Observational Study

Medicine®

OPEN

Clinical outcomes of esophagogastroduodenoscopy in critically ill patients using high-dose proton pump inhibitor for suspected bleeding

A retrospective cohort study

Won Gun Kwack, MD, PhD*

Abstract

Esophagogastroduodenoscopy (EGD) is a useful procedure performed for gastrointestinal (GI) bleeding. No definite clinical guidelines recommend EGD implementation in intensive care unit (ICU) patients with suspected GI bleeding. The objective of this study was to compare the clinical effectiveness of EGD in critically ill patients who are using high-dose proton pump inhibitor (PPI) for suspected GI bleeding.

We retrospectively analyzed ICU patients using high-dose PPI for suspected GI bleeding from January 2012 to September 2020. Major cases of GI bleeding, such as those with hematemesis and hematochezia, were excluded, and 1:1 propensity score matching was performed. The change in hemoglobin level, requirement of red blood cell transfusion, re-suspected bleeding event, length of ICU stay, and ICU mortality were compared between the EGD and non-EGD groups.

Of the 174 subjects included, 52 patients underwent EGD within 24 hours of PPI administration. In the EGD group, 22 (42.3%) patients showed normal findings, while esophagitis and gastritis were most common abnormal finding (n = 11, 21.2%), and 14 patients (26.9%) underwent a hemostatic procedure. While comparing the 2 groups, the EGD group required a higher amount of red blood cell transfusion (packs) than the non-EGD group for a week (3.04 ± 0.44 vs 2.07 ± 0.25, $P = .01$). There was no significant difference in the change in hemoglobin level after 1 week ($P = .15$). After propensity score matching, the EGD group showed similar the requirement of red blood cell transfusion and change in hemoglobin level for a week ($P = .52$, $P = .97$, respectively). In analyses for all patients and propensity score matched patients, there was no statistically significant difference in term of re-suspected bleeding event rate, duration of ICU stay, and ICU mortality. However, re-suspected bleeding event rate and ICU mortality were lower trend in the EGD group than the non-EGD group.

This study showed that EGD had no definite clinical benefit in ICU patients using high-dose PPI for suspected GI bleeding and aggressive EGD is not necessarily recommended. However, it is necessary to consider EGD in patients who are tolerant.

Abbreviations: EGD = esophagogastroduodenoscopy, GI = gastrointestinal, GBS = Glasgow-Blatchford score, ICU = intensive care unit, PF ratio = PaO_2/FiO_2 ratio, PPI = proton pump inhibitor, PSM = propensity score matching, RBC = red blood cell, SAPS = Simplified Acute Physiology Score.

Keywords: esophagogastroduodenoscopy, gastrointestinal bleeding, intensive care unit, proton pump inhibitor

1. Introduction

Intensive care unit (ICU) patients admitted for various reasons have a complex and stressful environment, along with frequent upper gastrointestinal (GI) bleeding. Occult or overt bleeding (positive nasogastric blood, mild fall in hemoglobin over several days, and melena) is observed in 5% to 25% of ICU patients and clinically significant bleeding is seen in 1.5% to 2% of patients.[1,2] Significant upper GI bleeding is associated with increased mortality and longer duration of ICU stay.[3] Core management of these patients consists of resuscitation, proton pump inhibitor (PPI), and endoscopic therapy.

Gastric acid suppression has been recommended in all ICU patients with high-risk stress-related mucosal damage.[4,5] Prophylactic PPIs have been shown to be more effective than histamine 2 receptor antagonists in preventing stress-related mucosal damage.[6] According to the 2019 multidisciplinary international consensus statement, high dose-PPI infusion (80 mg intravenous bolus followed by 72 hours of 8 mg/h continuous intravenous infusion) for patients with bleeding ulcers with high-risk stigmata after endoscopic therapy, is recommended.[7] A

Editor: Shreedhar Kulkarni.

The author has no conflicts of interest to disclose.

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Division of Pulmonary, Allergy and Critical Care Medicine, Department of Internal Medicine, Kyung Hee University Hospital, Seoul, Republic of Korea.

* Correspondence: Won Gun Kwack, Division of Pulmonary, Allergy and Critical Care Medicine, Department of Internal Medicine, Kyung Hee University Hospital, 23, Kyungheedae-ro, Dongdaemun-gu 02447, Seoul, Republic of Korea (e-mail: wongunnim@naver.com).

How to cite this article: Kwack WG. Clinical outcomes of esophagogastroduodenoscopy in critically ill patients using high-dose proton pump inhibitor for suspected bleeding: a retrospective cohort study. Medicine 2021;100:34(e27028).

Received: 21 February 2021 / Received in final form: 15 July 2021 / Accepted: 7 August 2021

http://dx.doi.org/10.1097/MD.0000000000027028

possible biological benefit of this high-dose regimen is to promote clot stability by sustaining the intra-gastric pH level above 6.

Esophagogastroduodenoscopy (EGD) is a useful management option with both diagnostic (macroscopic examination of the lesions and biopsy sampling) and therapeutic roles. The consensus groups suggest early endoscopy within 24 hours for patients with upper GI bleeding based on improved mortality.[7] However, the benefits of endoscopy in hemodynamically unstable patients remain debatable because of insufficient data. Procedure-induced complications, such as pulmonary aspiration and adverse reactions to medications used to achieve conscious sedation occurred more often (21% vs 2%) in critically ill patients (Acute Physiology and Chronic Health Evaluation II score >16 or hypotension prior to endoscopy).[8] In a previous study, in cases for which ICU admission was not warranted due to digestive bleeding, EGD had limited diagnostic and therapeutic benefit for critically ill patients with suspected bleeding but no massive GI bleeding. Most lesions identified through EGD required only pharmacologic management.[9] We therefore hypothesized that EGD would not exhibit clinical benefits in ICU patients admitted for reasons other than GI bleeding and who receiving high-dose PPI treatment for suspected GI bleeding during critical care. We conducted a comparative study for clinical effect of EGD in the abovementioned ICU patients.

2. Materials and methods

A retrospective cohort study was conducted on patients with suspected GI bleeding admitted to a medical or surgical ICU in a tertiary academic hospital from January 2012 to September 2020. All patients who were prescribed and used a high-dose PPI (pantoprazole or esomeprazole, 80 mg intravenous bolus followed by 72 hours of an 8 mg/h continuous intravenous infusion) for suspected upper GI bleeding were analyzed based on their electronic medical records. Patients admitted or those transported to gastroenterology for known GI lesions such as solid cancer and varices were excluded. Patients with massive hematemesis or hematochezia and those who underwent EGD 24 hours after high-dose PPI administration were also excluded. Suspected cases of upper GI bleeding were diagnosed with the change in the color of nasogastric tube drainage material to red or dark brown or resembling coffee grounds in texture; melena; and decreased hemoglobin level (drop in hemoglobin to up to 3 g/dL). This study was approved by the Institutional Review Board of Kyung Hee University Hospital (IRB no: 2020-10-006). The need for informed consent was waived due to the retrospective nature of the study, which only involved reviewing medical records. The study was conducted in accordance with the Declaration of Helsinki.

The data collected included age, sex, hypertension, diabetes, cerebral vascular disease, cardiovascular disease, chronic lung disease (chronic obstructive pulmonary disease, asthma, interstitial lung disease), chronic liver disease, chronic kidney disease, reason for ICU admission, Simplified Acute Physiology Score (SAPS) II at ICU admission, and length of ICU stay before suspected GI bleeding. Information on the PaO_2/FiO_2 ratio (PF ratio), Glasgow-Blatchford score (GBS),[10] initiation of mechanical ventilation, vasopressor use, EGD findings, and laboratory findings on suspected GI bleeding were also retrieved. The outcomes were: requirement of red blood cell (RBC) transfusion and change of hemoglobin level for a week after suspected GI bleeding, re-suspected bleeding events requiring RBC transfusion during hospital stay (from 1 week after suspected GI bleeding to last hospital day), length of ICU stay, and ICU mortality.

Gastroscopies were performed by expert gastroenterologists (senior physicians and clinical instructors) with standard Olympus video gastroscope (EVIS Lucera, Olymphus Optical, Tokyo, Japan). Gastroscopies were performed at the patient's bedside in the ICU or in the endoscopy room. A major lesion was defined as a lesion that required a hemostatic procedure, such as electrical coagulation, epinephrine injection, or clipping, and a minor lesion was a lesion that could be pharmacologically treated.

Continuous variables are expressed as means and standard errors. Categorical variables are expressed as numbers and percentages. Differences between the EGD group and the non-EGD group were analyzed using the independent sample *t* test for continuous variables, and Chi-squared tests or Fisher exact tests for categorical variables, respectively. Statistical analyses were performed using SPSS version 23.0 for Windows (SPSS, Chicago, IL). Using the OneToManyMTCH of SAS macro (SAS Institute Inc., Cary, NC) in case-control matching on the propensity score, we performed 1:1 propensity score matching (PSM) based on sex, age, SAPS II, PF ratio, and GBS. *P* values of $<.05$ were considered statistically significant.

3. Results

During the study period, 612 patients in the ICU were intaking a high-dose PPI for suspected GI bleeding. About 438 of them met the exclusion criteria, and 174 patients were finally enrolled. Among the enrolled patients, 45 patients underwent EGD during their ICU stay, and 45 patients from each group were selected for the 1:1 PSM (Fig. 1). The mean hospital stay of all enrolled patients was 46.34 ± 3.47 days and no significant difference was observed between both the groups ($P = .74$).

Without PSM, no significant difference was found in age, sex, the number of medical patients, and SAPS II score between the EGD and non-EGD groups (age, 66.83 ± 1.88 vs 67.59 ± 1.32; male, 50.0% vs 61.5%; medical patients, 67.3% vs 78.7%; SAPS II, 39.10 ± 1.62 vs 39.89 ± 1.33). Although the non-EGD group had a lower PF ratio, the difference was not statistically significant (289.12 ± 21.59 vs 329.39 ± 22.13; $P = .28$), and similar GBS scores were noted ($P = .34$). The mean length of ICU stay before suspected GI bleeding was 8.72 ± 0.71 days, and the most common cause of suspected GI bleeding was the color change of the nasogastric tube drainage material (EGD vs non-EGD, 51.9% vs 50.2%, $P = .89$) (Table 1).

In the EGD group, 42.3% of gastroscopies revealed normal findings. Among the abnormal results, esophagitis and gastritis was most common (n = 11, 21.2%), gastric ulcer occurred in 9 (17.3%) cases, and nasogastric tube erosion was observed in 7 (13.5%) cases. Major lesions requiring hemostatic procedures were seen in 14 patients (26.9%) (Table 2).

Without PSM, the EGD group's hemoglobin level at the time of suspected GI bleeding was lower than that of the non-EGD group (9.07 ± 0.27 vs 9.84 ± 0.18, $P = .02$). Hemoglobin level after 1 week was not significantly different between both the groups (EGD group vs non-EGD group, 9.45 ± 0.17 vs 9.76 ± 0.14, $P = .19$). The requirement for RBC transfusion in the EGD group was higher than that in the non-EGD group for a week ($P = .04$). There was no significant difference between the 2 groups in terms of re-suspected bleeding, length of ICU stay, and ICU mortality

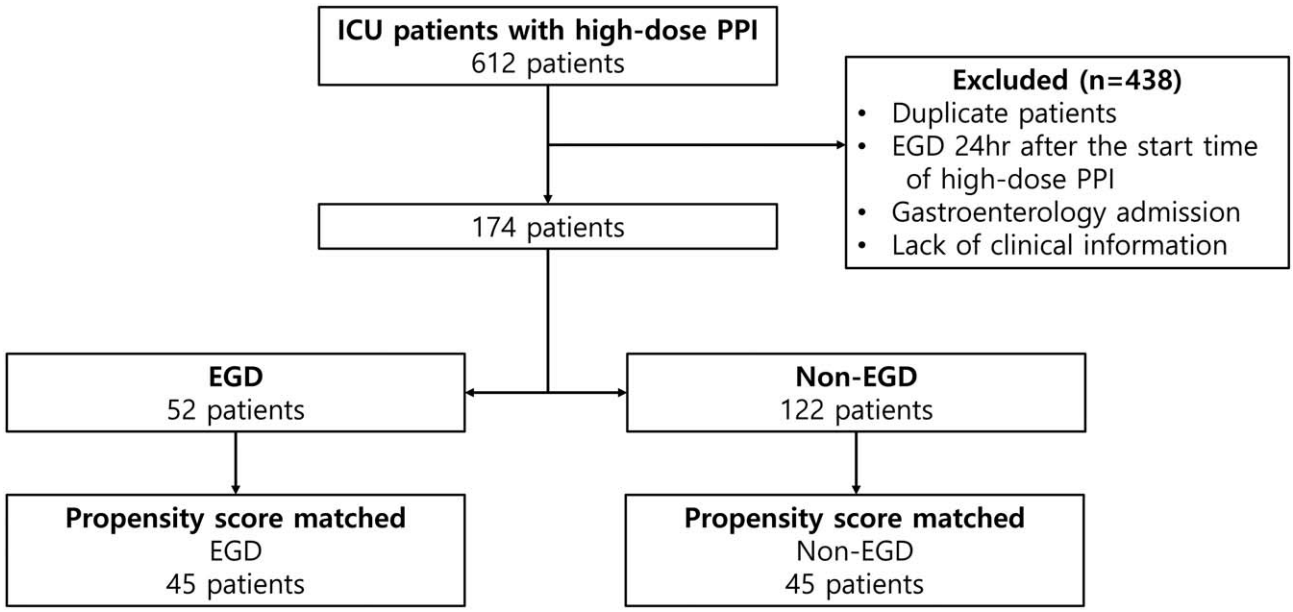

Figure 1. Flow diagram of participants through each stage of the study. EGD = esophagogastroduodenoscopy, ICU = intensive care unit, PPI = proton pump inhibitor.

($P = .57$, $P = .53$, and $P = .38$, respectively) (Table 3). After PSM, a comparison between the EGD and non-EGD groups showed that there were no significant differences in the initial hemoglobin level and hemoglobin level after 1 week, along with the requirement for RBC transfusion for a week ($P = .25$, $P = .09$, and $P = .52$, respectively). The length of ICU stay was similar in both the groups ($P = .27$) and, although there were no significant differences between the groups, re-suspected bleeding and ICU mortality were lower in the EGD group than that in the non-EGD group (15.6% vs 20.0%; $P = .58$, 20.0% vs 24.4%; $P = .61$, respectively) (Table 4). Regarding the change in hemoglobin level for a week of suspected GI bleeding, the EGD group showed increased hemoglobin level and the non-EGD group presented a decreased hemoglobin level. However, there was no statistically significant difference between the 2 groups in all patients (EGD vs non-EGD, 0.38 ± 0.32 vs -0.08 ± 0.16; $P = .15$); in PSM patients,

Table 1

General characteristics of suspected GI bleeding in the EGD and non-EGD groups.

Variables	Non-EGD (n = 122)	EGD (n = 52)	*P* value
Age (year)	67.59 ± 1.32	66.83 ± 1.88	.75
Male	75 (61.5)	26 (50.0%)	.16
Medical patients	96 (78.7)	35 (67.3)	.11
SAPS II score	39.89 ± 1.33	39.10 ± 1.62	.73
Hypertension	62 (50.8)	32 (61.5)	.19
Diabetes	42 (34.4)	12 (23.1)	.14
Cerebral vascular disease	24 (19.7)	7 (13.5)	.33
Cardiovascular disease	26 (21.3)	9 (17.3)	.55
Chronic lung disease	10 (8.2)	4 (7.7)	.91
Chronic kidney disease	11 (9.0)	6 (11.5)	.61
Chronic liver disease	6 (4.9)	2 (3.8)	.76
Mechanical ventilation	67 (54.9)	25 (48.1)	.41
PF ratio	289.12 ± 21.59	329.39 ± 22.13	.28
Vasopressor	50 (41.0)	17 (32.7)	.30
Glasgow-Blatchford score	7.62 ± 0.33	8.19 ± 0.50	.34
Time of suspected GI bleeding (days, after admission)	8.17 ± 0.75	10.01 ± 1.74	.29
Cause of suspected GI bleeding			
The change of nasogastric tube drainage material	62 (50.2)	27 (51.9)	.89
The change of nasogastric tube drainage material with Hb decrease	25 (20.5)	8 (16.7)	.57
Melena	8 (6.6)	7 (13.5)	.14
Melena with Hb decrease	5 (4.1)	4 (7.7)	.33
Hb decrease	22 (18.0)	6 (11.5)	.29

Values are presented as number (%) or mean ± standard error. EGD = esophagogastroduodenoscopy, GI = gastrointestinal, Hb = hemoglobin, PF ratio = PaO_2/FiO_2 ratio, SAPS = Simplified Acute Physiology Score.

Table 2

Findings of the EGD group (N = 52).

Normal	22 (42.3)
Esophagitis or gastritis	11 (21.2)
Nasogastric tube erosion	7 (13.5)
Gastric ulcer	9 (17.3)
Duodenal ulcer	2 (3.8)
Mallory-Weiss tear	1 (1.9)
Minor lesion	16 (30.8)
Major lesion	14 (26.9)

Values are presented as number (%).
EGD = esophagogastroduodenoscopy.

Table 3

Blood transfusion requirements and outcome in EGD and non-EGD patients.

Variables	Non-EGD (n = 122)	EGD (n = 52)	*P* value
Initial hemoglobin, g/dL	9.84 ± 0.18	9.07 ± 0.27	0.02
Initial hematocrit, %	29.45 ± 0.53	26.76 ± 1.15	0.04
Initial platelet, $10^{\wedge 3}/\mu L$	193.19 ± 9.91	214.38 ± 19.24	0.28
Hemoglobin (after 1 week), g/dL	9.76 ± 0.14	9.45 ± 0.17	0.19
Hematocrit (after 1 week), %	29.36 ± 0.41	28.78 ± 0.58	0.43
Platelet (after 1 week), $10^{\wedge 3}/\mu L$	230.67 ± 14.85	225.90 ± 19.19	0.86
RBC transfusion,* packs	2.07 ± 0.25	3.04 ± 0.44	0.04
Re-suspected bleeding†	23 (19.0)	8 (15.4%)	0.57
ICU stay, days	21.11 ± 1.74	23.21 ± 3.11	0.53
ICU mortality	31 (25.4)	10 (19.2)	0.38

Values are presented as number (%) or mean ± standard error.
EGD = esophagogastroduodenoscopy, GI = gastrointestinal, ICU = intensive care unit, RBC = red blood cell.
* The requirement of RBC transfusion for a week from suspected GI bleeding.
† Re-suspected bleeding events requiring RBC transfusion during hospital stay (from 1 week after suspected gastrointestinal bleeding to last hospital day).

both groups showed similar increased level of hemoglobin (EGD vs non-EGD, 0.31 ± 0.32 vs 0.32 ± 0.24; *P* = .97) (Fig. 2).

4. Discussion

The results of the present study showed that in ICU patients who were intaking high-dose PPI for suspected GI bleeding, the change in hemoglobin levels after 1 week from the time of suspected GI bleeding and the requirement of RBC transfusion for a week were similar between the EGD and non-EGD groups after PSM. Although there were no significant differences between the 2 groups, the length of ICU stay was shorter in the non-EGD group, and re-suspected bleeding and ICU mortality were lower in the EGD group.

Complicated risk factors in ICU patients were associated with stress-related mucosal damage, including mechanical ventilation, trauma, surgery, sepsis or severe burns, and related coagulopathy. GI bleeding is associated with a 20% to 30% increase in absolute risk of mortality and extends the length of ICU stay by about 4 to 8 days.[3] After the introduction of omeprazole, PPI has been the most effective currently available medication and is widely used for acid-related diseases, including peptic ulcers. It is also used in prophylactic treatment for critically ill patients and upper active GI bleeding. In acute GI bleeding, PPI therapy showed reduced rates of mortality and re-bleeding risk compared to control treatment (placebo or histamine 2 receptor antagonists) (odds ratio, 0.56 [confidence intervals, 0.34–0.94] and 0.43 [0.29–0.63], respectively).[7] Although 1 meta-analysis did not show any differences in the risk for mortality or re-bleeding

Table 4

Blood transfusion requirements and outcomes in EDG and non-EGD patients after PSM.

Variables	Non-EGD (n = 45)	EGD (n = 45)	*P* value
Initial hemoglobin, g/dL	9.61 ± 0.28	9.15 ± 0.28	.25
Initial hematocrit, %	29.00 ± 0.81	26.98 ± 1.24	.18
Initial platelet, $10^{\wedge 3}/\mu L$	192.36 ± 16.63	225.11 ± 20.97	.22
Hemoglobin (after 1 week), g/dL	9.93 ± 0.20	9.46 ± 0.18	.09
Hematocrit (after 1 week), %	29.93 ± 0.59	28.87 ± 0.63	.22
Platelet (after 1 week), $10^{\wedge 3}/\mu L$	205.58 ± 19.51	236.18 ± 20.90	.29
RBC transfusion,* packs	2.31 ± 0.45	2.73 ± 0.47	.52
Re-suspected bleeding†	9 (20.0)	7 (15.6)	.58
ICU stay, days	19.02 ± 2.80	24.00 ± 3.50	.27
ICU mortality	11 (24.4)	9 (20.0)	.61

Values are presented as number (%) or mean ± standard error. EGD = esophagogastroduodenoscopy, GI = gastrointestinal, ICU = intensive care unit, PSM = propensity score matching, RBC = red blood cell.
* The requirement of RBC transfusion for a week from suspected GI bleeding.
† Re-suspected bleeding events requiring RBC transfusion during hospital stay (from 1 week after suspected gastrointestinal bleeding to last hospital day).

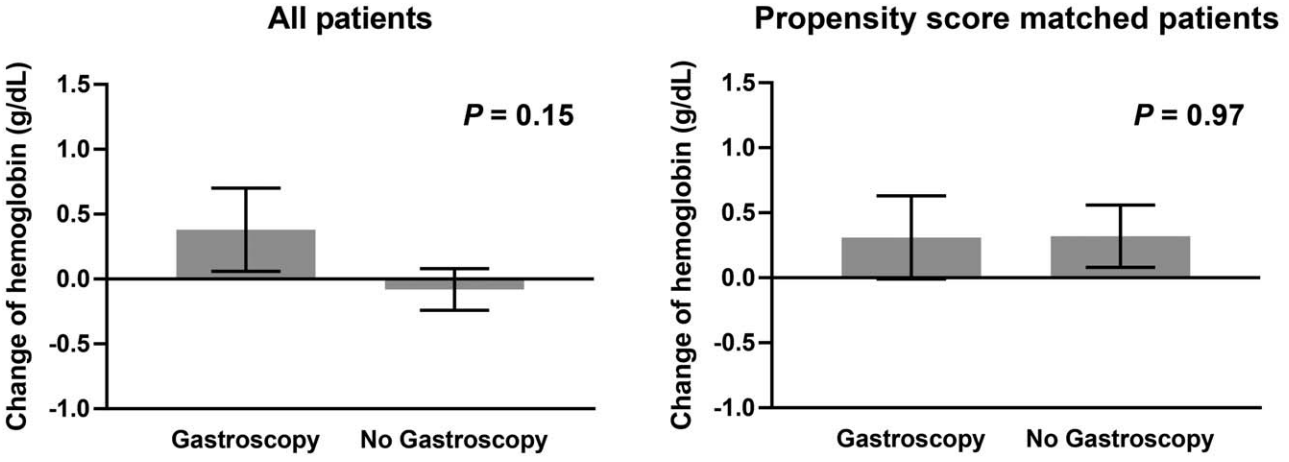

Figure 2. Comparison of the change of hemoglobin between the EGD group and non-EGD group. EGD = esophagogastroduodenoscopy.

between high-dose and non-high-dose PPIs, high-dose PPI treatment seems to be tolerable in critically ill patients, considering that an indirect comparison study yielded the superiority of high-dose PPI therapy; adverse effects of high-dose PPI were poorly reported in most studies.[11,12] In this study as well, no critical adverse events such as thrombophlebitis or discontinuous infusion was reported.

EGD is a useful tool for controlling acute GI bleeding and has diagnostic and therapeutic purposes. However, the procedure related complications are higher in ICU patients than that in non-ICU patients. Other studies reported that the rate of post-procedure cardiopulmonary complications, such as newly developed pulmonary infiltration and edema were 20% to 50% in critically ill patients.[13,14] The consensus guideline recommended early EGD (within 24 hours of GI bleeding) based on the fact that EGD performed within 24 hours was associated with lower in-hospital mortality,[15] however, the guideline could not provide recommendations for hemodynamically unstable patients owing to lack of data and debatable results.[15,16] There is no randomized study on the profitability of immediate EGD for suspected GI bleeding in critically ill patients without massive GI bleeding. When GI bleeding is suspected without massive bleeding during the ICU treatment, it is always challenging to determine whether or not to perform an endoscopy by comparing the benefits and risks. In a previous study, which was not a comparative study, among 84 patients who underwent EGD during their ICU stay, only 5.8% required a hemostatic procedure during EGD, while the other 94.2% had normal findings (30%), or the lesions required only pharmacologic treatment.[9] In this study on patients with suspected GI bleeding, the percentage of normal findings (42.3%) was higher and that of peptic ulcers (21.1%) was lower than previous studies on hospitalized patients admitted for overt GI bleeding.[17,18]

In a clinical setting, especially in critically ill patients, concerns regarding acute exacerbation of respiratory failure following EGD have a significant influence on the decision to perform EGD, except for definite cases of massive GI bleeding. This study also showed that the non-EGD group tended to have a lower PF ratio than the EGD group. However, there was no significant deterioration due to endoscopy, except for 2 case that showed a temporary decrease in PF ratio in the EGD group. Endoscopy examinations in ICU patients have higher morbidity and workload of medical personnel, including the transport of equipment or patients, than general ward patients. In this study, compared to the non-EGD group, EGD group could not decrease the requirement of RBC transfusion and increase the elevation of hemoglobin level, and there were no other definite clinical benefits in terms of the length of ICU stay, re-suspected bleeding, and ICU mortality. For these reasons, it is appropriate to prioritize high-dose PPI treatment and to consider differing EGD when GI bleeding is suspected in extremely unstable ICU patients until the patient's condition in stable rather than aggressively performing EGD. However, we cannot overlook the diagnostic and therapeutic value of EGD because 57.7% of EGD achieved diagnostic purpose to identify the bleeding focus and hemostatic procedures performed in 26.9% of EGD. A previous study showed that early EGD (performed within 24 hours of detecting the GI bleeding) had higher effectiveness for diagnosis (82% vs 73%) and hemostatic treatment (32% vs 12%) in critically ill patients with GI bleeding than late EGD.[19] Although there was no statistical difference, re-suspected bleeding and ICU mortality were lower in the EGD group, as in this study. It is necessary to consider EGD in patients who are relatively tolerant to examination. Future studies on the applicable time of EGD according to the PF ratio in critically ill patients is expected to provide more accurate information regarding the safe application of EGD.

Our study has several limitations. First, this study was conducted in a single center with a relatively small sample size. A small sample size may have underpowered our analysis of clinical benefits. One of reasons is that we aimed to determine the usefulness of EGD in suspected bleeding. Second, EGD and hemostatic procedures were performed by gastroenterologists, and the amount of transfusion was decided by the attending physician. There may be various factors that influenced the decision, which were not fully investigated due to the study's retrospective nature. However, we analyzed PSM results after matching for general characteristics and severity, and excluded massive GI bleeding patients who required endoscopic procedures for hematemesis or hematochezia. Therefore, we believe that this study is meaningful in determining the value of EGD in critically ill patients with suspected GI bleeding but no massive GI bleeding. Third, the results may differ depending on different medical centers, population, as well as treatment strategies regarding PPI and EGD. Hence, further studies with larger populations and multiple centers are needed for accurately investigating the usefulness of EGD in critically ill patients with suspected GI bleeding.

5. Conclusion

EGD in critically ill patients using high-dose PPI for suspected GI bleeding, except massive bleeding, had no definite benefits, and aggressive EGD is not necessarily recommended. However, performing EGD can be considered in ICU patients who are tolerant to the procedure because of considerable diagnostic value in bleeding focus detection. Therefore, an individualized management approach based on a complete clinical picture should be prioritized.

Acknowledgments

I would like to thank Dr Jeoung Mi Lee for data acquisition and processing and Su Jin Jeong from the Statistics Support Department at the Kyung Hee Medical Science Research Institute for statistical consulting services. This document has been released as a pre-print at Research Square; after that, the author has revised it to the final version.

Author contributions

Conceptualization: Won Gun Kwack.
Data curation: Won Gun Kwack.
Formal analysis: Won Gun Kwack.
Writing – original draft: Won Gun Kwack.
Writing – review & editing: Won Gun Kwack.

References

[1] Cook DJ, Fuller HD, Guyatt GH, et al. Risk factors for gastrointestinal bleeding in critically ill patients. Canadian Critical Care Trials Group. N Engl J Med 1994;330:377–81.
[2] Daley RJ, Rebuck JA, Welage LS, Rogers FB. Prevention of stress ulceration: current trends in critical care. Crit Care Med 2004;32: 2008–13.

[3] Cook DJ, Griffith LE, Walter SD, et al. The attributable mortality and length of intensive care unit stay of clinically important gastrointestinal bleeding in critically ill patients. Crit Care (London, England) 2001;5:368–75.
[4] Tryba M, Cook D. Current guidelines on stress ulcer prophylaxis. Drugs 1997;54:581–96.
[5] ASHP therapeutic guidelines on stress ulcer prophylaxis. ASHP Commission on Therapeutics and approved by the ASHP Board of Directors on November 14, 1998. Am J Health Syst Pharm 1999;56:347–79.
[6] Levy MJ, Seelig CB, Robinson NJ, Ranney JE. Comparison of omeprazole and ranitidine for stress ulcer prophylaxis. Dig Dis Sci 1997;42:1255–9.
[7] Barkun AN, Almadi M, Kuipers EJ, et al. Management of nonvariceal upper gastrointestinal bleeding: guideline recommendations from the International Consensus Group. Ann Intern Med 2019;171:805–22.
[8] Cappell MS, Iacovone FMJr. Safety and efficacy of esophagogastroduodenoscopy after myocardial infarction. Am J Med 1999;106:29–35.
[9] Jean-Baptiste S, Messika J, Hajage D, et al. Clinical impact of upper gastrointestinal endoscopy in critically ill patients with suspected bleeding. Ann Intensive Care 2018;8:75.
[10] Chang A, Ouejiaraphant C, Akarapatima K, Rattanasupa A, Prachayakul V. Prospective comparison of the AIMS65 Score, Glasgow-Blatchford Score, and Rockall Score for predicting clinical outcomes in patients with variceal and nonvariceal upper gastrointestinal bleeding. Clin Endosc 2020.
[11] Leontiadis GI, Sharma VK, Howden CW. Proton pump inhibitor treatment for acute peptic ulcer bleeding. Cochrane Database Syst Rev 2006;CD002094.
[12] Neumann I, Letelier LM, Rada G, et al. Comparison of different regimens of proton pump inhibitors for acute peptic ulcer bleeding. Cochrane Database Syst Rev 2013;CD007999.
[13] Lipper B, Simon D, Cerrone F. Pulmonary aspiration during emergency endoscopy in patients with upper gastrointestinal hemorrhage. Crit Care Med 1991;19:330–3.
[14] Rehman A, Iscimen R, Yilmaz M, et al. Prophylactic endotracheal intubation in critically ill patients undergoing endoscopy for upper GI hemorrhage. Gastrointest Endosc 2009;69:e55–9.
[15] Laursen SB, Leontiadis GI, Stanley AJ, Møller MH, Hansen JM, Schaffalitzky de Muckadell OB. Relationship between timing of endoscopy and mortality in patients with peptic ulcer bleeding: a nationwide cohort study. Gastrointest Endosc 2017;85: 936–44. e3.
[16] Cho SH, Lee YS, Kim YJ, et al. Outcomes and role of urgent endoscopy in high-risk patients with acute nonvariceal gastrointestinal bleeding. Clin Gastroenterol Hepatol 2018;16:370–7.
[17] Rockall TA, Logan RF, Devlin HB, Northfield TC. Incidence of and mortality from acute upper gastrointestinal haemorrhage in the United Kingdom. Steering committee and members of the National Audit of Acute Upper Gastrointestinal Haemorrhage. BMJ 1995;311: 222–6.
[18] Blatchford O, Davidson LA, Murray WR, Blatchford M, Pell J. Acute upper gastrointestinal haemorrhage in west of Scotland: case ascertainment study. BMJ 1997;315:510–4.
[19] Kim JH, Kim JH, Chun J, Lee C, Im JP, Kim JS. Early versus late bedside endoscopy for gastrointestinal bleeding in critically ill patients. Korean J Intern Med 2018;33:304–12.