

ABC score is an effective predictor of outcomes in peptic ulcer bleeding

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Abstract

Background: Risk stratification is recommended for patients with gastrointestinal (GI) bleeding. The ABC score is a new scoring tool with high accuracy for upper and lower GI bleeding. We aimed to evaluate the effectiveness of the ABC score in predicting the outcomes of patients with peptic ulcer bleeding.

Methods: This single-center retrospective study included 809 patients, each with symptoms of upper GI bleeding, and who were diagnosed with ulcerative lesions between October 2011 and March 2021. The association between the ABC score's variables and the patients' outcome was analyzed. The score's performance in predicting the patients' outcome was validated using receiver-operating characteristic curve analysis and compared with that of other scores.

Results: The study analyzed 772 patients with peptic ulcer bleeding. The primary outcome measure was all-cause 30-day mortality. Secondary outcome measures included rebleeding within 30 days and the need for radiologic/surgical intervention. Age ($P = .013$), serum albumin levels ($P < .001$), serum creatinine levels ($P = .004$), mental status ($P < .001$), and American Society of Anesthesiologists score ($P < .001$) were associated with the primary outcome. The ABC score predicted the 30-day mortality (area under the receiver-operating characteristic curve [AUROC] 0.927; 95% confidence interval [CI] 0.899–0.956) better than other scores. However, it was less accurate in predicting rebleeding (AUROC 0.630; 95% CI 0.563–0.697) and need for radiologic/surgical intervention (AUROC 0.641; 95% CI 0.550–0.732).

Conclusions: The ABC score accurately predicts the 30-day mortality in patients with peptic ulcer bleeding. However, it may not be suitable for predicting rebleeding or the need for radiologic/surgical interventions.

Abbreviations: ASA = American Society of Anesthesiologists, AUROC = area under the receiver-operating characteristic curve, CI = confidence interval, GBS = Glasgow-Blatchford score, GI = gastrointestinal, NPV = negative predictive value, PPV = positive predictive value, PUD = peptic ulcer disease, UGIB = upper gastrointestinal bleeding.

Keywords: endoscopy, gastrointestinal hemorrhage, mortality, peptic ulcer hemorrhage, sensitivity, specificity

1. Introduction

Acute upper gastrointestinal bleeding (UGIB) is an emergency condition with high morbidity and economic burden.^[1,2] The reported incidence of UGIB is 37–172/100,000 adults.^[3,4] Peptic ulcer disease (PUD) is the main cause of bleeding and is responsible for 28% to 59% of UGIB cases.^[5] Despite advances in the treatment of PUD, such as endoscopic techniques and anti-ulcer medication, PUD is still associated with a high admission and mortality rate.^[6] Several factors may increase the incidence of PUD, such as age and use of non-steroidal anti-inflammatory drugs.^[7] Elderly patients have more

comorbidities and tend to experience worse prognoses than younger patients.^[8]

Patients with UGIB present with a range of severities, from insignificant bleeding to death.^[9] Several prognostic systems, including the Glasgow-Blatchford score (GBS),^[10] AIMS65,^[11] and MAP(ASH) score^[12] are available to identify high-risk patients. The ABC score is a relatively new scoring tool proposed by Laursen et al in 2021 to predict mortality in acute upper and lower gastrointestinal (GI) bleeding.^[13] The 8 parameters of the ABC score are as follows: age, urea, albumin, creatinine, altered mental status, liver cirrhosis, disseminated malignancy, and American Society of Anesthesiologists (ASA)

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

Ethics approval was obtained for all protocols from the local institutional review board (IRB) (IRB file number: CNUH2021-10-058), confirming that the study met national and international guidelines for research involving humans, and was conducted in accordance with the tenets of the Declaration of Helsinki or comparable ethical standards. The requirement for informed consent from patients was waived owing to the retrospective nature of this study.

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score (Table 1). Because parameters such as albumin, altered mental status, and liver cirrhosis may be associated with variceal bleeding, we investigated whether this scoring tool can be used in patients with peptic ulcer bleeding. We statistically analyzed the association between the parameters and patient outcomes. We also checked the validity of the ABC score by comparing it with other scoring tools.

2. Methods

2.1. Study design and population

This study was designed as a single-center retrospective analysis and included patients with peptic ulcer bleeding between October 2011 and March 2021 at the Chungnam National University Hospital. Peptic ulcer bleeding was defined as the occurrence of melena, hematemesis, hematochezia, and an unexplained decrease in hemoglobin levels, in which subsequent endoscopy revealed the source of bleeding to be a peptic ulcer.^[14] This study included only patients who visited the emergency room or outpatient department; therefore, patients already hospitalized for other causes were not considered. Our exclusion criteria included patients presenting with the following: an iatrogenic ulcer caused by therapeutic procedures such as endoscopic mucosal resection or endoscopic submucosal dissection; an ulcer diagnosed as cancer; an esophageal ulcer; and failure to follow-up for 30 days from the presentation of symptoms.

Ethics approval was obtained for all protocols from the local institutional review board (IRB) (IRB file number: CNUH2021-10-058). The requirement for informed consent from patients was waived owing to the retrospective nature of this study.

2.2. Study outcomes

The primary outcome measure was all-cause 30-day mortality. Secondary outcome measures included: rebleeding within 30 days and the need for radiological and surgical intervention to stop bleeding.

2.3. Statistical analyses

Variables examined for the primary outcome included demographic factors (age and sex), the 8 components of the ABC score, rebleeding, and the need for radiologic/surgical

intervention. Chi-squared test, Fisher's exact test, and the *t* test were used to determine the relationship between the variables and the patients' outcome. Statistical significance was set at $P < .05$.

The discriminative abilities of the ABC score to predict the primary and secondary outcomes were evaluated by receiver-operating characteristic curve analysis with 95% confidence intervals (CIs). The optimal cutoff value was determined using the Youden index.^[15] Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated at the cutoff point. The performance of the ABC score was compared with that of other known scoring tools, including AIMS65, MAP(ASH), and GBS. Data were analyzed using IBM SPSS Statistics for Windows version 26 (IBM Corp., Armonk, NY) software.

3. Results

3.1. Patient characteristics

We reviewed 809 patients hospitalized with symptoms of GI bleeding. All patients had been diagnosed with ulcer bleeding in the upper GI tract by endoscopy. We excluded 37 patients: 30 patients diagnosed with diseases other than peptic ulcer (16: iatrogenic ulcer due to endoscopic mucosal resection or endoscopic submucosal dissection, 12: cancer bleeding, and 2: esophageal ulcer) and 7 patients who failed to follow-up for 30 days. The study included the remaining 772 patients (Fig. 1), whose median age was 65.2 years, and 73.8% of the patients were men. Patients presented with the following symptoms: melena, 461 (59.7%); hematemesis, 233 (30.2%); hematochezia, 47 (6.1%); and a decrease in hemoglobin levels, 31 (4.0%). Sources of bleeding were revealed as gastric ulcer in 553 (71.6%) patients and as duodenal ulcer in 219 (28.4%) patients.

3.2. Primary outcome

The primary outcome group comprised 20 patients (2.6%). Among the ABC score parameters, age ($P = .004$), serum albumin ($P < .001$), serum creatinine ($P = .004$), mental status ($P < .001$), and ASA score ($P < .001$) were significantly associated with 30-day mortality. Additionally, rebleeding ($P < .001$) was associated with 30-day mortality (Table 2).

The ABC score outperformed other scoring tools in predicting 30-day mortality (area under the receiver-operating characteristic curve [AUROC] 0.927; 95% confidence interval [CI] 0.899–0.956). In comparison, the AUROC of the other tools were as follows: 0.821 (95% CI 0.745–0.898) for AIMS65, 0.825 (95% CI 0.736–0.914) for MAP(ASH), and 0.752 (95% CI 0.636–0.869) for GBS (Fig. 2, Table 3).

The ABC score also had the highest accuracy for predicting the 30-day mortality, with an optimal cutoff point of 7, as determined by the Youden index. The sensitivity and specificity at the cutoff point were 90.0% and 86.0%, respectively. The sensitivity, specificity, PPV, NPV, and accuracy of the other scoring tools are shown in Table 4.

3.3. Secondary outcomes

Rebleeding occurred in 80 patients (10.4%) within 30 days, and radiological or surgical intervention was required in 33 patients (4.3%). The ABC score was less accurate at predicting the secondary outcomes (AUROC 0.632, 95% CI 0.570–0.694) (Fig. 3). AUROC, sensitivity, specificity, PPV, NPV, and accuracy of the ABC score for each secondary outcome are shown in Table 5.

Table 1

The ABC score for the prediction of 30-day mortality.

| Variable | Assigned score |
|-------------------------|----------------|
| Age | |
| 60–74 years | 1 |
| ≥75 years | 2 |
| Blood tests | |
| Urea > 10 mmol/L | 1 |
| Albumin < 30 g/L | 2 |
| Creatinine | |
| 100–150 μmol/L | 1 |
| >150 μmol/L | 2 |
| Comorbidity | |
| Altered mental status | 2 |
| Liver cirrhosis | 2 |
| Disseminated malignancy | 4 |
| ASA score | |
| 3 | 1 |
| ≥4 | 3 |

ABC = age, blood tests, and comorbidities, ASA = American Society of Anaesthesiologists.

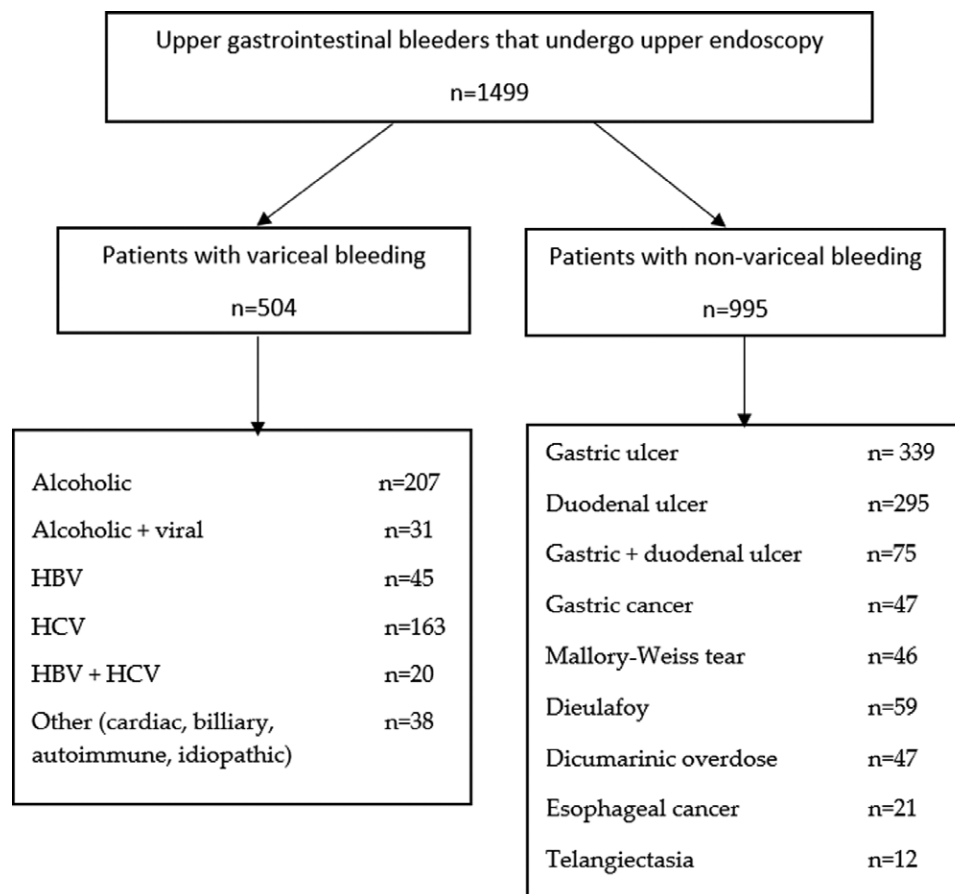


Figure 1. Study enrollment. GI = gastrointestinal.

4. Discussion

Just as risk assessment can be used to predict rebleeding and mortality rate in patients with peptic ulcer bleeding, it is recommended to use scoring tools as an indicator to decide patients' admission, treatment in the intensive care unit, and endoscopy timing.^[16,17] The ability to select patients who will benefit the most from intensive treatment is an important step in the rational use of resources.^[18]

In this study, we validated the ABC score in Korean populations with peptic ulcer bleeding. The ABC score was reported to have high accuracy in predicting 30-day mortality in both upper and lower GI bleeding.^[13] Some parameters of the score, such as albumin level and liver cirrhosis, are associated with variceal bleeding. Hence, its utility in cases of non-variceal upper GI bleeding, such as peptic ulcers, should be investigated.

We found that the ABC score was an excellent predictor of 30-day mortality, yielding an AUROC of 0.927 (95% CI 0.899–0.956). This result was higher than those of AIMS65, GBS, and MAP(ASH). However, the scores were similar in their ability to predict the secondary outcomes of rebleeding and the need for radiological or surgical intervention to stop bleeding.

The ABC score has 8 variables that are predictors of 30-day mortality (age, albumin, creatinine, altered mental status, liver cirrhosis, disseminated malignancy, ASA score) and low risk of death (urea).^[13] In the current study, 5 out of the 8 variables of the ABC score (age, albumin, creatinine, altered mental status, ASA score) showed a statistically significant association with the 30-day mortality. However, 3 components (urea, liver cirrhosis, and disseminated malignancy) were not associated with the 30-day mortality. This may be attributed to the different characteristics of patients as our study excluded bleeding other than peptic ulcer bleeding such as variceal bleeding. Considering this, it is notable that hypoalbuminemia is a significant predictor of

mortality because hypoalbuminemia is usually accompanied by liver dysfunction and variceal bleeding. Furthermore, hypoalbuminemia is a risk factor for mortality owing to some diseases as it is associated with several debilitating clinical conditions such as malnutrition and diabetes.^[19] Our study reinforces these known risk factors, proving that hypoalbuminemia remains a valid predictor of mortality in peptic ulcer bleeding.

Rebleeding and the need for radiologic or surgical intervention to stop peptic ulcer bleeding may be indicators of severe peptic ulcer or difficult location to manage endoscopically. In the present study, patients with rebleeding had significantly higher 30-day mortality rates ($P < .001$); however, the ABC score showed disappointing results with respect to predicting mortality. However, the ABC score was not inferior to other scores such as GBS, AIMS65, and MAP(ASH).

Our study has several limitations. Firstly, since this study was designed as a single-center retrospective study using medical records, the number of patients is small, especially in the mortality group ($n = 20$). Further prospective multicenter studies with larger patient groups would strengthen the reliability of the ABC score. Secondly, only patients who underwent endoscopy were included, which might have created a selection bias. Thirdly, this study was limited to patients with peptic ulcer bleeding; therefore, the results may be different in other clinical settings. Finally, ethnic differences should be considered, as this study included only Korean patients.

5. Conclusions

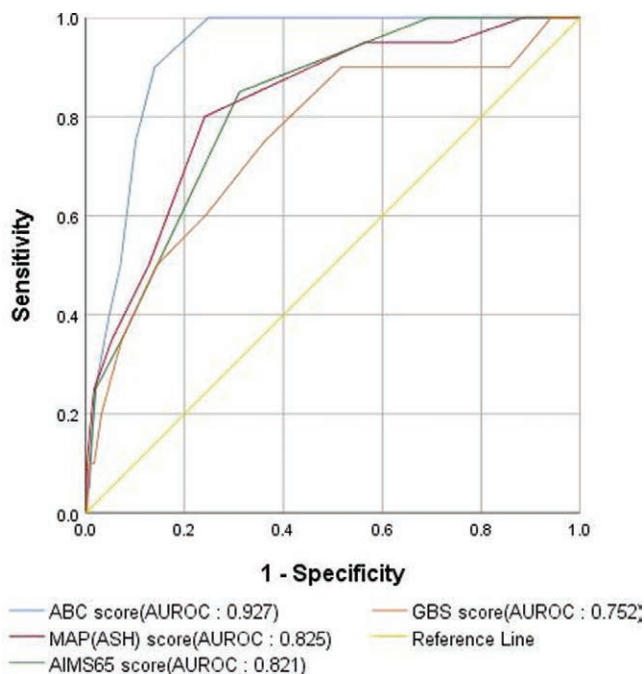
The present study targeted patients with peptic ulcer bleeding irrespective of their age, sex, or underlying diseases. In this study, an AUROC of 0.927 was obtained, which is considerably

Table 2
Characteristics of alive and dead patients, n (%).

| Characteristic | | Total (n = 772) | Alive (n = 752) | Dead (n = 20) | P-value |
|----------------------------------|-----------|-----------------|-----------------|---------------|---------|
| Sex | Male | 570 (73.8) | 555 (73.8) | 15 (75.0) | .904 |
| | Female | 202 (26.2) | 197 (26.2) | 5 (25.0) | |
| Age | Mean ± SD | 65.2 ± 15.5 | 64.9 ± 15.6 | 75.0 ± 10.9 | .004 |
| | <60 | 260 (33.7) | 259 (34.4) | 1 (5.0) | .013 |
| | 60–74 | 266 (34.5) | 258 (34.3) | 8 (40.0) | |
| Urea (mmol/L) | ≥75 | 246 (31.8) | 235 (31.3) | 11 (55.0) | |
| | Mean ± SD | 15.5 ± 9.2 | 15.4 ± 9.2 | 19.0 ± 10.2 | .085 |
| | ≤10 | 220 (28.5) | 216 (28.7) | 4 (20.0) | .394 |
| Albumin (g/dL) | >10 | 552 (71.5) | 536 (71.3) | 16 (80.0) | |
| | Mean ± SD | 3.2 ± 0.6 | 3.17 ± 0.6 | 2.49 ± 0.6 | <.001 |
| | <3 | 281 (36.4) | 263 (35.0) | 18 (90.0) | <.001 |
| Creatinine (μmol/L) | ≥3 | 491 (63.6) | 489 (65.0) | 2 (10.0) | |
| | Mean ± SD | 130.6 ± 165.5 | 128.6 ± 163.7 | 205.8 ± 213.6 | .039 |
| | <100 | 524 (67.9) | 517 (68.8) | 7 (35.0) | .004 |
| Mental status | 100–150 | 130 (16.8) | 124 (16.4) | 6 (30.0) | |
| | >150 | 118 (15.3) | 111 (14.7) | 7 (35.0) | |
| | Alert | 750 (97.2) | 735 (97.7) | 15 (75.0) | <.001 |
| Liver cirrhosis | Altered | 22 (2.8) | 17 (2.3) | 5 (25.0) | |
| | No | 738 (95.6) | 720 (95.7) | 18 (90.0) | .219 |
| Disseminated malignancy | Yes | 34 (4.4) | 32 (4.3) | 2 (10.0) | |
| | No | 736 (95.3) | 719 (95.6) | 17 (85.0) | .061 |
| ASA score | Yes | 36 (4.7) | 33 (4.4) | 3 (15.0) | |
| | ≤2 | 341 (44.2) | 341 (45.3) | 0 (0.0) | <.001 |
| | 3 | 343 (44.4) | 340 (45.2) | 3 (15.0) | |
| Rebleeding | ≥4 | 88 (11.4) | 71 (9.4) | 17 (85.0) | |
| | No | 692 (89.6) | 680 (90.4) | 12 (60.0) | <.001 |
| Radiologic/surgical intervention | Yes | 80 (10.4) | 72 (9.6) | 8 (40.0) | |
| | No | 739 (95.7) | 721 (95.9) | 18 (90.0) | .209 |
| | Yes | 33 (4.3) | 31 (4.1) | 2 (10.0) | |

Mean ± SD tested using the *t* test.

n (%) tested using the chi-square test and Fisher's exact test.

**Figure 2.** Comparison of the ABC score, AIMS65, MAP(ASH), and GBS in the prediction of primary outcome (30-day mortality) in peptic ulcer bleeding. AUROC = area under the receiver-operating characteristic curve.

favorable; this value can be used as evidence to support that the ABC score aids in predicting mortality with high accuracy in patients with peptic ulcer bleeding. However, this study included only Korean patients and was performed in a single center where the endoscopic procedure could be performed throughout the

Table 3
AUROC for the 4 scoring tools for the primary outcome.

| Score | AUROC | SE | 95% CI | | Significance |
|----------|-------|-------|--------|-------|--------------|
| | | | Lower | Upper | |
| ABC | 0.927 | 0.015 | 0.899 | 0.956 | <0.001 |
| AIMS65 | 0.821 | 0.039 | 0.745 | 0.898 | <0.001 |
| MAP(ASH) | 0.825 | 0.045 | 0.736 | 0.914 | <0.001 |
| GBS | 0.752 | 0.059 | 0.636 | 0.869 | <0.001 |

AUROC = area under the receiver operating characteristic curve, CI = confidence interval, SE = standard error.

Table 4
Discriminative abilities of the 4 scoring tools for the primary outcome.

| Score | Cutoff point | Sensitivity | Specificity | PPV | NPV | Accuracy |
|----------|--------------|-------------|-------------|------|------|----------|
| ABC | 7 | 90.0 | 86.0 | 14.6 | 99.7 | 85.5 |
| AIMS65 | 2 | 85.0 | 68.9 | 6.8 | 99.4 | 68.8 |
| MAP(ASH) | 4 | 80.0 | 75.9 | 8.1 | 99.3 | 75.4 |
| GBS | 12 | 75.0 | 63.8 | 5.2 | 99.0 | 63.6 |

GBS = Glasgow-Blatchford score, NPV = negative predictive value, PPV = positive predictive value.

day by endoscopists. Results may vary depending on the races of patients or the different availability of medical resources in other centers. Therefore, a wider range of data is recommended.

Author contributions

All authors contributed to the study conception and design. HSM and HYJ designed and directed the study. SHK and JKS

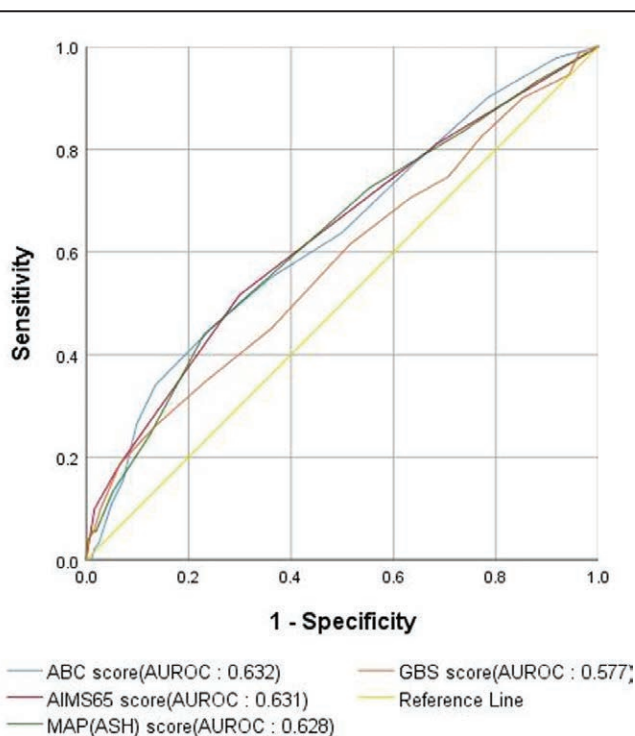


Figure 3. Comparison of the ABC score, AIMS65, MAP(ASH), and GBS in the prediction of secondary outcomes (rebleeding and need for radiologic/surgical intervention) in peptic ulcer bleeding. AUROC = area under the receiver operating characteristic curve.

Table 5
Discriminative abilities of the ABC score for the secondary outcomes.

| Outcome | AUROC (95% CI) | Cutoff point | Sensitivity | Specificity | PPV | NPV | Accuracy |
|----------------------------------|---------------------|--------------|-------------|-------------|------|------|----------|
| Rebleeding | 0.630 (0.563–0.697) | 7 | 36.3 | 86.4 | 23.6 | 92.1 | 80.6 |
| Radiologic/surgical intervention | 0.641 (0.550–0.732) | 5 | 57.6 | 62.7 | 6.4 | 97.1 | 62.0 |

AUROC = area under the receiver operating characteristic curve, CI = confidence interval, NPV = negative predictive value, PPV = positive predictive value.

collected and processed the data. SWC performed the statistical analysis and designed the figures. The first draft of the manuscript was written by HS, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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