to 2019: a retrospective national cohort analysis of 87,862 patients. Gastrointest Endosc. 2022;96:943-953.e11.*