

Multidisciplinary treatment for acute massive upper gastrointestinal bleeding secondary to post-burn stress in a paediatric patient: a case report

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ABSTRACT

Background. Severe burns can readily induce gastric and duodenal mucosal erosions and superficial ulcers. In severe cases, haemorrhage or perforation of peptic ulcers might occur, threatening the lives of patients. At present, gastrointestinal haemorrhage after burns is treated mainly with drugs and gastrointestinal endoscopy. However, multidisciplinary treatment of gastroscopy combined with vascular embolization is rare.

Case. A boy aged 3 years and 4 months was admitted to the hospital, scalded by boiling water on multiple parts of the body. On the 8th day after the injury, the patient continuously produced a large amount of tarry black stool, and the faecal occult blood test was positive. Haemostatic drug treatment was ineffective, and severe shock and disseminated intravascular coagulation (DIC) occurred. Under the guidance of a multidisciplinary team (MDT), a gastroscopy examination was performed and showed bleeding from a duodenal bulb ulcer. Due to a small intestinal lumen and thin intestinal wall, bleeding could not be controlled by gastroscopy. However, the bleeding point was clarified by gastroscopy and then gastroduodenal artery embolization was performed efficiently. No active gastrointestinal bleeding was observed after the surgery. The patient was followed for 6 months after discharge, and no gastrointestinal haemorrhage recurred.

Conclusions. This is a rare case of acute massive upper gastrointestinal bleeding secondary to post-burn stress in paediatric patients. For paediatric patients who cannot be treated by endoscopy, transcatheter embolization may be safer and more effective for achieving haemostasis. Through the collaboration of the MDT, gastroscopy combined with interventional embolization was performed, which successfully stopped the massive bleeding and saved the child's life, making it worthy of clinical reference.

Key words: curling ulcer, upper gastrointestinal bleeding, gastroscopy treatment, vascular embolization.

Severe burns can readily induce gastric and duodenal mucosal erosion or ulceration due to intense stress. Postburn stress ulcer, also known as Curling's ulcer, is a digestive system complication that occurs after severe burns. In addition to gastrointestinal mucosal oedema, congestion, bleeding and erosion, severe gastrointestinal bleeding ulcers or perforations

can occur, which directly threatens the patient's life.¹ The incidence of gastrointestinal ulcers combined with bleeding is approximately 4.7%, but in most cases, they are actually a diffuse oozing of blood in the intestinal cavity. At present, acute massive hemorrhage from gastrointestinal ulcers in burn patients is rare. A previous study has shown a 50% mortality rate observed in patients with ulcers/hemorrhages within 27 days of admission.² It is obvious that burns in pediatric patients are more dangerous and burdened with a higher risk of complications than burns in adults.³ For the active treatment of the primary disease and

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the elimination of stress factors, sedation, anti-shock, acid suppression and pharmacological haemostasis are mainly used⁴, and the use of endoscopy combined with interventional embolization for haemostasis is extremely rare. A case report of the diagnosis and treatment of acute upper gastrointestinal haemorrhage in a paediatric burn patient is reported.

Case Report

1. Admission

The patient was 3 years and 4 months old. The patient was accidentally scalded on the torso, both lower limbs, the left upper limb and the buttocks by boiling water at home 4 days prior to presentation. Immediately after the injury, the wound was treated with Chinese herb medicine powder at the local clinic (the specific formula that was used is unknown), and the patient was admitted to our hospital due to aggravation of his condition. At the time of admission, the patient was in poor general condition. Physical examination showed that the burn wounds were distributed on the trunk, both lower limbs, the left upper limb and the buttocks, covering a total area of approximately 9% (Fig. 1). Most of the wounds were covered with dark brown eschar, and the area surrounding the wounds was red and swollen. Diagnosis on admission indicated that the depth of burns was 3rd degree with 9% total burn surface area (TBSA). The patient had no previous systemic diseases, including congenital heart disease or gastrointestinal ulcer.

2. Diagnosis and treatment after admission

After admission, the patient was treated with intensive care, anti-infection treatment, acid suppression, correction of hypoproteinaemia, maintenance of the stability of the internal environment and wound dressing changes. The electrocardiogram (ECG) and chest X-ray showed no abnormalities at the time



Fig. 1. The patient's wound at the time of admission.

of admission. Procalcitonin (PCT) was 11.57 ng/mL, the white blood cell count (WBC) was $9.64 \times 10^9/L$, the neutrophil percentage (Neu%) was 76.00% and C-reactive protein (CRP, colloidal gold method) was >200.00 mg/L. The increase in infection indicators in the patient may have been caused by the absorption of toxins from the burn wounds. To remove necrotic tissue in a timely manner and control the infection, wound eschar removal + autologous skin transplantation was performed on the 7th day after injury. Degenerative necrosis of the adipose tissue under the eschar was observed during surgery, and some wounds reached the deep fascia and muscle tissues. The operative area was 9%, and the duration of the operation was 2 hours and 25 minutes. Intraoperative blood loss was approximately 350 ml, and 400 ml of red blood cell suspension and 180 ml of plasma were transfused. Intraoperative vital signs were relatively stable, and postoperative rehydration, haemostasis and acid suppression treatments were performed.

3. Diagnosis and treatment of gastrointestinal bleeding

At 07:05 on postoperative Day 1, the patient was found to have tarry black stool, with a volume of approximately 100 ml. Given the bleeding tendency of gastrointestinal stress ulcers, the intravenous push administration of haemocoagulase was immediately used to stop the bleeding, and 200 ml of red blood cell suspension was transfused. An emergency complete blood count (CBC) showed a red blood cell count (RBC) of $1.79 \times 10^{12}/L$, haemoglobin (HGB) of 48 g/L, haematocrit (HCT) of 13.60% and a platelet count (PLT) of $39 \times 10^9/L$. After an emergency multidisciplinary team (MDT) consultation was conducted with the departments of paediatrics, gastroenterology and haematology, the patient was diagnosed with upper gastrointestinal bleeding. The patient was given intravenous haemagglutinin, an intramuscular injection of vitamin K1, a gastric tube injection of norepinephrine with ice-cold saline, esomeprazole acid suppression, somatostatin, fluid infusion and blood transfusion to prevent shock, but the patient continued to produce a large amount of tarry black stool, his blood pressure dropped to 80/35 mmHg, and his heart rate increased to 165 beats/min despite continuous massive rehydration and supplementation with blood products. Repeated CBC suggested that HGB and platelets still showed a progressive decline. Due to persistent gastrointestinal bleeding, the treatment effect was not sufficient, and treatment was difficult. Therefore, the MDT collaborated again in cooperation with the departments of gastroenterology, vascular surgery, paediatrics, critical care medicine, general surgery and blood transfusion to develop a stepwise treatment regimen. The following regimen was used: 1. Rehydration and anti-shock therapy to maintain blood pressure; 2. Emergency gastroscopy and haemostasis; 3. If the haemorrhage could not be stopped under gastroscopy, vascular embolization could be

considered; 4. If gastroscopy and interventional haemostasis failed, a surgical treatment plan of open abdominal exploration + resection of the bleeding gastrointestinal segment would be considered.

Gastroscopy (OLYMPUS GIF-Q260J; Endoscope outer diameter 9.9mm, Endoscope inside diameter 3.2mm; Image processing system CV-260SL) revealed active bleeding in the duodenal bulb. Due to the patient's small intestinal cavity, it was difficult for the fibre-optic cable of the gastroscopy at our hospital to penetrate the duodenal bulb to stop the bleeding, and there was a risk of repeated damage to the intestinal wall. Due to the possibility of heavy bleeding, the regimen of haemostasis under gastroscopy was abandoned. At this time, the patient's condition further deteriorated. Blood gas analysis showed that the pH was <6.80 , the lactate level (Lac) was 14.5 mmol/L, HGB and HCT could not be detected, and coagulation function continued to deteriorate (activated partial thromboplastin time (APTT) >170 sec, prothrombin time (PT) >120 sec, thrombin time (TT) >120 sec). When respiratory circulation became relatively stable, vascular embolization was performed immediately. Digital subtraction angiography (DSA) showed that a gastroduodenal artery pseudoaneurysm had developed. The gastroduodenal artery underwent microcatheter superselection. After successful superselection was confirmed by smoke, an appropriate volume of PVA500 particles was used to embolize the pseudoaneurysm-bearing artery. No pseudoaneurysm was observed in the follow-up angiography, and haemostasis was successful (Fig. 2). After the operation, the patient's blood pressure gradually stabilized, no tarry stool was observed, and blood gasses, CBC, coagulation and other indicators gradually returned to normal.

The patient suffered from severe upper gastrointestinal bleeding resulting in severe postoperative ischaemia and hypoxia and poor survival of skin grafts. After his general

condition improved, on the 18th day after admission, wound debridement and skin grafting were performed again. After the surgery, the wound was completely healed, and scar management and rehabilitation were

performed (Fig. 3). After discharge, the patient was followed for 6 months. His growth and development were the same as his peers, and no further gastrointestinal bleeding occurred.

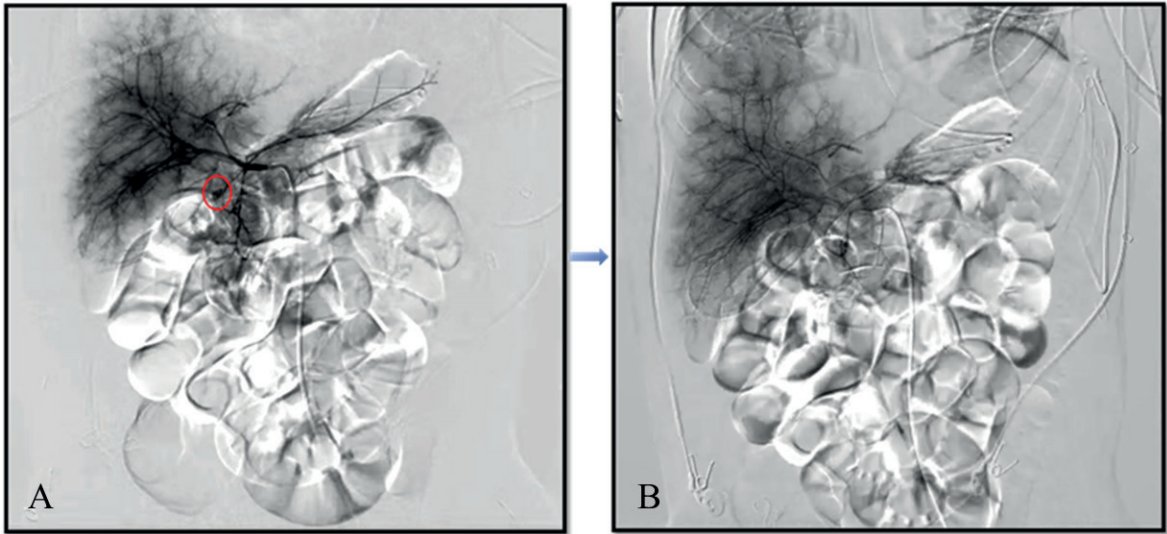


Fig. 2. DSA vascular embolization. A. Before embolization treatment: the red circle shows the bleeding site; B. After embolization treatment, there was no bleeding point. DSA: digital subtraction angiography.



Fig. 3. Scar management and rehabilitation after wound healing.

Discussion

Postburn stress ulcers are a common complication of burns and are prone to ulcerative bleeding, which increases treatment difficulty and prolongs the hospitalization of paediatric patients. The gastrointestinal tract of severe burn victims is not routinely examined by gastroscopy, so mucosal damage is often not detected before bleeding or perforation occurs.⁵ The specific pathogenesis of postburn acute gastrointestinal ulcers may be due to gastric mucosal ischaemia–reperfusion injury caused by postburn body stress response. This leads to a decrease in the levels of prostaglandin E2 and bicarbonate, resulting in a decrease in the defence level of the gastric mucosa.⁶ Additionally, a strong and excessive stress response will cause a series of damages to the body, including tissue decomposition and energy consumption, ischaemia and hypoxia, immune suppression and endocrine disorders.⁷ After severe burns, a series of neuroendocrine reactions occur in the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system, resulting in increased excitability of the vagus nerve.⁸ A dysregulation of blood flow in the gastric mucosa under stress may also result from sympathetic nervous system activation.^{9,10} In addition, after burns, the body is in a high metabolic state, with accelerated protein decomposition and insufficient protein synthesis¹¹, and the repair ability of the gastric mucosa is reduced, which further increases the risk of gastrointestinal bleeding. This patient was admitted to hospital for severe burns in multiple locations on the body, and his PCT level, which is considered to be related to body stress and the absorption of toxins from the wound, was significantly increased. Due to the child's poor self-regulation ability, the systemic stress response was severe, the infection progressed deeper into the wound due to improper postinjury wound treatment, and the child became increasingly prone to complicated gastrointestinal ulcers. In addition, debridement and skin grafting may have

aggravated the body's stress response, leading to the occurrence of Curling's ulcer combined with massive haemorrhage.¹²

In addition, surgical stress may also be an aggravating factor for gastrointestinal bleeding in this child, but it is not the main factor. Firstly, the intraoperative and postoperative hemodynamics of the patient were in good condition. Secondly, laboratory testing carried out the night after surgery showed that coagulation function was normal. Furthermore, post-operative stress ulcers occurred late, between the eighth and the thirty-seventh day after the operation. Most likely due to the superposition of septicaemia on the systemic reaction following the operation.¹³

Gastrointestinal bleeding in children can easily result in coagulation dysfunction and organ dysfunction. Therefore, children with burns complicated with gastrointestinal bleeding should receive emergency treatment to avoid delays in recovery.¹⁴ Bleeding in Curling's ulcer is mostly diffuse blood oozing from the canal wall, and active arterial haemorrhage is rare. However, in the child described in the present study, gastroscopy showed that the bleeding was not diffuse oozing from the intestinal wall but focal active bleeding in the duodenal bulb. This may have been related to the relative weakness of the child's duodenal bulb structure.^{15,16} At present, treatment is still based primarily on pharmacological haemostasis or further haemostasis under gastroscopy. Interventional haemostasis is rare. Vascular DSA does not only locate the bleeding site but can also be used to perform embolization or drug perfusion treatment of the bleeding artery. The continuous development of DSA technology and coaxial microcatheters now enables microcatheters to be rapidly inserted into the proximal end of the bleeding artery for embolization or the perfusion of vasoconstrictor drugs to achieve effective haemostasis. Studies suggest that for patients with haemodynamic instability, those with failure or non-use of

endoscopic treatment and those in whom computed tomography angiography (CTA) cannot detect bleeding vessels, transcatheter embolization may be safer, showing a lower 30-day mortality.¹⁷ When the patient in the present study presented gastrointestinal bleeding symptoms (continuous production of tarry black stool), haemostatic drugs, fluids and blood transfusions were administered through intravenous and gastric tube injections. At the same time, an MDT of representatives from the departments of gastroenterology, vascular surgery, paediatrics, intensive care medicine, general surgery and blood transfusion developed a stepwise treatment plan. The patient's condition deteriorated due to the ineffectiveness of the previous pharmacological haemostasis treatment. Emergency gastroscopy was performed to clarify the bleeding site. Due to the patient's small intestinal lumen, the intestinal wall was thin and could not be used for haemostasis under conventional gastroscopy. Subsequently, given the location of the bleeding, rapid and precise gastroduodenal arterial embolization was performed. Therefore, for paediatric burn patients with upper gastrointestinal haemorrhage, gastroscopy should be performed to confirm the bleeding site when pharmacological haemostatic treatment is ineffective, and if necessary, combining it with vascular embolization can improve the success rate of treatment.

Curling's ulcers combined with massive haemorrhage after burns in children are rare. They are characterized by a rapid onset, fast changes in the disease and extremely difficult treatment. An MDT that includes representatives from gastroenterology, interventional radiology, paediatrics, intensive care, general surgery and blood transfusion should be convened to discuss and develop a treatment plan. Full use of gastrointestinal endoscopy and interventional vascular treatment should be made to obtain the maximum benefit/risk ratio for patients and improve the success rate of treatment.

Ethical approval

Written informed consent was obtained from the parent of the patient for publication of the patient's clinical details and clinical images.

Author contribution

The authors confirm contribution to the paper as follows: study conception and design: YW, HS; data collection: YW, YY; analysis and interpretation of results: YW, YY, ZS; draft manuscript preparation: YW, HS. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest.

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