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ORIGINAL ARTICLE

Safety and Efficacy of Sedation During Emergency Endoscopy for Upper Gastrointestinal Bleeding: A Propensity Score Matching Analysis

Daisuke Yamaguchi[1,2] · Goshi Nagatsuma[1] · Yasuhisa Sakata[2] · Yumi Mizuta[1] · Tadahiro Nomura[1] · Azuki Jinnouchi[1] · Kasumi Gondo[1] · Ryosuke Asahi[1] · Satoshi Ishida[1] · Shunichiro Kimura[1] · Shun Fujimoto[1] · Akane Shimakura[1] · Amane Jubashi[1] · Yuki Takeuchi[1] · Kei Ikeda[1] · Yuichiro Tanaka[1] · Wataru Yoshioka[1] · Naoyuki Hino[1] · Tomohito Morisaki[1] · Keisuke Ario[1] · Seiji Tsunada[1] · Motohiro Esaki[2]

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Abstract

Background and Aim This study aimed to compare patients with and without sedation during emergency endoscopy for upper gastrointestinal bleeding (UGIB) and to clarify the safety and efficacy of sedation in emergency endoscopy.

Methods We retrospectively collected 389 patients who underwent emergency endoscopy for UGIB at Ureshino Medical Center from 2016 to 2021. Patients were divided into two groups: sedation group during emergency endoscopy and nonsedation group. Clinical characteristics, patient status on admission, and UGIB etiology were evaluated. Treatment outcomes and adverse events were evaluated using propensity score matching (PSM), and risk factors for mortality from UGIB were investigated using Cox multivariate analysis.

Results The sedation group was significantly younger, composed of a higher proportion of males, and had chronic liver disease. Blood pressure and hemoglobin level on admission were significantly higher in the sedation group. The main cause of bleeding was peptic ulcer, which was significantly higher in the nonsedation group. PSM created 133 matched pairs. The success rate of endoscopic hemostasis was similar in both groups, and procedure time was significantly shorter in the sedation group than in the nonsedation group (17.6 ± 10.0 versus 20.2 ± 10.2 min, $P = 0.04$). There were no significant differences in adverse events between groups. Cox multivariate analyses revealed that red blood cell transfusion [hazard ratio (HR) 4.45, $P < 0.02$] and rebleeding (HR 3.30, $P = 0.03$) were associated with increased risk of 30-day mortality from UGIB.

Conclusions Sedation reduced the procedure time during emergency endoscopy for UGIB. Sedation during emergency endoscopy for UGIB is acceptable for safe endoscopic procedures.

Keywords Bleeding · Emergency endoscopy · Sedation · Mortality · Propensity score matching

Abbreviations

UGIB	Upper gastrointestinal bleeding
PSM	Propensity score matching
EVL	Endoscopic variceal ligation
RBC	Red blood cell
NSAIDs	Nonsteroidal anti-inflammatory drugs
HR	Hazard ratio

Introduction

Upper gastrointestinal bleeding (UGIB) is the most common gastroenterological emergency, with an incidence of mortality of 5–10% [1]. UGIB is broadly classified into variceal and nonvariceal bleeding. Ruptured esophageal varices cause approximately 70% of all UGIB in cirrhosis [2, 3]. Among patients with nonvariceal UGIB, the major cause is peptic gastroduodenal ulcer [4–6]. *Helicobacter pylori* (*H. pylori*) infection and the use of nonsteroidal anti-inflammatory drugs (NSAIDs), including aspirin, were

✉ Daisuke Yamaguchi
daisukehawks@gmail.com;
yamaguchi.daisuke.np@mail.hosp.go.jp

[1] Department of Gastroenterology, National Hospital Organization Ureshino Medical Center, Ureshino, Japan

[2] Division of Gastroenterology, Department of Internal Medicine, Faculty of Medicine, Saga University, Saga 849-8501, Japan

the major causes of bleeding peptic ulcer disease in past years, but the epidemiology and pathophysiology of UGIB has changed with the widespread eradication of *H. pylori* and the increased use of antithrombotic drugs [7–12].

Emergency endoscopic hemostasis is useful in all cases of UGIB [13–15]. Regarding timeliness, urgent endoscopy within 24 h is reported to reduce the risk of mortality and surgical intervention in high-risk cases of UGIB, and it is recommended in guidelines that endoscopy be carried out within 24 h [16–19].

Sedation in gastroenterological endoscopy has become an important medical option in routine clinical care [20]. Sedation during emergency endoscopy is considered useful for safe and reliable emergency endoscopy when vital signs are stable, especially when the patient is agitated or anxious, although sedation may not be useful when the patient's general condition deteriorates or the hemodynamics are unstable [21–24].

The guidelines for sedation in gastroenterological endoscopy by the Japan Gastroenterological Endoscopy Society and the Japanese Society of Anesthesiologists recommend the use of antagonists or sedatives with a short half-life as suitable sedation during emergency endoscopy with security monitoring and in an environment where emergency treatment can be conducted, but do not specify whether sedation during emergency endoscopy is safe and effective [20].

The aims of the present retrospective study were (1) to compare the clinical outcomes of patients with and without sedation during emergency endoscopy for UGIB and (2) to identify the risk factors for mortality from UGIB in these patients.

Methods

Study Design and Ethical Issues

This retrospective chart review included patients who underwent emergency endoscopy and endoscopic hemostasis for UGIB at the National Hospital Organization Ureshino Medical Center from January 2016 to December 2021. Patients older than 20 years who fulfilled the following criteria were candidates for the study: (1) suspected UGIB requiring emergency endoscopy; (2) underwent endoscopic hemostasis within 24 h of symptom onset; (3) had a clear level of consciousness as well as stable respiratory and circulatory dynamics. Patients who had been endotracheally intubated or whose respiratory and circulatory status was sufficiently unstable to preclude emergency endoscopy and those with missing data were excluded. Written informed consent was obtained from patients who met the inclusion criteria after endoscopic hemostasis.

This study was conducted in accordance with the Declaration of Helsinki and the guidelines of the Consolidated Standards of Reporting Trials (CONSORT). The study protocol and the consent procedure were approved by the Ethics Review Committee of the National Hospital Organization Ureshino Medical Center (approval number 20-86).

Study Endpoints

The primary endpoint was the success rate of endoscopic hemostasis according to use of sedation during emergency endoscopy for UGIB. Treatment success was defined as controlled by endoscopic hemostasis and no rebleeding within 5 days after endoscopic hemostasis.

The secondary endpoints were rebleeding, procedure time, adverse events, and 30-day mortality after emergency endoscopy for UGIB. Rebleeding was defined as follows: (1) follow-up endoscopy identified recurrent UGIB or the stigmata of recent hemorrhage within 30 days or (2) melena and progressive anemia with a decrease in hemoglobin level greater than 2 g/dL and/or with a decrease in systolic blood pressure < 80 mmHg. The procedure time was defined as the time interval between insertion and removal of the endoscope [25, 26].

Sedation and Monitoring During Emergency Endoscopy

For urgent endoscopic treatment, each of the 17 endoscopists performed emergency endoscopy with or without sedation, based on their judgment. Thereby patients were divided into two groups: those who underwent emergency endoscopy with sedation (sedation group) and those who underwent the same procedure without sedation (nonsedation group). Sedatives used during emergency endoscopy were midazolam, diazepam, or propofol, and analgesics were pentazocine or pethidine hydrochloride [20, 27]. The type of sedative and analgesic drugs was selected by each endoscopist considering patients' age and physical condition. Details of sedative procedures are provided in Online Appendix S1.

Vital signs including blood pressure, heart rate, and blood oxygen saturation were recorded before the introduction of sedatives. During the endoscopy, vital signs were monitored every 5 min. When oxygen saturation was below 92%, nasal oxygen supplementation (2 L/min) was initiated. When the vital signs fluctuated by 20% or more compared with baseline values, the endoscopic procedure was temporarily stopped until the recovery of those values. Flumazenil, an antagonist of benzodiazepines, was administered after endoscopy as necessary.

Endoscopic Hemostasis

Endoscopic hemostasis was performed mainly by high-frequency soft coagulation, hemoclipping, or endoscopic variceal ligation (EVL) [26, 28–30]. The choice of procedure was at the endoscopists' discretion. Details of endoscopic hemostasis are presented in Online Appendix S2. Each procedure was repeated until hemostasis was endoscopically confirmed. Interventional radiology and/or surgery were implemented when endoscopic hemostasis was considered ineffective.

After endoscopic hemostasis was achieved, all patients were hospitalized and managed conventionally (fasting with peripheral parenteral nutrition and intravenous proton pump inhibitors). The indications for red blood cell (RBC) transfusion were a hemoglobin level < 6 g/dL on admission or a rapid drop in hemoglobin level > 2 g/dL in patients with hemoglobin levels < 10 g/dL at baseline. Follow-up endoscopy was performed on patients for whom it was judged necessary by the endoscopist 48–72 h after the initial endoscopy, and repeat endoscopic hemostasis was applied in cases where recurrent UGIB was detected. Interventional radiology and/or surgery were implemented when endoscopic hemostasis was considered ineffective.

Endoscopic hemostasis was performed by all 17 endoscopists, comprising 7 specialists and 10 trainees. Specialists were defined as endoscopists who had performed endoscopy for more than 5 years with experience in more than 40 endoscopic submucosal dissection procedures after mastering the required fundamental skills and knowledge [31, 32].

Clinical Outcomes and Statistical Analysis

Clinical data collected in the retrospective cohort were age, gender, alcohol consumption, smoking habit, *H. pylori* infection, American Society of Anesthesiologists physical status, use of antithrombotic agents, nonsteroidal anti-inflammatory drugs (NSAIDs), or gastric acid secretion inhibitor, and comorbidity (including Charlson comorbidity score). *H. pylori* infection was diagnosed by the serum levels of anti-*H. pylori* antibodies, the urea breath test, or the rapid urease test. Patient status on admission, including initial symptoms, initial vital signs, initial laboratory data, and transfusion volume, was collected. Three scoring systems (Rockall score, Glasgow-Blatchford score, and AIMS65 score) have been reported to be useful in predicting mortality, rebleeding, need for transfusion, and hemostasis [33–36]. These scoring systems were applied, on the basis of admission history, clinical and laboratory data, endoscopic findings, treatment, and clinical follow-up. Accumulated information concerning the cause of UGIB, endoscopic findings, and types of anesthesia drugs was also collected.

Treatment outcomes and adverse events were compared between the two groups using propensity score matching analysis. This method was applied to adjust significant differences in the baseline characteristics of the patients and reduce the influence of possible confounding factors [37]. The two groups were matched at a 1:1 ratio (133 patients in each group) with adjustment for 13 covariates (age, gender, *H. pylori* infection, use of antithrombotic agents, use of NSAIDs, chronic liver damage, Rockall score, Glasgow-Blatchford score, AIMS65 score, systolic blood pressure, diastolic blood pressure, hemoglobin level, and peptic ulcer) to minimize inherent bias. These 13 covariates were selected on the basis of the opinions of seven expert endoscopists. This model yielded a *C* statistic of 0.705, indicating a preferable ability for comparison between two groups. The caliper width of propensity score matching was 0.20.

Categorical data were expressed as a number (percentage), and chi-squared test was used to identify differences between the two groups. Numerical data for normal distribution were expressed as the mean ± standard deviation, and Student's *t*-test was used to determine differences between the two groups. Numerical data for a skewed distribution were expressed as median interquartile range, and the Mann–Whitney *U*-test was applied. Levels of significance for all comparisons made were reported, whether significant or not, with *P* values or confidence intervals. A *P* value of < 0.05 was statistically significant for each test. Survival was analyzed using Kaplan–Meier plots with log-rank tests. The Cox proportional hazard model was then used to adjust confounding factors in the analysis of 30-day mortality from UGIB. All statistical analyses were performed with JMP version 13.0.0 (SAS Institute, Tokyo, Japan).

Results

Clinical Characteristics and Endoscopic Findings of Patients with UGIB

During the period between January 2016 and December 2021, we underwent emergency endoscopy for UGIB in 402 patients. Among them, endotracheal intubation was applied in five patients, respiratory and circulatory status was unstable in three patients, and missing data were found in five patients. Thirteen patients were thus excluded, and 389 patients were assessed as eligible for the present study.

Of the 389 patients, 171 patients (44.0%) received sedation during emergency endoscopy, and the remaining 218 patients (56.0%) did not receive sedation during the procedure (Fig. 1). Baseline patient characteristics are presented in Table 1. The sedation group was significantly younger with more male patients, and had *H. pylori* infection and chronic liver disease. The use of antithrombotic agents and

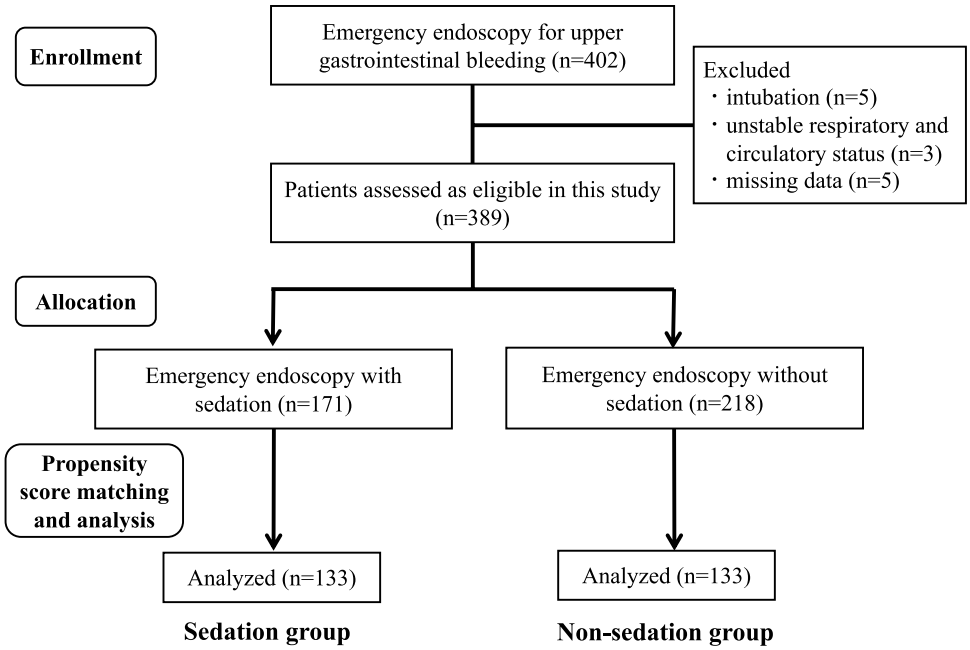

Fig. 1 Flow diagram showing selection of patients with UGIB who underwent emergency endoscopy

Table 1 Characteristics of patients

	Sedation	Nonsedation	*P* value
Number of patients (*N*)	171	218	
Age (years)	70.1 ± 13.9	74.8 ± 12.3	< 0.01
Gender, males	123 (71.9%)	133 (61.0%)	0.03
BMI (%)	21.5 ± 3.9	21.2 ± 3.8	0.48
ASA-PS classification I–II	136 (79.5%)	169 (77.5%)	0.71
Alcohol drinking	76 (44.4%)	80 (36.7%)	0.14
Smoking	81 (47.4%)	91 (41.7%)	0.30
Helicobacter pylori infection	50 (29.2%)	41 (18.8%)	0.02
Using antithrombotic agents	45 (26.3%)	86 (39.5%)	0.01
Using NSAIDs	31 (18.1%)	61 (28.0%)	0.03
Using gastric acid secretion inhibitor	57 (33.3%)	81 (37.2%)	0.46
Comorbidity			
Cardiovascular diseases	22 (12.9%)	43 (19.7%)	0.08
Cerebrovascular diseases	16 (9.4%)	27 (12.4%)	0.42
Chronic kidney diseases	28 (16.4%)	46 (21.1%)	0.25
Chronic liver diseases	46 (26.9%)	38 (17.4%)	0.03
Diabetes mellitus	49 (28.7%)	56 (25.7%)	0.57
Hypertension	90 (52.6%)	123 (56.4%)	0.47
Malignant diseases	51 (29.8%)	56 (25.7%)	0.42
Charlson comorbidity score	2.2 ± 1.8	2.0 ± 1.8	0.40
Scoring system			
Rockall score	4.4 ± 1.4	4.7 ± 1.5	0.01
Glasgow-Blatchford score	9.8 ± 4.2	10.9 ± 3.8	0.01
AIMS65 score	1.4 ± 0.9	1.6 ± 1.0	< 0.01

BMI body mass index, *ASA-PS* American Society of Anesthesiologists physical status, *NSAIDs* nonsteroidal anti-inflammatory drugs

Results are presented as mean ± SD or number of patients

NSAIDs was higher in the sedation group. Three scoring systems (Rockall score, Glasgow-Blatchford score, and AIMS65 score) were significantly higher for the sedation group.

UGIB patient status on admission is presented in Table 2. Systolic and diastolic blood pressure and hemoglobin levels were significantly higher in the sedation group. Initial laboratory data other than hemoglobin level did not differ between the sedation and nonsedation groups. There were no significant differences between the two groups in the number of patients who received RBC transfusions and the total volume of RBC transfused.

Table 3 demonstrates the endoscopic findings of UGIB. The main cause of bleeding was peptic ulcers (49.1% in the sedation group and 59.6% in the nonsedation group, $P = 0.04$). The number and size of peptic ulcers did not differ significantly between the two groups.

Administered dosages of sedatives are presented in Table S1. One hundred and thirteen patients (66.1%) were sedated using midazolam, for whom the mean dose of midazolam was 4.2 ± 1.8 mg. In addition, 54 (31.6%) and 4 (2.3%) patients underwent sedation using diazepam and propofol.

Comparison of Clinical Outcomes Between the Two Groups by Propensity Score Matching

Table 4 compares the clinical characteristics between the two groups before and after propensity score matching. Before propensity score matching, mean age, gender, *H. pylori* infection, use of antithrombotic agents, use of NSAIDs, chronic liver damage, Rockall score, Glasgow-Blatchford

Table 2 Patient status on admission

	Sedation	Nonsedation	*P* value
Initial symptoms			
Vomiting blood	83 (48.5%)	96 (44.0%)	0.41
Black stools	86 (50.3%)	108 (49.5%)	0.92
Fainting attack	7 (4.1%)	10 (4.6%)	1.00
Initial vital signs			
Systolic blood pressure (mmHg)	121.0 ± 24.4	112.7 ± 26.7	< 0.01
Diastolic blood pressure (mmHg)	66.0 ± 14.4	61.3 ± 15.3	< 0.01
Pulse rate (beats/min)	89.6 ± 19.2	87.4 ± 22.1	0.29
Respiratory rate (breaths/min)	18.3 ± 4.1	18.9 ± 3.8	0.12
Arterial oxygen saturation (%)	97.8 ± 2.1	97.3 ± 2.7	0.06
Initial laboratory data			
White blood count (k/μL)	9.03 ± 5.16	8.34 ± 6.89	0.29
Hemoglobin (g/dL)	8.9 ± 3.0	8.1 ± 2.6	< 0.01
Platelets (k/μl)	25.4 ± 39.1	33.0 ± 48.4	0.09
Albumin (mg/dL)	3.1 ± 0.7	3.0 ± 0.8	0.38
Serum creatinine (mg/dL)	1.52 ± 1.78	1.59 ± 1.64	0.68
Serum BUN (g/dL)	39.2 ± 29.8	44.1 ± 32.3	0.12
Serum AST (U/L)	45.2 ± 90.8	55.1 ± 179.5	0.48
Serum ALT (U/L)	26.5 ± 36.3	37.6 ± 117.9	0.19
Serum total bilirubin (mg/dL)	1.3 ± 2.7	0.8 ± 1.8	0.07
Prothrombin time (s)	16.6 ± 11.4	16.3 ± 8.5	0.79
APTT (s)	35.3 ± 8.2	35.4 ± 9.6	0.95
INR	1.26 ± 0.4	1.32 ± 0.6	0.26
RBC transfusion	107 (62.6%)	156 (71.6%)	0.06
Amount of blood transfused (U)	3.3 ± 5.1	3.5 ± 3.2	0.76

BUN blood urea nitrogen, *AST* aspartate aminotransferase, *ALT* alanine aminotransferase, *APTT* activated partial thromboplastin time, *PT-INR* international normalized ratio of prothrombin time, *RBC* red blood cell

Results are presented as mean ± SD or number of patients

Table 3 Endoscopic findings of UGIB

	Sedation	Nonsedation	*P* value
Causes of UGIB			
Peptic ulcer	84 (49.1%)	130 (59.6%)	0.04
Esophageal varices	34 (20.0%)	20 (9.2%)	
GERD	10 (5.9%)	16 (7.3%)	
Post ESD ulcer	15 (8.8%)	10 (4.6%)	
Angioectasia	11 (6.4%)	13 (6.0%)	
Mallory–Weiss syndrome	5 (2.9%)	11 (5.1%)	
Malignant tumor	6 (3.5%)	10 (4.6%)	
Gastritis	3 (1.8%)	4 (1.8%)	
Polyps	3 (1.8%)	4 (1.8%)	
Location of ulcer			
Gastric ulcer	60 (71.4%)	98 (75.4%)	0.61
Upper third	13 (15.5%)	21 (16.2%)	
Middle third	32 (25.7%)	43 (33.1%)	
Lower third	15 (17.9%)	34 (26.1%)	
Duodenal ulcer	24 (28.6%)	32 (24.6%)	
Number of ulcers			
Single	64 (76.2%)	103 (79.8%)	0.61
Multiple	20 (23.8%)	26 (20.2%)	
Size of ulcer (mm)			
0–10	35 (41.7%)	60 (46.2%)	0.57
> 11	49 (58.3%)	70 (53.8%)	
Forrest classification			
Ia	13 (15.5%)	14 (10.8%)	0.22
Ib	29 (34.5%)	34 (26.1%)	
IIa	21 (25.0%)	43 (33.1%)	
IIb	21 (25.0%)	39 (30.0%)	
Atrophic gastritis			
Closed type	88 (51.5%)	105 (48.2%)	0.54
Open type	83 (48.5%)	113 (51.8%)	

UGIB upper gastrointestinal bleeding, *GERD* gastroesophageal reflux disease, *ESD* endoscopic submucosal dissection

score, AIMS65 score, systolic and diastolic blood pressure, hemoglobin level, and peptic ulcer were significantly different between the two groups. Propensity score matching subsequently created 133 matched pairs in the present study and averaged the differences in 13 covariates.

Table 5 compares the treatment outcomes after propensity score matching between the two groups. The success rate of endoscopic hemostasis was similar in both groups, with a significantly shorter procedure time in the sedation group than in the nonsedation group (17.6 ± 10.0 versus 20.2 ± 10.2 min, $P = 0.04$). The main modality of hemostasis was soft coagulation between the two groups. Adverse events such as aspiration pneumonia, rebleeding, and 30-day mortality did not differ significantly between the two groups.

Survival Analysis and the Risk Factors for Mortality from UGIB

In the survival analysis, the Kaplan–Meier plot demonstrated no impact of sedation on mortality within 30 days (Fig. S1). Table 6 lists the risk factors for 30-day mortality from UGIB. The Cox proportional hazard model demonstrated that RBC transfusion and rebleeding were risk factors for 30-day mortality from UGIB: hazard ratio (HR) [95% confidence interval] 4.45 [1.50–19.11], $P < 0.01$; and HR 3.30 [1.14–8.36], $P = 0.03$. Nevertheless, sedation endoscopy was not associated with 30-day mortality after adjusting for potential confounders: HR 1.39 [0.64–3.02], $P = 0.40$.

Table 4 Characteristics of patients before and after propensity score matching

	Sedation	Nonsedation	*P* value	Standardized difference
Before propensity score matching				
Number of patients (*N*)	171	218		
Age (years)	70.1 ± 13.9	74.8 ± 12.3	< 0.01	0.36
Gender, males	123 (71.9%)	133 (61.0%)	0.03	0.23
Helicobacter pylori infection	50 (29.2%)	41 (18.8%)	0.02	0.25
Using antithrombotic agents	45 (26.3%)	86 (39.5%)	0.01	0.28
Using NSAIDs	31 (18.1%)	61 (28.0%)	0.03	0.24
Chronic liver damage	46 (26.9%)	38 (17.4%)	0.03	0.23
Rockall score	4.4 ± 1.4	4.7 ± 1.5	0.01	0.21
Glasgow-Blatchford score	9.8 ± 4.2	10.9 ± 3.8	0.01	0.27
AIMS65 score	1.4 ± 0.9	1.6 ± 1.0	< 0.01	0.21
Systolic blood pressure (mmHg)	121.0 ± 24.4	112.7 ± 26.7	< 0.01	0.32
Diastolic blood pressure (mmHg)	66.0 ± 14.4	61.3 ± 15.3	< 0.01	0.32
Hemoglobin (g/dL)	8.9 ± 3.0	8.1 ± 2.6	< 0.01	0.28
Peptic ulcer	84 (49.1%)	130 (59.6%)	0.04	0.22
After propensity score matching				
Number of patients (*N*)	133	133		
Age (years)	71.1 ± 13.8	72.7 ± 12.6	0.31	0.12
Gender, males	91 (68.4%)	92 (69.2%)	1.00	0.02
Helicobacter pylori infection	34 (25.6%)	35 (26.3%)	1.00	0.02
Using antithrombotic agents	40 (30.1%)	40 (30.1%)	1.00	0.00
Using NSAIDs	27 (20.3%)	27 (20.3%)	1.00	0.00
Chronic liver damage	34 (25.6%)	32 (24.1%)	0.89	0.03
Rockall score	4.5 ± 1.4	4.5 ± 1.4	0.96	0.00
Glasgow-Blatchford score	10.5 ± 3.7	10.1 ± 4.1	0.34	0.10
AIMS65 score	1.5 ± 1.0	1.5 ± 1.0	0.95	0.00
Systolic blood pressure (mmHg)	118.9 ± 23.4	119.4 ± 28.0	0.88	0.02
Diastolic blood pressure (mmHg)	64.4 ± 13.7	62.9 ± 15.9	0.40	0.10
Hemoglobin (g/dL)	8.4 ± 2.7	8.6 ± 2.7	0.43	0.07
Peptic ulcer	69 (51.9%)	72 (54.1%)	0.81	0.04

NSAIDs nonsteroidal anti-inflammatory drugs

Results are presented as mean ± SD or number of patients

Discussion

Endoscopic hemostasis is the gold standard for the treatment of UGIB, and more stable techniques are required in emergency situations [13–19]. The benefits of sedation in endoscopy have already been recognized, and the frequency of sedation endoscopy is increasing [20, 21]. Sedation is effective for conducting safe and secure emergency treatment if vital signs are stable, particularly when the patient is in an agitated or anxious state [38], but sedation may not be effective depending on the patient's performance status or extent of symptoms [22]. Some endoscopists hesitate to use sedation during emergency endoscopy for gastrointestinal bleeding because of concerns about potential adverse events related to sedatives, such as respiratory depression and cardiovascular instability [24]. The present study focused on whether sedatives are safe and effective when administered during emergency endoscopy in patients with UGIB.

Some cohort studies reported the safety of sedation during emergency gastrointestinal endoscopy for variceal bleeding or peptic ulcers, respectively [21, 26]. In practice, however, the source of bleeding, whether variceal or nonvariceal, is not known at the time when sedation is initiated. Therefore, this study investigated the usefulness of sedation during emergency endoscopy in patients with UGIB, including both nonvariceal and variceal bleeding. A previous report has shown that shock is more common with variceal than with nonvariceal bleeding [39]. Thus, given that there are some differences in patient background between nonvariceal and variceal bleeding, in this study we analyzed the data using propensity score matching to equalize the patient background.

Table 5 Treatment outcomes and adverse events after propensity score matching

	Sedation	Nonsedation	*P* value
Number of patients (*N*)	133	133	
Successful endoscopic hemostasis	123 (92.5%)	123 (92.5%)	1.00
Mean procedure time (min)	17.6 ± 10.0	20.2 ± 10.2	0.04
Time to emergency endoscopy ≤ 3 h	88 (66.2%)	86 (64.7%)	0.90
Main modality of hemostasis			
Soft coagulation	63 (47.4%)	63 (47.4%)	1.00
EVL	23 (17.3%)	14 (10.6%)	0.16
Thrombin spraying	17 (12.8%)	14 (10.6%)	
Hemoclips	12 (9.0%)	16 (12.0%)	
APC	3 (2.3%)	4 (3.0%)	
HSE	1 (0.8%)	3 (2.2%)	
EMR	2 (1.5%)	0 (0%)	
EIS	2 (1.5%)	0 (0%)	
Operator of hemostasis			
Trainees	77 (57.9%)	89 (66.9%)	0.16
Specialists	56 (42.1%)	44 (33.1%)	
Surgery performed	0 (0%)	0 (0%)	1.00
IVR performed	3 (2.3%)	0 (0%)	0.25
Adverse events			
Hypotension	4 (3.0%)	7 (5.3%)	0.54
Bradycardia	3 (2.3%)	3 (2.3%)	1.00
Hypoxia	2 (1.5%)	4 (3.0%)	0.68
Aspiration pneumonia	10 (7.5%)	7 (5.3%)	0.62
Rebleeding	10 (7.5%)	10 (7.5%)	1.00
30-Day mortality	12 (9.0%)	9 (6.8%)	0.65

EVL endoscopic variceal ligation, *APC* argon plasma coagulation, *HSE* hypertonic saline-epinephrine, *EMR* endoscopic mucosal resection, *EIS* endoscopic injection sclerotherapy, *IVR* interventional radiology

Results are presented as mean ± SD or number of patients

In the present study, emergency endoscopy for UGIB could be performed in a shorter time in the sedation group than in the nonsedation group. It is speculated that sedation may have calmed the patient's agitation, stabilized body movements, and allowed the endoscopist to perform emergency endoscopy more easily. Furthermore, success rates of endoscopic hemostasis were similar between the sedation group and nonsedation group. These data may indicate that the use of sedation in emergency endoscopy is useful.

Sedation endoscopy did not increase the incidence of adverse events such as aspiration pneumonia, rebleeding, and mortality compared with nonsedation endoscopy. This was also true when comparing sedated ($n = 38$) and nonsedated ($n = 85$) patients excluded from this propensity score matching analysis. The incidence of adverse events (16.5% versus 15.8%; $P = 1.00$) and 30-day mortality (7.9% versus 5.9%; $P = 0.70$) were comparable between the two groups outside the propensity score matching analysis. In addition, the incidence of these adverse events was similar to that in some previous reports [26, 40, 41]. Therefore, we believe that sedatives can be safely used during emergency endoscopy for UGIB.

In the Cox multivariate analysis, risk factors for 30-day mortality after endoscopic hemostasis with UGIB were RBC transfusion and rebleeding, which have previously been reported as risk factors for mortality from UGIB [26, 33], and the present study was no different in this regard. Sedation endoscopy did not increase mortality in patients with UGIB, demonstrating that sedation is not directly related to the cause of death in patients with UGIB. Sedation is considered safe in emergency endoscopy because it does not adversely affect the course of treatment of UGIB in the short term.

Table 6 Univariate and multivariate analysis of risk factors for 30-day mortality of UGIB

Factors	Kaplan–Meier	Cox multivariate analysis			
	P value	Hazard ratio	95% CI		*P* value
Age, > 70 years	0.66	1.03	0.44	2.51	0.94
Sex, male	0.43	1.38	0.61	3.43	0.45
Using antithrombotic agents	0.74	1.01	0.42	2.29	0.97
Chronic liver damage	0.41	1.56	0.61	3.71	0.34
Malignant diseases	0.20	0.54	0.18	1.34	0.19
AIMS65 score ≥ 2	0.74	0.97	0.43	2.15	0.97
Systolic blood pressure, < 110 mmHg	0.24	1.48	0.67	3.29	0.33
RBC transfusion	0.01	4.45	1.50	19.11	< 0.01
Peptic ulcer	0.66	0.68	0.32	1.47	0.33
Sedation endoscopy	0.41	1.39	0.64	3.02	0.40
Successful endoscopic hemostasis	0.65	1.02	0.22	3.14	0.98
Mean procedure time, 20 > min	0.82	1.08	0.49	2.33	0.84
Aspiration pneumonia	0.54	0.99	0.23	2.91	0.99
Rebleeding	0.01	3.30	1.14	8.36	0.03

UGIB upper gastrointestinal bleeding, *RBC* red blood cell, *95% CI* 95% confidence interval

The present study has several limitations. It was a single-center study, and the number of patients was small. Being a retrospective study there was a patient selection bias, and the use of sedatives was at the discretion of the endoscopist. Although propensity score matching analysis was applied to minimize the difference in clinical characteristics between the two groups, the results of the present study should be interpreted with caution. Further prospective studies with a larger number of subjects should be carried out to validate our results.

In conclusion, sedation reduces endoscopic procedure time for UGIB, and sedatives can be used safely during emergency endoscopy.

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Author's contribution D.Y. designed the research; D.Y., G.N., Y.M., T.N., A.J, K.G., R.A., S.I., S.K., S.F., A.S., A.J., Y.T., K.I., Y.T., W.Y., N.H., T.M., K.A., and S.T. performed sedative endoscopy, acquired the patient data, and made substantial contributions to the conception; D.Y. designed the work; D.Y. analyzed the data; D.Y., Y.S., and M.E. wrote the paper; M.E. was a major contributor in writing the manuscript. All authors read and approved the submitted version, and approved the final manuscript. All authors have agreed both to be personally accountable for the author's contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated and resolved, and the resolution documented in the literature.

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

Declarations

Conflict of interest The authors declare that they have no competing interests.

Ethical approval This study was conducted in accordance with the Declaration of Helsinki and the guidelines of the Consolidated Standards of Reporting Trials (CONSORT). The study protocol and the consent procedure were approved by the Ethics Review Committee of the National Hospital Organization Ureshino Medical Center (approval number 20-86).

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