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Original Research Article

Prevention of stress-related mucosal damage using intravenous omeprazole

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Abstract

Purpose: *To evaluate the effect of using intravenous injection of omeprazole to prevent stress-related mucosal damage (SRMD) in critically ill patients.*
Methods: *80 critically ill patients from the Eighth People's Hospital of Qingdao, Qingdao, China were recruited and randomly divided into control and study groups comprising 40 patients each. Control group received conventional symptomatic treatment comprising nutritional support, acid-base balance regulation, electrolyte level monitoring and correction, maintenance of fluid and electrolyte equilibrium, respiratory function management, and anti-infection measures. Study group received intravenous injection of omeprazole (20 mg/day) and conventional symptomatic treatment for 3 months. Treatment effect, gastric pH, and gastroscopic observation of the two groups of patients were recorded.*
Results: *The study group demonstrated significantly higher treatment efficacy (97.5 %) compared to control group (80 %, $p < 0.05$). Pre-treatment gastric pH did not differ significantly between the groups ($p > 0.05$). After treatment, the study group exhibited significantly higher pH levels ($p < 0.05$). Normal endoscopic findings increased to 85 % in the study group compared to 20 % in control group ($p < 0.05$).*
Conclusion: *Intravenous omeprazole significantly prevents SRMD in critically ill patients, improves gastric pH regulation and reduces abnormal endoscopic findings. Larger-scale, multicenter, and long-term studies are needed to validate the findings of this study.*

Keywords: *Intravenous injection, Omeprazole, Prevention, Critically ill patients, Stress-related mucosal damage*

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INTRODUCTION

Critically ill patients refer to those with severe abnormal vital signs such as trauma, infection, and poisoning which are life-threatening [1]. Critically ill individuals frequently encounter diverse stressors, including infections, injuries, and surgical procedures, all of which potentially destroy the mucous lining of the gastrointestinal tract [2]. Stress-related mucosal damage (SRMD) is very common in critically ill patients and leads to digestive system complications such as gastritis, gastric ulcers, and gastrointestinal bleeding [3]. These complications affect the quality of life and disease prognosis [4]. Therefore, prevention and treatment of SRMD

have emerged as a focal point in medical studies. At present, strategies to prevent and treat SRMD primarily involve gastro-protective medications, proton pump inhibitors, and similar approaches [5]. Omeprazole is a proton pump inhibitor that inhibits gastric acid secretion and effectively prevents gastric mucosal damage [6]. In clinical practice, omeprazole is used to treat diseases such as gastric ulcers, duodenal ulcers, and reflux esophagitis [7]. However, among critically ill patients, there is a controversy surrounding the administration method and dosage of omeprazole, particularly regarding the clinical significance of intravenous omeprazole injection. Hence, this study was aimed at investigating the effect of intravenous omeprazole administration in preventing SRMD among critically ill patients in order to offer insights and guidance for treatment.

METHODS

Subjects

This study enrolled 80 critically ill patients from The Eighth People's Hospital of Qingdao, Qingda, China randomly assigned into control and study groups with 40 patients each. Basic clinical information such as gender, age, body mass index (BMI), Glasgow Coma Scale (GCS) score, and etiology of critical illness were recorded.

Ethical approval

This study was approved by the Ethical Committee of the Eighth People's Hospital of Qingdao (approval no. 2020-04-013). This study was performed in strict accordance with the guidelines of Declaration of Helsinki [8].

Inclusion criteria

Patients aged 18 years or older, patients diagnosed with severe illness meeting established diagnostic criteria, no gastrointestinal discomfort symptoms prior to enrollment but may have experienced abdominal discomfort, loss of appetite, or have a medical history of such symptoms; patients with normal liver function, negative results on fecal occult blood tests, underwent gastroscopy examination revealing no relevant mucosal damage, willing to participate in the study, and provided signed informed consent.

Exclusion criteria

Patients with evident gastrointestinal diseases such as gastric ulcer, or duodenal ulcer; gastrointestinal complications, such as a history of gastric bleeding or gastrointestinal perforation, pregnant or lactating women, other conditions unsuitable for participation in the study, such as severe heart disease, liver or kidney dysfunction.

Treatments

Control group received routine symptomatic treatment comprising of nutritional support, acid-base balance regulation, electrolyte level monitoring and correction, maintenance of fluid and electrolyte equilibrium, respiratory function management, and anti-infection measures. Nutritional support methods were tailored to individual patient needs, including oral, enteral, or total parenteral nutrition, to ensure adequate nourishment. Acid-base balance was monitored and maintained within normal range. Electrolyte levels were monitored, and any abnormalities were promptly corrected. Fluid and electrolyte balance was maintained through appropriate infusion and other interventions. Respiratory function was monitored, and mechanical ventilation was provided when necessary. Additionally, proactive measures were taken to prevent and treat infections in patients. The study group received intravenous omeprazole (H20030945, AstraZeneca Pharmaceutical Co., Ltd.) in addition to routine symptomatic treatment at a dose of 20mg once daily for 3 months. Throughout the treatment period, both groups of patients underwent regular follow-up examinations to assess treatment outcomes, gastric pH levels, fecal occult blood tests, and gastroscopy findings. Treatment plans were adjusted as necessary based on these assessments.

Evaluation of parameters/indices

Treatment effect

Patients underwent gastroscopy examination at the hospital after 3 months of treatment. Specific treatment effect was evaluated based on observation of the patient's relevant mucosal condition through gastroscopy and mucosal filling. In this study, the criterion for judging the positive result of fecal occult blood test was based on color change on the test paper. If the color change on the test paper exceeded the set threshold, it was considered positive. The effectiveness of the treatment was categorized as follows:

Significantly effective

Patients did not exhibit any stress-related mucosal damage and reported no digestive adverse reactions, such as loss of appetite,

bloating, diarrhea, vomiting, or abdominal pain. Fecal occult blood test results were negative, and all physiological parameters tended towards normalcy.

Effective

Patients did not either experience SRMD or demonstrated only partial congestion, alongside mild digestive adverse reactions (1-2 symptoms). Fecal occult blood test results remained negative, and overall physiological indicators improved compared to pre-treatment levels.

Ineffective

Patients presented with SRMD, multiple digestive adverse reactions, a positive fecal occult blood test result, and severe abnormalities in physiological parameters.

Gastric pH value

Before and after treatment, gastric fluid pH values were determined using pH test paper during gastroscopy examination.

Gastroscopic observation

After 3 months of treatment, gastroscopy was conducted to assess the status of the relevant mucosa and to observe for signs of congestion, edema, erosion, ulceration, and other abnormalities at the mucosal site. The findings were categorized as either normal or abnormal. An abnormal result indicated the presence of congestion, edema, erosion, ulceration, or other abnormalities in the mucosa. Conversely, a normal result indicated the absence of any such abnormal conditions in the mucosa.

Statistical analysis

GraphPad Prism 8 (GraphPad Software, San Diego, CA, USA) was employed for graphical presentations, while Statistical Packages for Social Sciences version 20.0 (SPSS Inc., Chicago, USA) was utilized for statistical analysis. Continuous data were presented as mean ± standard deviation (SD), while t-tests or analysis of variance were employed to compare differences between the two groups.

Categorical data were presented as frequency and percentage, and Chi-square or Fisher's exact tests were used to compare differences between the two groups. $P < 0.05$ was considered statistically significant.

RESULTS

Baseline characteristics of patients

There was no significant difference in baseline characteristics between the two groups of patients ($p > 0.05$; Table 1).

Efficacy

There was a significant difference in effectiveness/efficacy between the two groups of patients ($p < 0.05$) (Table 2).

Table 1: Baseline characteristics of patients (N = 40)

Basic data information	Control group	Study group	t/χ^2	*P*-value
Gender			0.202	0.653
Male	23	21		
Female	17	19		
Age)	45.5±6.8	45.7±6.9	0.130	0.896
BMI (kg/m²)	23.2±3.4	23.4±3.2	0.270	0.787
GCS score (points)	5.2±1.1	5.3±1.2	0.388	0.698
Cause of serious illness			0.000	1.000
Cerebral hemorrhage	4	6		
Infect	12	10		
Trauma	15	13		
Others	9	11		

Table 2: Clinical efficacy (N = 40)

Group	Significantly effective	Effective	Ineffective	Overall effectiveness (%)
Control	9	23	8	80.0%
Study	12	27	1	97.5%
χ^2	-	-	-	4.507
P-value	-	-	-	0.033

Table 3: Comparison of gastroscopy findings among the patients

Group	Normal	Abnormal			
		Congestion	Edema	Erosion	Ulcer
Control	8	11	9	5	7
Study	34	3	1	1	1
χ^2	33.884	-	-	-	-
P-value	<0.001	-	-	-	-

Gastric pH

Before treatment, there were no significant differences in gastric pH between the two groups ($p > 0.05$). However, after 3 months of treatment, the study group exhibited significantly higher gastric pH compared to control group ($p < 0.05$).

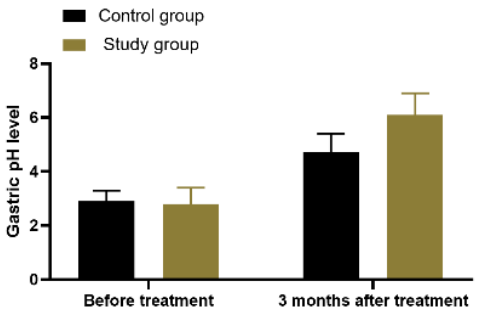

Figure 1: Comparison of gastric pH. *$P < 0.05$ compared to before treatment

Gastroscopy findings

The proportion of normal gastroscopy findings in the study group was significantly higher than in the control group ($p < 0.05$) (Table 3).

DISCUSSION

Stress-related mucosal damage (SRMD) in critically ill patients refers to gastrointestinal mucosal epithelial cell damage or necrosis, leading to inflammation, congestion, edema, bleeding, erosion, ulcers, and other lesions in the sub-mucosal and muscular layers. This occurs during periods of severe stress, such as major surgery, severe infection, or serious trauma [9]. In addition, SRMD may prolong hospital stays and increase treatment costs. As one of the more common complications in critically ill patients with severe diseases, this complication often occurs in intensive care units and is one of the key medical concerns. Previously, prevention and treatment often involved routine symptomatic interventions such as stress control, gastric mucosal protection, maintenance of fluid and electrolyte balance, and nutritional support [10]. However, the overall therapeutic effect of SRMD in critically ill patients is poor. A previous study has reported that poor efficacy of routine symptomatic interventions may be related to insufficient gastric acid inhibition [11].

The stress state of critically ill patients leads to dysregulation of the neuroendocrine system, which in turn affects the physiological function of the gastrointestinal tract, including regulation of gastric acid secretion [12]. Under stress conditions, sympathetic nervous system activation and increased secretion of adrenaline stimulate gastric acid secretion, while parasympathetic nervous system activation inhibits gastric acid secretion [13]. In addition, the release of inflammatory mediators also stimulates gastric acid secretion. Excessive gastric acid secretion is one of the important causes of SRMD. Gastric acid is a highly corrosive chemical that damages the gastric mucosal barrier, destroying mucosal epithelial cells and inducing inflammation. In stress state, excessive gastric acid secretion exceeds the capacity of the mucosal barrier, leading to gastric mucosal damage and stress-related mucosal injury [14]. It is therefore speculated that the key to preventing SRMD in critically ill patients lies in good gastric acid inhibition. Omeprazole is a proton pump inhibitor primarily used to inhibit gastric acid secretion [15]. Omeprazole reduces gastric acid secretion by blocking the activity of the proton pump on gastric wall. Omeprazole is used to treat various gastric acid-related diseases such as peptic ulcers, gastroesophageal reflux disease, and gastrointestinal ulcers caused by non-steroidal anti-inflammatory drugs. In addition, studies related to critical care medicine have shown that omeprazole is also used to prevent SRMD. However, studies on the efficacy of omeprazole in preventing SRMD in critically ill patients remain relatively scarce. Therefore, this study compared stress-related mucosal injury indicators between patients who received omeprazole and those who did not. Total effectiveness rates observed in this study align with findings from prior related studies [16,17].

These studies have affirmed that the addition of intravenous omeprazole to standard symptomatic treatment effectively regulates gastric juice pH and prevents SRMD. Omeprazole as a proton pump inhibitor effectively suppresses gastric acid secretion. By doing so, it diminishes the

corrosive impact of gastric acid on gastric mucosa, thus playing a crucial role in both preventing and treating gastric mucosal damage. Additionally, omeprazole helps to alleviate common gastrointestinal symptoms experienced by critically ill patients, including stomach pain, nausea, vomiting, and diarrhea. By providing relief from these symptoms, omeprazole contributes to improving the overall health of patients undergoing treatment.

Also, omeprazole promotes the repair and regeneration of the gastric mucosa, expediting the healing process following mucosal damage. Finally, omeprazole aids in regulating the pH of gastric juice, ensuring it remains within the normal range. This regulation helps mitigate the corrosive effects of gastric acid on the gastric mucosa, further preventing the occurrence of gastric mucosal damage. The addition of intravenous omeprazole plays a role in preventing and treating SRMD in severely ill patients from multiple aspects and is more effective than conventional symptomatic intervention in relieving gastrointestinal symptoms, promoting gastric mucosal repair, and regulating the pH of gastric juice.

Limitations of the study

The sample size was small, with only 80 patients included, potentially affecting the reliability of the results. Also, treatment duration was short, lasting only 3 months, which may not adequately assess the therapeutic effect of omeprazole on stress-related mucosal damage. Longer treatment durations should be considered in future studies. Furthermore, there was a lack of long-term follow-up, as the study only conducted one evaluation 3 months after treatment. Lastly, this study did not consider the influence of other factors, such as dietary habits and disease status, on stress-related mucosal damage. Therefore, the potential impact of these factors may affect study results.

CONCLUSION

Intravenous injection of omeprazole effectively regulates gastric juice pH, and reduces the likelihood of abnormal findings during gastroscopic observations. Larger-scale, multicenter, and long-term studies are needed to validate the findings of this study.

DECLARATIONS

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Ethical approval

None provided.

Availability of data and materials

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

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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