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Case report

# Successful treatment of acute coronary syndrome complicated with massive gastrointestinal bleeding: A case report

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A B S T R A C T

Life-threatening gastrointestinal bleeding during the rescue of acute coronary syndrome with repeated cardiac arrest is a difficult challenge to overcome during treatment. The success rate of rescue can be improved through the multidisciplinary cooperation of the rescue team, the selection of a reasonable rescue plan, and timely implementation. Surgical hemostasis has rarely been reported in the literature. Here, we have reported our successful treatment experience with a case of acute coronary syndrome that was complicated by massive gastrointestinal hemorrhage and required an operation to stop the bleeding.

## 1. Introduction

Acute myocardial infarction (AMI), a crucial cardiac complication, is a major cause of cardiac arrest [1] and one of the leading causes of death across the world, with an estimated prevalence of 3 million in the near future [2]. AMI involves the occurrence of myocardial necrosis due to acute obstruction of a coronary artery and cardiac arrest due to the cessation of cardiac mechanical activity that stops the blood flow circulation.1 AMI can occur unexpectedly in patients [3]. The treatment of cardiac arrest involves high-quality cardiopulmonary resuscitation (CPR; an emergency lifesaving procedure); rapid defibrillation for shockable rhythms (ventricular fibrillation or ventricular tachycardia); early administration of epinephrine for nonshockable rhythms; treatment of the primary cause if feasible/detected; post-resuscitative care. However, timely out-of-hospital and in-hospital CPR is currently the key to reducing the rate of mortality associated with cardiac arrest [4]. Extracorporeal membrane oxygenation (ECMO) is employed for cardiac failure when conventional management, including CPR, is unsuccessful [5]. ECMO can improve the survival of patients with recurrent cardiac arrest. However, the development of complications such as multiple organ dysfunction, acute renal failure, acute liver injury, and life-threatening gastrointestinal bleeding during the rescue operation through ECMO is quite challenging. Overcoming these challenges is the key to increasing the success of rescue outcomes. Although data are available on increased mortality due to gastrointestinal bleeding, data on the treatment of such conditions under ECMO are limited [6]. This paper reports the case of a patient with acute coronary syndrome (ACS) who developed a small intestinal hemorrhage during treatment in the light of literature as well as summarizes the entire rescue treatment strategy so as to contribute to the accumulated clinical experience on the rescue of such patients in the future.

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## 2. Case presentation

A 45-year-old male patient was admitted to the emergency department for complaints of chest discomfort for the past 2 days. Two hours before his hospital admission, the patient experienced a sudden cardiac arrest and respiratory arrest. The patient's family members immediately performed CPR and called the "emergency medical service (EMS)." Electrocardiogram exhibited ST-segment elevation in leads II, III, and augmented vector foot (avF) (Fig. 1); increased myoglobin level of 2611.6 ng/mL; increased hsTnI level of 136.8 pg/mL. Recurrent cardiac arrest was noted during CPR, and the patient was immediately admitted to the coronary care unit (CCU) for further rescue treatment. A primary diagnosis of ACS was made at this time point. The patient had a history of laparoscopic-assisted right hemicolectomy for appendiceal carcinoid more than 3 years ago. CPR, electrical defibrillation, and dual antiplatelet therapy (with aspirin and ticagrelor) were continued after admission. During CPR in the CCU, the patient experienced several more cardiac arrests.

After consultation with a multidisciplinary team (MDT), the patient was placed on a tracheal intubation ventilator to assist respiration. ECMO implantation (left femoral artery and right femoral vein) was performed. Then, the patient was transferred to the intensive care unit (ICU) for further treatment, which included continuous oral ventilator-assisted respiration, ECMO support, administration of double antiplatelet agents (with aspirin and ticagrelor) for thromboprophylaxis, mild hypothermia, and dehydration treatment. Initially, owing to the critical condition of the disease, the family did not consent to PCI, hence no invasive operation was performed. During this period, acute liver injury and acute renal failure also occurred. Liver protection (reduced glutathione, ademetionine, and ursodesoxycholic acid), bedside continuous renal replacement therapy (CRRT), and other symptomatic treatments such as correcting the internal environment disorders and acid suppression therapy with lansoprazole were undertaken. 5 days after ECMO implantation, the patient's blood pressure stabilized, his consciousness recovered, and ECMO was discontinued. 7 days after hospitalization, the patient's vital signs were stabilized and his spontaneous breathing resumed, after which the ventilator was stopped and the endotracheal tube was removed. 11 days later, the patient's head computed tomography exhibited a small subdural hematoma. At this point, aspirin was discontinued after consultation, but antiplatelet therapy with ticagrelor was continued. After 3 weeks in hospital, melena was noted, and the stool routine and occult blood tests came positive, with 2+ red blood cells (RBCs). The blood routine examination revealed $2.5 \times 1012$/L RBCs, 77 g/L hemoglobin (HGB), and 24% hematocrit. Accordingly, ticagrelor and low-molecular-weight heparin were immediately discontinued and antiacid and gastric protection therapy (esomeprazole) was intensified. 1 day after melena, 4 U of concentrated RBCs were transfused into the patient. 2 days later, the HGB level on the blood routine test was 87 g/L, and 2 U of concentrated RBCs were again transfused. After 3 days, the patient produced 800 mL of tarry stool. The patient's RBC count was $2.3 \times 1012$/L and the HGB level was 73 g/L. Accordingly, bleeding in the digestive tract was considered to continue, for which the patient was transfused with 4 U of concentrated RBCs. On the same day, gastroscopy and colonoscopy were performed, and no active bleeding lesions were found. However, small intestinal bleeding was confirmed. 5 days later, the patient again produced a tarry stool, and his blood routine re-examination revealed 81 g/L HGB and $63 \times 109$/L platelets. Digital subtraction angiography (DSA) examination in the intervention room demonstrated active bleeding of the intestinal vessels. Coronary angiography exhibited nearly 90% stenosis at the proximal end of the right coronary opening. The patient was thus considered to have developed extensive gastrointestinal bleeding, and his medical treatment was deemed ineffective. In fact, the continuation of bleeding was considered life-threatening. The MDT of cardiology, intervention, gastrointestinal surgery, and ICU experts realized that conservative treatment could not effectively stop the bleeding. Accordingly, surgical exploration was deemed critical to stop the bleeding. The patient and his family members were informed of the disease and the patient's condition, and they consented to the suggested surgical exploration. Coronary artery stenosis was treated at a later stage, and surgical treatment was performed immediately. Exploratory laparotomy was performed under general anesthesia the same day. No hemoperitoneum was observed during the operation. Through the small intestine incision, a small intestinal endoscopic examination was conducted. This examination revealed dark RBCs and blood clots in the terminal ileum and colon near the previous anastomosis. Two anastomotic nails were exposed at the site of anastomosis, and a small amount of blood actively oozed out around one of the nails (Fig. 2). Two long strip ulcers were noted with a white moss covering the surface and a small amount of active oozing of blood. However, no obvious abnormality was noted in the small intestine at rest. According to the exploration, anastomosis resection (approximately 20 cm of the ileum and 10 cm of the colon) was performed immediately. The

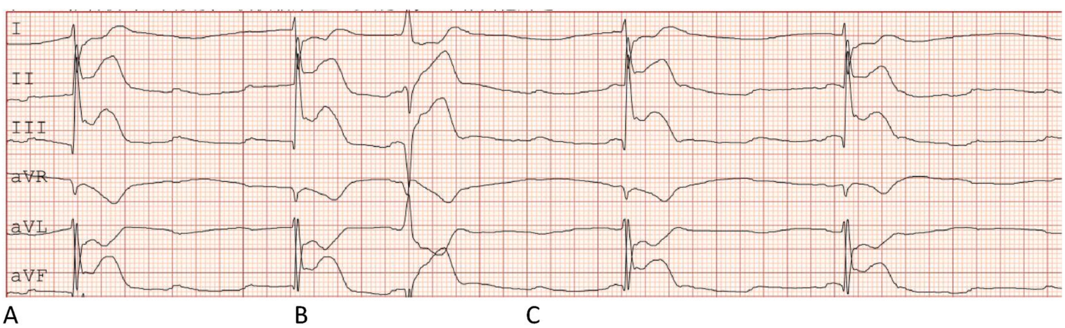


**Fig. 1.** Patient's electrocardiogram at the time of admission
avR: augmented vector right; avL: augmented vector left; avF: augmented vector foot.

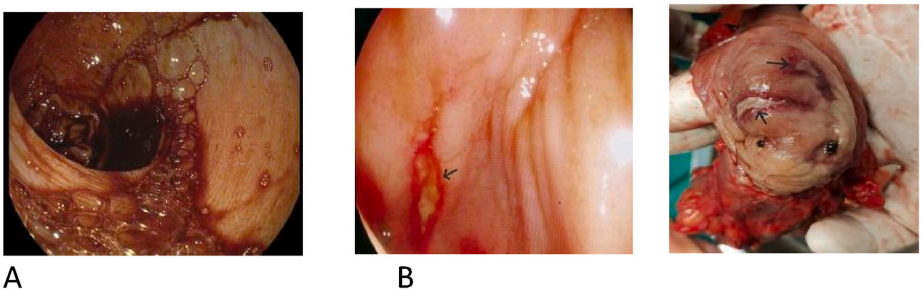


**Fig. 2.** Endoscopic examination and specimen of operation A) Colonoscopy detected blood near the anastomosis site before surgery; B) colonoscopy showing an ulcer (arrow) near the anastomosis site during the surgery; C) surgical specimen exhibiting two ulcers (arrows).

digestive tract was successfully reconstructed through the end-to-side anastomosis of the terminal ileum and transverse colon. The operation was successful. Postoperative treatment was continued in the ICU, where the patient was transfused with 0.8 g/L fibrinogen and 10 U cryoprecipitate. No continuous hematochezia was noted after the operation. 3 days after surgery, the blood routine examination exhibited $3.1 \times 1012$/L RBCs and 98 g/L HGB, indicating that the small intestinal bleeding had stopped. 5 days later, the patient produced 1250 mL of urine and normal stool, and therefore, CRRT was stopped. After this day, the patient produced more than 400 mL of urine per day. However, 19 days after operation, the patient repeatedly complained of chest tightness and discomfort. He immediately underwent drug-eluting coronary artery stent implantation at the right coronary artery (RCA) stenosis under intervention (Fig. 3), and the operation was successful. After the patient gradually recovered, he was discharged from the hospital. Presently, at a 2-year follow-up, the patient's general condition has been recorded as stable.

## 3. Discussion

Cardiogenic shock is a cardiac dysfunction syndrome caused by various factors that substantially reduce the cardiac output and cause severe acute circulatory failure; it is mainly characterized by persistent hypotension and hypoperfusion of the organs and tissues [7]. ACS is the main cause of cardiogenic shock, accounting for 81% of all cases, and includes ST-segment elevation myocardial infarction (STEMI) and non-STEMI (NSTEMI) [8]. Cardiogenic shock caused by STEMI accounts for 8% of all cases. The mortality rate of AMI-induced cardiogenic shock can reach 40%–50%, especially within 30 days of its occurrence [9,10]. Because of the decreased cardiac output state of circulatory failure that results in end-organ hypoperfusion and tissue hypoxia, the body cannot effectively meet the metabolic demands of the tissues and cardiogenic shock then progresses to multiorgan failure [11]. Our case patient was diagnosed with ACS, cardiogenic shock, acute liver failure, and acute renal failure along with cardiac arrest, loss of consciousness, oliguria, and abnormal liver and renal functions. For multiple organ dysfunctions, the corresponding symptomatic and supportive treatment was administered, such as CRRT for acute renal failure and liver protection, subsiding jaundice and maintaining the stability of liver microcirculation for acute liver injury; and mild hypothermia treatment for the head to reduce intracranial metabolism. Because acute multiple organ dysfunction is caused by the acute problem of insufficient blood supply, stable hemodynamics and stable blood supply to various organs are necessary and must be maintained until the patient's health is restored. In the present case, the patient's liver and kidney functions subsequently returned to normal.

Mechanical circulatory support devices have evolved as novel strategies for restoring systemic perfusion to allow cardiac recovery in the short term or as durable support devices in refractory heart failure in the long term [12]. These devices are crucial for treating ACS patients. Venoarterial (VA) ECMO is a clinically used life-support technology for treating patients with heart and lung failure. In

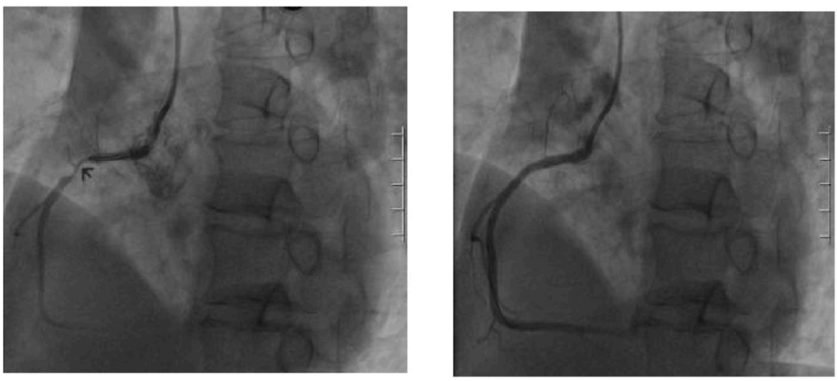

**Fig. 3.** Coronary angiogram and percutaneous coronary intervention (PCI). A) Right coronary artery (RCA) stenosis (90%, arrow) of the coronary artery, B) RCA after PCI.

this technology, a membrane oxygenator is placed in the extracorporeal circulation. This oxygenator provides oxygen and removes carbon dioxide from the blood circulation. VA-EMCO is crucial for the treatment of AMI-induced cardiogenic shock. In patients with refractory cardiac arrest, ECMO can significantly improve the effect of applied treatment. According to observational studies, ECMO can improve the survival of patients with cardiogenic shock and increase the nerve injury effect, but whether the effect of early use of EMCO is higher remains controversial [13,14]. We implemented EMCO on the admission day to maintain the patient's life and save time for further rescue. With the use of EMCO for 5 days, the patient's blood pressure stabilized and his consciousness recovered, following which ECMO was terminated.

Antiplatelet aggregation therapy is a cornerstone in ACS treatment, regardless of the medical therapy or percutaneous coronary intervention (PCI) revascularization being available for full myocardial reperfusion. Dual-antiplatelet therapy (i.e., with aspirin and P2Y12 receptor inhibitor) improves the ACS outcome [15,16]. However, life-threatening massive bleeding in patients treated with antiplatelets indicates a significantly increased risk of mortality in ACS patients [17,18]. Before applying the dual antiplatelet therapy, the bleeding risk must be assessed. The ESC guidelines recommend the combination of DAPT with PPI in patients with high-risk gastrointestinal bleeding. During treatment, according to the severity of bleeding, drugs associated with a low bleeding risk can be observed, adjusted, and administered. DAPT can be changed to use a P2Y12 receptor inhibitor alone or discontinue the use of all antiplatelet drugs.16 Past studies have reported that patients with mutations in the platelet CYP2C19 gene (CYP2C19*2 and CYP2C19*3) are less effective at inhibiting platelets with clopidogrel, while patients without mutations display no difference in the negative thrombotic events between clopidogrel and ticagrelor or prasugrel; however, the clopidogrel group significantly reduced the bleeding events; hence, the selection of P2Y12 inhibitors guided by platelet gene testing may bring better benefits to ACS patients [19,20]. Another study guides the de-escalation of antiplatelet for ACS patients through platelet function testing (PFT); for those with high on-treatment platelet reactivity (HPR), potent prasugrel is continued; for those without HPR, prasugrel is adjusted to the less potent clopidogrel. The results showed no difference in the occurrence of ischemic events between these two groups, albeit there was a significant decrease in the bleeding events in the descending group [21]. Thus, antiplatelet therapy guided by platelet genetic testing or PFD may better balance ischemic and bleeding events [22,23]. Bleeding in different parts can occur because of the use of EMCO equipment [24]. The bleeding rate with ECMO use is as high as 29%, with a 10% risk of major bleeding and 4%–10% risk of intracranial hemorrhage. This high bleeding risk can be attributed to multiple patient- and treatment-related factors associated with ECMO [25]. Several studies have investigated the bleeding risk assessment, and the Academic Research Consortium for High Bleeding Risk (ARC-HBR) consensus suggests that patients who have undergone recent surgery or trauma exhibit a relatively high risk of bleeding. Similarly, in the present case patient, who had undergone a right hemicolectomy 4 years ago, the surgical exploration results confirmed that it was related to bleeding near the then anastomosis site [26,27]. For patients with cardiogenic shock, bleeding may occur during the dual antiplatelet therapy. In such cases, after weighing the pros and cons, discontinuing the therapy is usually not deemed conducive to AMI treatment. Moreover, aggravated gastrointestinal bleeding may lead to insufficient blood volume, aggravate myocardial ischemia, and even induce a life-threatening hemorrhagic shock. If medical treatment cannot resolve such a condition, endoscopic hemostasis and interventional embolization or surgical treatment may be required.

## 4. Conclusion

Based on our case experience, we conclude that [1] the MDT discussion mechanism is a crucial player in the treatment of difficult conditions [2]; ECMO can maintain the cardiopulmonary function in the rescue of patients with refractory cardiac arrest and offer a time guarantee for subsequent effective treatment [3]; antiplatelet therapy is the cornerstone of ACS rescue, albeit the bleeding risk in ACS patients varies with time and individual differences. Bleeding brings significant challenges to the treatment of ACS patients. The treatment should therefore be adjusted according to the patient's specific conditions, including the reduction of the types of antiplatelet drugs or even discontinuing them, as required, strengthening antacids, and transfusing RBCs. Whenever necessary, surgical exploration must be performed to identify the cause of bleeding and perform surgical hemostasis [4]; during ACS rescue, the main problems must be constantly judged, because they may be different at different stages. The treatment strategy varies accordingly and must therefore be judged and adjusted according to the changes in the patient's condition.

## Informed consent

All participants/patients (or their proxies/legal guardians) provided informed consent to participate in the study, and provided informed consent for the publication of their anonymized case details and images.

## Data availability statement

All data generated or analyzed during this case report are included in this article.

## CRediT authorship contribution statement

**Peihua Zhou:** Writing – review & editing, Supervision, Formal analysis, Data curation, Conceptualization. **Wei Wang:** Writing – original draft, Investigation, Data curation. **Zhi Wang:** Resources, Investigation, Data curation. **Sheng Wang:** Writing – original draft, Investigation, Formal analysis, Data curation.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reporpted in this paper.


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