

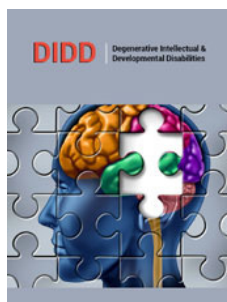
Case Report on the Management of Multiple Organ Failure Following Ruptured Cerebral Aneurysm

Mengling Chang¹, Fenglin Zhang² and Jianchu Lin^{3*}

¹The Affiliated Huai'an No. 1 People's Hospital of Nanjing Medical University, China

²The Second People's Hospital of Huai'an/The Affiliated Huai'an Hospital of Xuzhou Medical University, China

³Huai'an University, Faculty of Computer and Software Engineering, China



***Corresponding author:** Jianchu Lin, Huai'an University, Faculty of Computer and Software Engineering, 223003, Huai'an, China

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Abstract

Objective: To review the diagnosis and treatment of patients with multiple organ failure after cerebral aneurysm surgery, and to provide a reference for further improving clinical practice.

Methods: The clinical data of a 52-year-old female patient were retrospectively analyzed, summarizing the process from emergency admission, interventional surgery, occurrence of postoperative complications, multidisciplinary collaborative treatment to recovery and discharge.

Result: After interventional therapy and active management of related complications, the patient regained consciousness, achieved stable respiration and circulation, and was discharged in improved condition.

Conclusion: Multiple organ failure after ruptured aneurysm surgery is complex and critical, requiring multidisciplinary collaboration and timely surgical intervention. Electroencephalogram and brain-computer interface can help evaluate the patient's condition and improve prognosis.

Keywords: Posterior communicating artery aneurysm; Subarachnoid hemorrhage; Multiple organ failure; Electroencephalogram; Brain-computer interface

Introduction

Intracranial aneurysm is a pathological dilation formed by local weakness of the intracranial arterial wall. After rupture, it can cause Subarachnoid Hemorrhage (SAH), which is the main cause of SAH, accounting for 80% [1]. It is highly likely to result in death or disability. This report retrospectively reviews the diagnosis and treatment of a patient with ruptured right posterior communicating artery aneurysm complicated with SAH and postoperative multiple organ failure, to provide a reference for clinical practice.

Case Data

A 52-year-old female patient was admitted to the emergency department of our hospital on August 25, 2025, due to "sudden unconsciousness for 3 hours". Emergency imaging examinations were performed, followed by tracheal intubation. She was then admitted to the Department of Neurosurgery for emergency surgery. A series of complications occurred during the course of the disease. With multidisciplinary collaboration, the patient finally recovered and was discharged. The relevant diagnosis and treatment process are shown in Table 1.

Table 1: Timeline of clinical course, interventions, and outcomes.

Hospital Day	Clinical Events / Findings	Interventions / Management	Outcomes / Remarks
Day 0 (Admission, 2025 08 25)	Sudden loss of consciousness (3 h), GCS 3 (E1V1M1), head CT/CTA: SAH, intraventricular hemorrhage, right posterior communicating artery aneurysm; chest CT: diffuse pulmonary infiltrates	Emergency intubation, mechanical ventilation, symptomatic stabilization, admission to neurosurgery	Patient comatose, hemodynamically unstable
Day 0 (within 24h)	High grade aneurysm rupture	Emergency endovascular coil embolization with stent assistance	Successful aneurysm occlusion, no intra procedural complications
Day 2	Follow up head CT: no new hemorrhage or infarction; chest CT: pulmonary edema improved	Continued ICU/ward support	Neurological status unchanged
Day 5	Persistent airway dependence	Tracheostomy	Facilitated airway management and ventilation
Day 8	Improvement in consciousness	Ongoing supportive care, infection control	Patient began to regain alertness
Days 8-9	Recurrent fever, hemodynamic instability	Broad spectrum antibiotics, fluid resuscitation, vasoactive support	Partial control of infection, stabilization of circulation
Day 10	Abdominal distension; CT: pneumoperitoneum, intestinal obstruction; CTA: SMA normal; pulmonary emboli; DVT in lower limbs	IVC filter placement; exploratory laparotomy → right hemicolectomy with ileostomy	Postoperative stabilization; bowel perforation repaired
Days 11-20	Distributive shock; hypernatremia, polyuria	Fluid resuscitation, CRRT for sodium correction, hormone replacement therapy	Hemodynamic stabilization; correction of electrolyte and endocrine disturbances
Days 21-53	Rehabilitation phase	Neuro nutrition support, early physical therapy, limb exercises	Progressive motor recovery: upper limbs grade 5, right lower limb grade 4, left lower limb grade 3
Day 53	Discharge to local hospital	Continued rehabilitation	Patient stable with partial functional independence

Discussion

Primary disease

The patient had a right posterior communicating artery aneurysm with a Glasgow Coma Scale (GCS) score of 3 on admission. Surgical timing was strictly controlled, and endovascular embolization was performed within 24 hours after admission, resulting in initial postoperative improvement. The patient was classified as Hunt-Hess grade was grade V. Relevant clinical studies have shown that the in-hospital mortality of such patients is as high as 71% [2]. These studies indicate that reducing early brain injury and rebleeding of aneurysms after SAH, as well as preventing and treating complications, can further lower the mortality after SAH. Current surgical treatments for ruptured intracranial aneurysms include craniotomy, endovascular treatment, and hybrid surgery. For aneurysmal SAH, the optimal treatment timing is within 24 hours after onset; early surgery helps improve prognosis. For patients with internal carotid artery and posterior communicating artery aneurysms, endovascular embolization yields better outcomes [3].

Complications

The patient developed infectious complications such as pneumonia and sepsis during the course of the disease. The infection was controlled after active treatment, but recurrent fever persisted. Further hormonal examinations suggested hypothalamic insufficiency. Such patients often present with systemic inflammatory response syndrome, so it is necessary to distinguish

infectious from non-infectious causes [3]. Vascular ultrasound after cerebral hemorrhage showed venous thrombosis in multiple parts of both lower extremities, and an inferior vena cava filter was implanted. The incidence of Venous Thromboembolism (VTE) is high in such patients. The safety and efficacy of pharmacological prophylaxis for VTE have been verified by clinical trials. Early pharmacological thromboprophylaxis [4] may be safe in patients with ruptured aneurysms or diffuse SAH with negative angiography. Delayed cerebral ischemia and cerebral vasospasm are also common complications of aneurysmal SAH. The patient underwent regular imaging re-examinations, showing no new cerebral infarction. Relevant imaging examinations [5] include DSA, CTA, CTP, and magnetic resonance angiography for diagnosis and evaluation. The patient developed significant hormonal disorders during the course, considered to be related to catecholamine storm after SAH [6], leading to paralytic ileus, intestinal ischemia, and intestinal perforation. After early active surgical intervention by gastrointestinal surgery, combined with anti-infection, anti-shock, and nutritional support treatments, the patient's vital signs finally stabilized.

Prognosis

Rehabilitation plays a crucial role in promoting functional recovery and improving overall prognosis. Previous studies have confirmed that early rehabilitation is both safe and effective, and that higher-intensity activity is not associated with postoperative complications [7]. Long-term rehabilitation should also focus on the patient's psychological, cognitive, and mental status [3].

Multidisciplinary team-based treatment and rehabilitation can shorten hospital stay and improve prognosis [8]. Although the patient recovered and was discharged, there is still room for improvement in the diagnosis and treatment process.

Assessment and monitoring of consciousness disturbance

Clinically, impaired consciousness is often assessed using bedside neurological examination. Electroencephalogram (EEG) is a non-invasive method for monitoring cortical electrical activity and an important tool for clinicians to evaluate the consciousness status of patients with disturbance. It reflects dynamic changes and functional alterations of subtle brain structures by recording postsynaptic potentials of cortical neurons, determines the integrity of the corticothalamic pathway to assess brain injury, and detects abnormal brain function that cannot be demonstrated by CT or MRI. The severity of EEG abnormalities is also well correlated with GCS score and prognosis [9], so it can help further evaluate the patient's condition both pre- and postoperatively. Non-invasive EEG-based Brain-Computer Interface (BCI) has also been applied clinically. BCI establishes a novel signal pathway between the brain and computers or other electronic devices to achieve brain-machine control. It assists in examining and diagnosing the consciousness status of critically ill patients, helps patients with damaged neural pathways communicate with the outside world, and may even become the only communication method for those with consciousness disturbance [10]. Through BCI, the accuracy of voluntarily generated EEG signals during rehabilitation training can be monitored, enabling precise active regulation. Indirect modulation enhances rehabilitation signals to achieve neural remodeling in target areas and functional recovery.

Doctor-patient communication and ethics

Unexpectedly, the family filed a medical complaint after the patient's discharge. The family believed that severe complications resulted from improper medical management, leading to prolonged hospitalization, increased financial burden, and physical and psychological harm. Reviewing the overall treatment, the patient's condition was extremely critical with an extremely high theoretical mortality risk, complicated with pulmonary edema. Statistics show that the mortality of SAH patients complicated with pulmonary edema is nearly twice that of those without pulmonary edema (40.2% vs. 22.5%) [11]. The Department of Neurosurgery, Intensive Care Unit, and Gastrointestinal Surgery of our hospital actively treated the primary disease and complications sequentially according to the characteristics and progression of the disease, and the patient finally turned the corner. We not only successfully saved her life but also restored her ability of self-care. Overall, the treatment was reasonable and appropriate, and the outcome far exceeded theoretical expectations [12]. Although we repeatedly communicated the condition with the family during hospitalization, the critical illness placed huge psychological and financial pressure on them, which easily triggers doctor-patient conflicts.

Conclusion

Multiple organ failure after ruptured aneurysm surgery is complex and critical. Successful treatment requires multidisciplinary collaboration, precise anti-infection, timely surgical intervention, and continuous organ support. EEG can evaluate disease severity, and BCI can accurately guide early rehabilitation to improve prognosis. The treatment should not only be rational but also strengthen doctor-patient communication, ensure the patient's full understanding of disease severity and medical costs, reduce financial burden, and provide humanistic care to minimize the risk of medical disputes.

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