ORIGINAL RESEARCH

DOI: 10.4274/ejgg.galenos.2025.2024-12-3
Eur J Geriatr Gerontol 2025;7(1):6-10

Predictors of Early Mortality After Percutaneous Endoscopic Gastrostomy in Geriatric Patients

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Abstract

Objective: We aimed to determine the risk factors that may be responsible for early mortality in patients planned for percutaneous endoscopic gastrostomy (PEG).

Materials and Methods: This study was retrospectively designed, including patients over 65 years of age who underwent PEG between January 2014 and March 2019. Early mortality rates (within 30 days) following the PEG procedure were evaluated. Variables analyzed included demographic characteristics, blood samples, and the Charlson Comorbidity Index (CCI). Predictors of 30-day mortality were identified using logistic regression.

Results: Of the 178 patients who underwent PEG placement, 93 were female (52.2%) and 85 were male (47.8%). Early mortality was observed in 115 patients, accounting for 64.6% of the cohort. Age was positively associated with early mortality [odds ratio (OR)=1.049 (95% confidence interval (CI)=1.013-1.086), p=0.007]. A CCI greater than 7 was associated with a 6.147-fold increase in the risk of early mortality (95% CI=1.221-30.951, p=0.028). Elevated C-reactive protein levels (>3.99 mg/L) increased the risk of early mortality by 3.991-fold (95% CI=1.614-9.968, p=0.003). Conversely, lower sodium levels (<130.5 mmol/L) and phosphorus levels (<2.25 mg/dL) were also associated with higher mortality risks [OR=3.610 (95% CI=1.524-8.548, p=0.004) and OR=2.976 (95% CI=1.075-8.240, p=0.036), respectively].

Conclusion: When planning a PEG procedure, especially for elderly patients, it is crucial to consider risk factors associated with early mortality.

Keywords: Percutaneous endoscopic gastrostomy, elderly patients, early mortality, risk factors, Charlson Comorbidity Index

Introduction

Nutritional disorders, impaired oral intake, and comorbidities are becoming increasingly significant issues in geriatrics (1). Enteral nutrition is the preferred method as long as the gastrointestinal system remains functional, due to its lower cost, reduced bacterial translocation, and decreased risk of sepsis (2). Percutaneous endoscopic gastrostomy (PEG) is a reliable method with low morbidity, commonly used to provide sustained enteral nutrition for individuals who cannot maintain adequate oral intake (3). The increasingly common indications for PEG placement include elderly patients who have lost the ability to eat due to cerebrovascular diseases, chronic neurological disorders, and advanced dementia (4). Although procedure-related complication rates are low, PEG placement has been associated with early mortality rates in patients of advanced age and those with comorbid conditions (5,6). This study aims to determine the risk factors linked to early mortality that may assist in decision-making for elderly patients scheduled for PEG placement.

Materials and Methods

Study Design

This study was retrospectively designed and conducted by reviewing the records of 258 patients who underwent PEG

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Received: 07.12.2024 **Accepted:** 27.01.2025 **Epub:** 20.03.2025 **Publication Date:** 28.03.2025

Cite this article as: Sezer S, Aytaç Ş. Predictors of early mortality after percutaneous endoscopic gastrostomy in geriatric patients. Eur J Geriatr Gerontol. 2025;7(1):6-10

placement between January 2014 and March 2019 at Ankara Yıldırım Beyazıt University Yenimahalle Training and Research Hospital. Patients who underwent endoscopy-guided PEG were included in the study (7). Participants with incomplete records and individuals younger than 65 were not included in the study. A total of 178 patients were included. Mortality status was analysed at the end of the first month following the PEG procedure (Figure 1). Patient backgrounds and hematological data were compared between the two groups. Ethical approval was obtained from the Ankara Yıldırım Beyazıt University Yenimahalle Training and Research Hospital Ethics Committee (approval number: 2019.03.05 date: 26.03.2019). A waiver of the requirement for informed written consent under the Helsinki Declaration was granted, as only the medical data from the patients' electronic records were obtained.

Data Collection

The records of patients undergoing PEG were reviewed for age, gender, primary diagnosis (chronic neurological diseases, tumors, dementia, head and neck tumors), comorbidities, and laboratory data [albumin; C-reactive protein (CRP); hemoglobin (HB); white blood cell count (WBC); sodium (Na); potassium (K); phosphorus (P); alanine aminotransferase (ALT); blood urea nitrogen]. The laboratory tests and comorbidities were collected from data obtained concurrently with the PEG procedure. Complications related to the procedure (such as wound site infection, bleeding, peritonitis, dislodgement of the PEG set, etc.) were evaluated within the one-month period following the PEG procedure.

The Charlson Comorbidity Index (CCI) was used to evaluate patients' comorbidities based on detailed medical histories. The CCI includes various medical conditions weighted between 1 and 6 points (Figure 2). A score of 0 was considered associated with a low risk of mortality, 1-2 points with a moderate risk of mortality, and ≥3 points with a high risk of mortality (8).

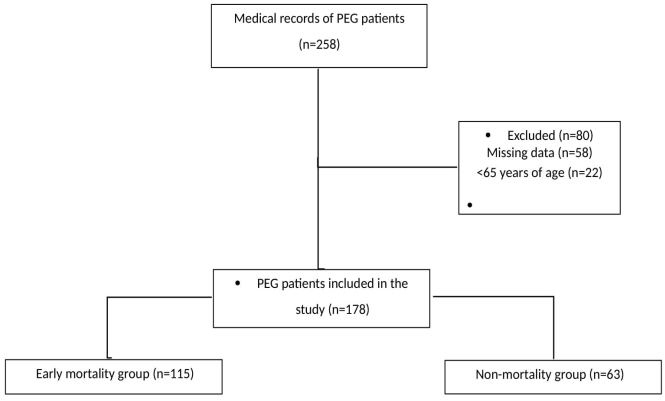

Figure 1. Flowchart of the study

PEG: Percutaneous endoscopic gastrostomy

Statistics

Whereas categorical variables were displayed as counts and percentages, continuous variables were represented as means ± standard deviations, medians, and interquartile ranges. The Kolmogorov-Smirnov test was used to assess the normality of the data distribution. The Mann-Whitney U test was used to compare continuous variables between survivors and non-survivors. For nominal variables, group comparisons in contingency tables were performed using the chi-square test or Fisher's Exact test. The diagnostic performance of laboratory parameters was evaluated by analyzing the area under the receiver operating characteristic (ROC) area under the curve (AUC). The optimal cut-off value was determined using Youden's Index. Risk factors associated with early mortality were analyzed through multivariate logistic regression. IBM SPSS 20.0 (SPSS Inc., Chicago, IL) was utilized for statistical analysis, with the significance level set at $p<0.05$.

Results

The average age of the 178 patients included in the study was 79.25±10.97, with 52% of them being female. Early mortality was observed in 115 patients, accounting for 64.6% of the cohort. The general characteristics and laboratory findings of the patients are summarized in Table 1 and Table 2. Laboratory findings revealed that individuals with early mortality had higher CRP levels and lower albumin, Na, and p values (all $p<0.05$). There were no notable differences in K, urea, creatinine, HB, WBC, or ALT levels between the groups (all $p>0.05$). Factors that may influence early mortality are presented in Table 3. Patients who experienced early mortality were older and had higher CCI scores compared to those who survived (both $p<0.01$). When the comorbid diseases identified during the PEG procedure were analyzed separately, they were found to have no significant impact on early mortality. No major complications

Diseases	
Ischemic heart disease, heart failure, peripheral arterial disease, cerebrovascular disease, dementia, chronic lung disease, mild liver disease, uncomplicated diabetes mellitus	1 points each
Complicated diabetes mellitus, renal failure, hemiplegia or paraplegia, non-metastatic cancer	2 points each
Liver cirrhosis	3 point
Metastatic cancer, acquired human immunodeficiency syndrome	6 points each

Figure 2. Charlson Comorbidity Index

Calculation of the Charlson Comorbidity Index: The total CCI score is calculated by summing the assigned points for each comorbid condition present in a patient. Higher scores indicate greater comorbidity and are associated with an increased risk of 1-year mortality

CCI: Charlson Comorbidity Index

Table 1. Demographic and clinical characteristics (n=178)

Characteristic	Value	Percentage (%)
Age (Mean ± SD)	79.25±10.97	-
Charlson Comorbidity Index (Median, IQR)	6 (5-7)	-
Female	93	52.2%
Male	85	47.8%
Diabetes mellitus	34	19.1%
Chronic lung disease	33	18.5%
Coronary artery disease	57	32.0%
Pneumonia	56	31.5%
Chronic kidney disease	12	6.7%
Urinary tract infection	10	5.6%
Alzheimer's disease	81	45.5%
Stroke	48	27.0%
Parkinson's disease	13	7.3%
Dementia	18	10.1%

SD: Standard deviation, IQR: Interquartile range

such as bleeding, perforation, or peritonitis, which could lead to mortality, were observed in association with the PEG procedure.

Regression Analysis

Binary logistic regression analysis demonstrated significant predictors of early mortality among PEG patients (Table 4). Age was positively associated with early mortality [OR=1.049 (95% CI=1.013-1.086), p=0.007]. A CCI greater than 7 was associated with a 6.147-fold increase in the risk of early mortality (95% CI=1.221-30.951, p=0.028). Elevated CRP levels (>3.99 mg/L) increased the risk of early mortality by 3.991-fold (95% CI=1.614-9.968, p=0.003). Conversely, lower Na levels (<130.5 mmol/L) and p levels (<2.25 mg/dL) were also associated with higher mortality risks [OR=3.610 (95% CI=1.524-8.548, p=0.004) and OR=2.976 (95% CI=1.075-8.240, p=0.036), respectively].

Threshold Values and ROC Analysis

ROC curve analysis identified critical thresholds for predicting early mortality. For CRP, p value of >3.99 mg/L was determined to be the optimal threshold [AUC=0.631 (95% CI: 0.536-0.726)].

Table 2. Laboratory findings and comparison between groups

Laboratory	Non-mortality (n=63)	Early mortality (n=115)	p
CRP (mg/L)	5.80 (1.44-12.5)	8.54 (5.37-13.01)	0.004
Albumin (g/dL)	2.88 (2.50-3.22)	2.60 (2.22-2.90)	<0.001
Sodium (mmol/L)	134 (132-136)	130 (128-134)	<0.001
Phosphorus (mg/dL)	3.2 (2.5-4.0)	2.5 (2.0-3.3)	<0.001
Potassium (mmol/L)	3.9 (3.6-4.0)	3.8 (3.0-4.0)	0.058
Urea (mg/dL)	43 (31-52)	45 (32-54)	0.126
Creatinine (mg/dL)	1.1 (0.9-1.5)	1.3 (1.0-1.4)	0.242
Hemoglobin (g/dL)	10.0 (9.5-10.9)	9.9 (9.2-11.0)	0.317
WBC (x10^3/µL)	8800 (6000-11000)	7200 (4800-10000)	0.102
ALT (U/L)	49 (28-65)	55 (40-67)	0.056

Data are presented as median (25%-75% interquartiles) or mean ± SD. Statistically significant values are marked in bold.
CRP: C-reactive protein, ALT: Alanine aminotransferase, WBC: White blood cell count

Table 3. Comparison of demographic characteristics between non-mortality and early mortality group patients

Characteristic	Non-mortality (n=63)	Early mortality (n=115)	p
Age (years)	76 (68-84)	84 (77-89)	<0.001
Charlson Comorbidity Index	5 (4-6)	6 (5-8)	0.002
Gender			
Female	35 (55.6%)	58 (50.4%)	0.513
Male	28 (44.4%)	57 (49.6%)	
Diabetes mellitus (%)	14 (22.2%)	20 (17.4%)	0.453
Chronic lung disease (%)	10 (15.9%)	23 (20.0%)	0.498
Coronary artery disease (%)	24 (38.1%)	33 (28.7%)	0.199
Pneumonia (%)	16 (25.4%)	40 (34.8%)	0.197
Chronic kidney disease (%)	2 (3.2%)	10 (8.7%)	0.218
Urinary tract infection (%)	2 (3.2%)	8 (7.0%)	0.498

Table 4. Multivariate logistic regression analysis for early mortality in percutaneus endoscopic gastrostomy patients

Variable	Odds ratios	95% confidence intervals	p
Age	1.049	1.013-1.086	0.007
Charlson Index >7	6.147	1.221-30.951	0.028
CRP >3.99 mg/L	3.991	1.614-9.968	0.003
Sodium <130.5 mmol/L	3.610	1.524-8.548	0.004
Phosphorus <2.25 mg/dL	2.976	1.075-8.240	0.036

CRP: C-reactive protein

Similarly, Na levels <130.5 mmol/L [AUC=0.721 (95% CI: 0.648-0.794)] and p levels <2.25 mg/dL [AUC=0.684 (95% CI: 0.606-0.763)] were significant predictors of early mortality. These thresholds align with the observed clinical trends and suggest critical markers for prognosis.

Discussion

In our study, we investigated the relationship between risk factors and early mortality following the PEG procedure. Our results showed that early mortality was 6 times higher ($p<0.05$) in patients with CCI >7, 4 times higher ($p<0.01$) in those with CRP >3.99 mg/L, 3.6 times higher ($p<0.01$) in those with Na <130.5 mmol/L, and 3 times higher ($p<0.05$) in those with p<2.25 mg/dL. Age was a risk factor for early mortality ($p<0.01$). Albumin was not associated with early mortality ($p>0.05$). It is recommended to encourage hand feeding, especially in malnourished patients with dementia (9). Nevertheless, if patients show early signs of malnutrition, nasoenteral feeding may be preferred with a multidisciplinary approach (4). In a study conducted by Bond et al. (10), it was observed that the multidisciplinary approach reduced the 30-day mortality rate. The 2021 guidelines recommend early PEG in selected patients with chronic diseases who experience weight loss despite continued oral nutrition (11). PEG tube placement is not advised for individuals whose expected survival is under 30 days (11). Studies on the timing of PEG tube placement have been performed (12,13). In their large-scale study investigating the timing of PEG indications, Teno et al. (14) found that the timing of PEG tube placement did not affect survival in patients with dementia.

Complications associated with PEG, along with risk factors related to early and late mortality, have been evaluated in an effort to establish certain criteria (15,16). High CRP levels have been identified as an independent factor predicting early mortality, with each unit increase in CRP shown to raise the mortality risk by 0.8% (17). High CRP levels, low albumin levels, advanced age, and diabetes mellitus (DM) were found to be associated with early mortality after PEG (15,18). Muratori et al. (19) found that Na ≥150 mmol/L, and high CRP levels was associated with an early mortality. In our study, we similarly found an association between high CRP levels and early mortality. Conversely, we identified an association between early mortality and patients with Na <130 mmol/L and low Phosphorus levels. However, no association was observed between early mortality and albumin levels. Sanders et al. (20) found a 28% mortality rate in the early period after PEG, with a mortality rate of 54% in patients with dementia. Abuksis et al. (21) found an early mortality rate of 72% in hospitalized PEG patients, 46% of whom had dementia, while in nursing home patients, 87% of whom had dementia, the mortality rate was 39.5%. Zopf et al. (6) found a 30-day early mortality rate of 6.5% after PEG procedures in patients 75% of whom had malignancies. The predictive factors for the increase in early mortality were found to be older age and the presence of DM.

In our study, approximately 90% of our patients were diagnosed with Alzheimer's or other dementias, and cerebrovascular disorders, while 2% had malignant diseases. We found an early mortality rate of 64.6%. These rates are similar to the early mortality rates in hospitalized patients reported by Abuksis et al. (21). The significant difference in mortality between our study and that of Zopf et al. (6) can be explained by the very small number of malignant patients in our study. This suggests that underlying diseases and hospitalization have a significant impact on mortality in patients undergoing PEG. We found that comorbidities such as DM, coronary artery disease, pneumonia, chronic kidney disease, and urinary tract infections did not independently affect mortality. However, when we used the CCI, we observed a significant increase in early mortality. Each year of increase in patient age was associated with a 4.9% increase in early mortality, which is consistent with the literature. Based on these findings, we believe that the CCI could be an important indicator in determining the indication for PEG.

In particular, life expectancy in elderly patients with comorbidities who are hospitalized in intensive care units should be evaluated by considering risk factors, and the limits of nasoenteral feeding should be carefully reconsidered. In high-risk patients, a multidisciplinary approach should be adopted when making the decision to proceed with PEG, balancing social, economic, and ethical values.

Study Limitations

The limitations of this retrospective study are that some laboratory and comorbidity data were missing and that the clinical status of the patient before PEG was not fully known.

Conclusion

When planning a PEG procedure, especially for elderly patients, it is crucial to consider risk factors associated with early mortality. This not only helps prevent unnecessary invasive interventions but also guides the selection of alternative treatment options.

Ethics

Ethics Committee Approval: It was obtained from the Ankara Yıldırım Beyazıt University Yenimahalle Training and Research Hospital Ethics Committee (approval number: 2019.03.05 date: 26.03.2019).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.S., Ş.A., Concept: S.S., Ş.A., Design: S.S., Ş.A., Supervision: S.S., Ş.A., Resources: S.S., Ş.A., Material: S.S., Ş.A., Data Collection or Processing: S.S., Ş.A., Analysis or Interpretation: Ş.A., Literature Search: S.S., Ş.A., Writing: S.S.

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

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

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