

# Effectiveness of Combined Application of Shock Index and Early Warning Scoring System in Patients with Acute Gastrointestinal Hemorrhage

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**Abstract:** *Objective:* To explore the effect of the combined application of the Shock Index (SI) and the Early Warning Score (EWS) in patients with acute gastrointestinal bleeding. *Methods:* Seventy patients with acute gastrointestinal bleeding admitted to a hospital from June 2022 to May 2024 were selected and randomly divided into two groups: the control group and the observation group, with 35 patients in each group. The control group received conventional emergency care measures, while the observation group received SI combined with NEWS emergency care measures. The treatment effects in both groups were compared. *Results:* The observation group had shorter waiting times for consultation ( $4.45 \pm 1.59$  minutes), intravenous access establishment ( $6.79 \pm 2.52$  minutes), hemostasis time ( $4.41 \pm 1.52$  hours), and hospital stays ( $8.39 \pm 2.13$  days) compared to the control group, which had times of  $5.46 \pm 1.34$  minutes,  $8.41 \pm 2.16$  minutes,  $5.16 \pm 1.47$  hours, and  $10.26 \pm 2.98$  days, respectively. The differences were statistically significant ( $P < 0.05$ ). Before management, there were no significant differences in the levels of hemoglobin, prealbumin, and serum protein between the two groups ( $P > 0.05$ ). However, after systematic emergency management, the serum indexes in both groups significantly improved, with the observation group showing greater improvement than the control group, and these differences were statistically significant ( $P < 0.05$ ). In the observation group, only one case of cardiovascular complications occurred during the rescue period, with an incidence rate of 2.86%. In contrast, the control group experienced eight cases of complications, including hemorrhagic shock, anemia, multi-organ failure, cardiovascular complications, and gastrointestinal rebleeding, with an incidence rate of 22.85%. The difference between the groups was statistically significant ( $P < 0.05$ ). *Conclusion:* The application of SI combined with EWS emergency care measures in patients with acute gastrointestinal hemorrhage can effectively improve serum indexes, shorten resuscitation time and hospital stay, and reduce the risk of complications such as hemorrhagic shock, anemia, infection, multi-organ failure, cardiovascular complications, acute renal failure, and gastrointestinal rebleeding. This approach has positive clinical application value.

**Keywords:** Acute gastrointestinal bleeding; Shock Index; Early Warning Score; Clinical assessment; Prognosis optimization

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## 1. Introduction

Acute gastrointestinal bleeding (AGIB) is a common acute condition in clinical practice, characterized by rapid onset, severe symptoms, and numerous complications <sup>[1]</sup>. Patients with AGIB experience hemodynamic instability due to massive blood loss and may suffer serious complications such as shock and multi-organ failure, posing a significant threat to their lives. Therefore, quickly and accurately assessing the patient's condition and implementing effective interventions have become important topics in clinical research <sup>[2]</sup>.

The Shock Index (SI) is a commonly used rapid assessment tool in clinical practice, designed to evaluate a patient's hemodynamic status through the ratio of heart rate to systolic blood pressure. Studies have shown that the Shock Index is closely related to patient prognosis. However, the Shock Index provides only limited hemodynamic information and cannot fully reflect changes in the patient's condition <sup>[3]</sup>.

The Early Warning Score (EWS) is a comprehensive assessment tool that can identify patients with deteriorating conditions by monitoring basic vital signs (e.g., respiratory rate, heart rate, blood pressure, and temperature) and their trends. It has been shown to be effective in the early identification and intervention of patients with acute and critical illnesses in various clinical areas <sup>[4]</sup>.

This study analyzes the effectiveness of the combined application of SI and EWS in patients with acute gastrointestinal hemorrhage through a clinical trial.

## 2. Materials and methods

### 2.1. General information

Seventy patients with AGIB treated at a hospital between June 2022 and May 2024 were selected and randomly divided into two groups: the control group and the observation group, with 35 patients in each group. The age range of patients in the control group was 19–72 years, with a mean age of  $46.2 \pm 13.1$  years; among them, 23 were male and 12 were female, and they received routine emergency ambulance management. The observation group had an age range of 18–73 years, with a mean age of  $45.0 \pm 11.8$  years; 22 were male and 13 were female, and they received the SI and EWS in combination with emergency ambulance management measures. There were no significant differences between the two groups in terms of age, gender, severity of the disease, and other basic characteristics ( $P > 0.05$ ), indicating they were comparable.

### 2.2. Inclusion and exclusion criteria

Inclusion criteria:

- (1) Met the diagnostic criteria for AGIB.
- (2) Aged between 18 and 73 years old.
- (3) Agreed to participate in the study and signed the informed consent.
- (4) Had complete clinical data and follow-up records.

Exclusion criteria:

- (1) Patients with severe cardiac, hepatic, or renal failure, and other serious bleeding or coagulation disorders.
- (2) Pregnant or lactating women.
- (3) Patients with mental illness or cognitive disorders who were unable to cooperate with treatment and follow-up.
- (4) Patients in critical condition at the time of admission with a survival time of less than 24 hours.

## 2.3. Methodology

### 2.3.1. Control group

Patients received routine emergency ambulance management. After arriving at the hospital, an initial consultation was conducted to understand the patient’s medical history and current symptoms. A comprehensive assessment was then performed, followed by laboratory tests such as blood routine, coagulation function, liver and kidney function, and imaging tests to clarify the diagnosis and assess the degree of bleeding. Intravenous access was established for subsequent treatment. Patients were instructed to rest in bed and limit activity to reduce the risk of bleeding. All patients were placed under cardiac monitoring and provided oxygen to maintain vital signs stability. If a patient’s condition was critical, emergency measures such as blood transfusion or fluid resuscitation were administered to replenish blood volume and improve circulatory status. Symptomatic treatment, including the use of hemostatic drugs, acid-suppressing drugs, and antibiotics if necessary, was provided according to medical advice to control the condition’s progression and prevent infection. Once the patient’s condition stabilized, consultations with relevant departments were conducted to comprehensively assess the patient’s condition and treatment needs, ensuring sustained care and laying a solid foundation for subsequent specialized treatment.

### 2.3.2. Observation group

Patients received joint SI and EWS emergency ambulance management:

- (1) Scoring method and grading: The Shock Index (SI) reflects the patient’s bleeding volume and speed, calculated as heart rate ÷ systolic blood pressure. SI grading is as follows: SI = 1 indicates mild shock;  $1 < SI \leq 1.5$  indicates moderate shock;  $SI > 1.5$  indicates severe shock. The Early Warning Score (EWS) criteria are shown in **Table 1**. The total score ranges from 0 to 21 points. A score of 0 to 4 is low risk, corresponding to disease classification III/IV; a score of 5 to 6 or a single-dimension score of 3 is medium risk, corresponding to disease classification II; a score of  $\geq 7$  is high risk, corresponding to disease classification I. The SI aligns with the NEWS disease classification, and SI data were extracted from the EWS database.

**Table 1.** EWS scoring criteria

Dimension	3 points	2 points	1 point	0 point
Body temperature (°C)	$\leq 35.0$	$\geq 39.1$	35.1–36.0 / 38.1–39.0	36.1–38.0
Respiration (breaths/min)	$\leq 8 / \geq 25$	21–24	9–11	12–20
Heart rate (beats/min)	$\leq 40 / \geq 131$	91–130	41–50 / 91–110	51–90
Systolic blood pressure (mmHg)	$\leq 90 / \geq 220$	91–100	101–110	111–219
Oxygen saturation (%)	$< 91$	92–93	94–95	$\geq 96$
Oxygen support	-	<i>Present</i>	-	Absent
Consciousness	Unconscious	Responds to “one” radical in Chinese characters (Kangxi radical 1)	Responds to “one” radical in Chinese characters (Kangxi radical 1)	Alert

- (2) Application: Upon hospital admission, patient data were entered into the system within 3 minutes, and the system automatically calculated the score and condition grading for zoned rescue treatment. The emergency area was divided into Zone A (Resuscitation Room), Zone B (Resuscitation Room), and Zone C (Observation Room).

- (a) Zone A (Resuscitation Room): For Class I patients. All necessary medications and instruments for gastrointestinal hemorrhage resuscitation are available in the resuscitation room. During patient transfer, notify the doctor to standby in the resuscitation room and contact the gastroenterology department for consultation. An EMT at level N3 or above assists in resuscitation and continuously monitors the patient's vital signs.
- (b) Zone B (Resuscitation Room): For Class II patients. The transfer process is supervised by level N3 first-aiders. Upon arrival at the ward, the doctor assesses and diagnoses the patient's condition, assists with relevant examinations, and provides treatment according to medical advice; vital signs are monitored every 2 hours.
- (c) Zone C (Observation Room): For Class III/IV patients, supervised by level N2 first-aiders. Assist patients with examinations and therapeutic interventions according to medical advice, and monitor vital signs every 4 hours.

## 2.4. Observation indicators

Observed and recorded rescue times (consultation waiting time, time for establishing venous access, and hemostasis time), hospital stay duration, and the occurrence of hemorrhagic shock, anemia, multi-organ failure, cardiovascular complications, and gastrointestinal rebleeding during the rescue period in both groups. Total incidence rate = number of cases / total number of cases × 100%. Fasting blood samples were collected from the upper limb vein before and one week after the rescue, measuring levels of hemoglobin, prealbumin, and serum protein, and observing changes in serum indexes.

## 2.5. Statistical analysis

SPSS 24.0 statistical software was used to analyze and process the relevant data. Measured data were expressed as mean ± standard deviation (SD) and compared using a *t*-test; count data were expressed as [*n* (%)] and compared using a  $\chi^2$  test. A *P*-value of < 3..05 was considered statistically significant.

## 3. Results

### 3.1. Comparison of resuscitation time and hospitalization time between the two groups

The waiting time for consultation, time for establishment of venous access, time for hemostasis, and hospital stay of patients in the observation group were shorter than those in the control group, and the differences were statistically significant (*P* < 0.05). See **Table 2**.

**Table 2.** Comparison of resuscitation time and length of hospital stay between the two groups (mean ± SD)

Groups	Waiting time for consultation (min)	Time for establishment of venous access (min)	Time for hemostasis (h)	Hospital stay (d)
Control group ( <i>n</i> = 35)	5.46 ± 1.34	8.41 ± 2.16	5.16 ± 1.47	10.26 ± 2.98
Observation group ( <i>n</i> = 35)	4.45 ± 1.59	6.79 ± 2.52	4.41 ± 1.52	8.39 ± 2.13
<i>t</i>	2.8736	2.8876	2.0984	3.0203
<i>P</i>	0.0054	0.0052	0.0396	0.0036

### 3.2. Comparison of serum indices before and after ambulance management in the two groups

Before ambulance management, there were no significant differences in the levels of hemoglobin, prealbumin, and serum protein between the two groups ( $P > 0.05$ ). However, after systematic ambulance management, the serum indices of both groups significantly increased, with the observation group showing higher levels than the control group, and these differences were statistically significant ( $P < 0.05$ ). See **Table 3**.

**Table 3.** Comparison of serological indices between the two groups of patients before and after management (mean  $\pm$  SD)

Groups	Hemoglobin (g/L)		Prealbumin (mg/L)		Serum protein (mg/L)	
	Before	After	Before	After	Before	After
Control group ( $n = 35$ )	91.86 $\pm$ 5.59	102.53 $\pm$ 6.35 <sup>#</sup>	0.22 $\pm$ 0.04	0.42 $\pm$ 0.03 <sup>#</sup>	29.85 $\pm$ 2.11	31.87 $\pm$ 2.34 <sup>#</sup>
Observation group ( $n = 35$ )	91.78 $\pm$ 5.27	106.13 $\pm$ 5.44 <sup>#</sup>	0.23 $\pm$ 0.05	0.44 $\pm$ 0.02 <sup>#</sup>	29.63 $\pm$ 2.21	33.42 $\pm$ 2.45 <sup>#</sup>
<i>t</i>	0.0616	2.5448	0.9239	3.2817	0.4260	2.7066
<i>P</i>	0.9511	0.0132	0.3588	0.0016	0.6715	0.0086

Comparison before and after ambulance management within the group <sup>#</sup> $P < 0.05$

### 3.3. Comparison of the occurrence of complications during ambulance service in the two groups

The complication rate during ambulance service in the observation group was significantly lower than that in the control group, and the difference was statistically significant ( $P < 0.05$ ). See **Table 4**.

**Table 4.** Comparison of complication rates between two groups [ $n$  (%)]

Groups	Hemorrhagic shock	Anemic	Multi-organ failure	Cardiovascular complications	Rebleeding of the digestive tract	Rate of occurrence
Control group ( $n = 35$ )	1 (2.86)	1 (2.86)	3 (8.57)	1 (2.86)	2 (5.71)	8 (22.85)
Observation group ( $n = 35$ )	0	0	0	1 (2.86)	0	1 (2.86)
$\chi^2$						4.5902
<i>P</i>						0.0322

## 4. Discussion

AGIB is a common clinical emergency with various triggers, including peptic ulcer, rupture of esophagogastric fundal varices, acute gastric mucosal lesions, malignant tumors, and inflammatory bowel disease. The clinical manifestations are varied and easy to recur, posing serious threats to patients' lives and health <sup>[5]</sup>. Therefore, in emergency management, rapid identification, assessment of the degree of bleeding, and timely adoption of scientific and effective emergency care plans are essential to improve the success rate of treatment <sup>[6]</sup>. Despite great progress in modern medical technology, there are still major difficulties in the treatment of AGIB.

Firstly, the uncertainty of the rate and amount of bleeding causes the condition to develop rapidly, which can easily lead to hemorrhagic shock in patients. Secondly, the location and degree of bleeding vary with different etiologies, posing a challenge to diagnosis and treatment. Thirdly, patients are usually associated with underlying diseases or multiple comorbidities, increasing the complexity of treatment <sup>[7]</sup>. Fourthly, the high incidence of rebleeding makes it difficult to completely resolve the problem with conventional treatment.

In routine emergency ambulance management, the assessment of the degree of hemorrhage mostly relies on subjective experience and lacks uniform standards. Traditional methods of monitoring vital signs (e.g., blood pressure, heart rate) have limitations in early recognition of shock, which can delay the optimal time for treatment<sup>[8]</sup>. This, coupled with insufficient early warning and intervention measures for high-risk patients, results in some patients not being effectively treated in time when their condition deteriorates. Therefore, there is an urgent need for a more scientific and standardized assessment tool to improve emergency ambulance management.

The Shock Index (SI), which is the ratio of heart rate to systolic blood pressure, is an important indicator for assessing a patient's hemodynamic status. SI is not only simple and easy to perform but also reflects the early signs of hypovolemia and shock more sensitively. Studies have shown that when the SI is  $> 0.7$ , the patient may be at risk of hemorrhagic shock. The Early Warning Score (EWS) is a tool to assess the severity and trend of a patient's condition through the comprehensive scoring of multiple physiological parameters (e.g., respiratory rate, heart rate, systolic blood pressure, temperature, and state of consciousness). EWS can help healthcare professionals identify deteriorating patients early, allowing for safe and efficient interventions to improve the success rate of rescue<sup>[9]</sup>.

SI and EWS have their own advantages, and the combined application of the two in the emergency ambulance management of patients with AGIB can provide a standardized and objective assessment tool for healthcare professionals, reducing the reliance on physicians' personal experience. This approach helps them to more comprehensively and accurately assess the patient's condition and the risk of bleeding, thereby improving the effectiveness of the rescue treatment<sup>[10]</sup>.

The results of this study showed that the resuscitation time and hospitalization time of patients in the observation group were shorter than those in the control group ( $P < 0.05$ ). The analysis suggests that SI and EWS can quickly and accurately assess the severity of the patient's condition, allowing healthcare workers to identify high-risk patients in time, prioritize rescue treatment, reduce unnecessary delays, improve the efficiency and effectiveness of treatment, and accelerate the recovery process, thus shortening the resuscitation time and hospital stay. Before ambulance management, the differences in hemoglobin, prealbumin, and clear protein levels between the two groups of patients were not significant ( $P > 0.05$ ). However, after systematic ambulance management, the observation group was significantly better than the control group, with a statistically significant difference ( $P < 0.05$ ). The combined application of SI and EWS enabled the patients in the observation group to receive rapid and accurate assessment and targeted treatment after admission, effectively improving their nutritional status and overall health, enhancing the treatment effect, and promoting rapid recovery. This study also showed that the complication rate during ambulance service in the observation group was significantly lower than that in the control group, with a statistically significant difference ( $P < 0.05$ ). The analysis attributes this to the effective prevention of hemorrhagic shock through accurate condition assessment and timely interventions, reduction in the severity of anemia, and lowered risk of multi-organ failure through systematic monitoring and treatment. Additionally, timely cardiovascular monitoring and management reduced the emergence of cardiovascular complications, and early identification and management of the risk of gastrointestinal rebleeding significantly reduced the incidence of rebleeding.

In conclusion, in the management of acute gastrointestinal hemorrhage patients, the scientific application of SI combined with EWS can effectively improve the serum indexes of the patients, shorten the rescue time and hospital stay, and reduce the risk of related complications, demonstrating positive clinical application value.

## Disclosure statement

The author declares no conflict of interest.

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