



Case Report

Case of malignant brain edema despite successful recanalization after mechanical thrombectomy for anterior circulation stroke

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ABSTRACT

Background: Therapeutic reperfusion with endovascular treatment (EVT) for acute ischemic stroke is typically associated with better long-term functional outcome compared to standard medical care. However, post-procedural brain edema remained present in around half of EVT patients. Malignant brain edema (MBE) is a serious condition that can lead to increased intracranial pressure, rapid neurologic deterioration, and cerebral herniation, neutralizing the favorable efficacy of EVT on functional outcomes.

Case Description: A 51-year-old man with a history of atrial fibrillation presented with acute onset of hemiplegia and severe bradyarrhythmia. A head computed tomography-scan demonstrated hyperdense middle cerebral artery (MCA) sign. Intravenous thrombolysis was administered before temporary pacemaker insertion. The digital subtraction angiography confirmed occlusion of the M1 branch of the right MCA with no collaterals in the territory of the occluded vessel. Mechanical thrombectomy (MT) was performed 6 h after onset and successfully achieved modified thrombolysis in cerebral infarction 3 revascularization in 6 h 20 min. The patient later experienced massive brain edema that required emergent decompressive craniectomy. The modified Rankin scale score was 4 in 1- and 3-month's follow-up.

Conclusion: MBE after MT results in unsatisfactory functional outcomes, even if it has successful revascularization. No collateral in the territory of the occluded vessel in the initial angiogram is one of the predictors of MBE after MT.

Keywords: Acute ischemic stroke, Endovascular treatment, Large vessel occlusion, Malignant brain edema, Mechanical thrombectomy

INTRODUCTION

In anterior circulation acute ischemic stroke (AIS), therapeutic reperfusion with endovascular treatment (EVT) is consistently linked to a favorable long-term functional prognosis over standard medical care.^[7] However, up to 50% of patients who have undergone EVT still do not have a satisfactory functional outcome in 3 months, even if they have good reperfusion.^[17] Several factors to determine the outcome after EVT include old age, pre-stroke

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disability, comorbid conditions, chronic brain damage, hypertension, hyperglycemia, and fever.^[16] Notably, post-procedural brain edema remained present in around half of EVT patients, neutralizing the favorable efficacy of EVT on functional outcomes.^[11] Herein, we reported a case of AIS treated with EVT that resulted in successful recanalization but later developed malignant brain edema (MBE) that required surgical intervention.

CASE PRESENTATION

Clinical history

A 51-year-old man with a history of atrial fibrillation (AF) presented to the emergency department with acute onset of the left-sided weakness 45 min after his last known well (LNW). Further, anamnesis revealed that in the past 6th month, he did not take oral anticoagulation for his AF. The baseline National Institutes of Health Stroke Scale (NIHSS) score was 14, with left hemiplegia, right conjugate eye deviation, dysarthria, and facial paralysis. On initial examination, the patient was afebrile and alert with a Glasgow Coma Score (GCS) of 15, blood pressure was 140/67 mmHg, and his respiratory rate was 20 breaths/min. In addition to that, his pulse was low, around 36 beats/min. The electrocardiogram revealed a junctional rhythm. Sulfas atropine and dopamine were administered to treat the bradycardia since the pulse decreased to 20 beats/min and GCS dropped to 11 (E3V3M5). After hemodynamic stabilization, a head non-contrast computed tomography (NCCT) was performed (i.e., 2 h after LNW). A head NCCT revealed a hyperdense right middle cerebral artery (MCA) sign, suggesting a hyperacute thrombotic stroke [Figure 1]. All the laboratory studies were within a normal limit.

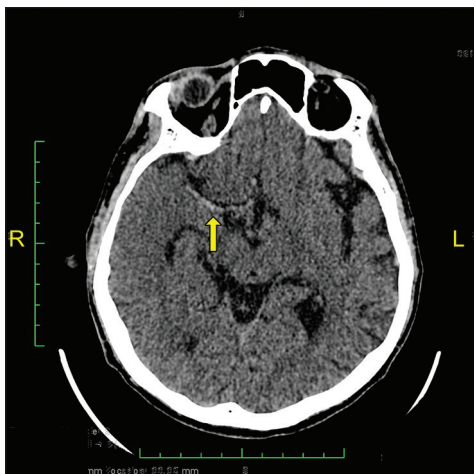


Figure 1: Head computed tomography scan without contrast revealed hyperdense right middle cerebral artery sign (yellow arrow).

EVT

At 4 h after LNW, the patient received IVT using recombinant tissue plasminogen activator (alteplase) (r-tPA). Under General anesthesia, he was taken for temporary pacemaker (TPM) insertion by cardiologist, followed by EVT by our endovascular surgeon. An angiogram of the right internal carotid artery at hour 6 confirmed occlusion of the M1 branch of the right MCA with no collaterals in the territory of the occluded vessel [Figure 2a]. The first attempt of manual aspiration thrombectomy successfully achieved modified thrombolysis in cerebral infarction 3 revascularization in 6 h 20 min [Figure 2b]. The occlusive thrombus [Figure 3] was all removed using the direct aspiration first pass technique with a catheter aspiration system.

Postoperative course

Post-thrombectomy, the patient was still intubated and sedated. During observation in the intensive care unit, he developed an occasional premature ventricular contraction



Figure 2: (a) Pre-thrombectomy angiogram showed occlusion of the right middle cerebral artery (white arrow) with no collateral flows and (b) post-thrombectomy angiogram showed successful recanalization (white arrow).

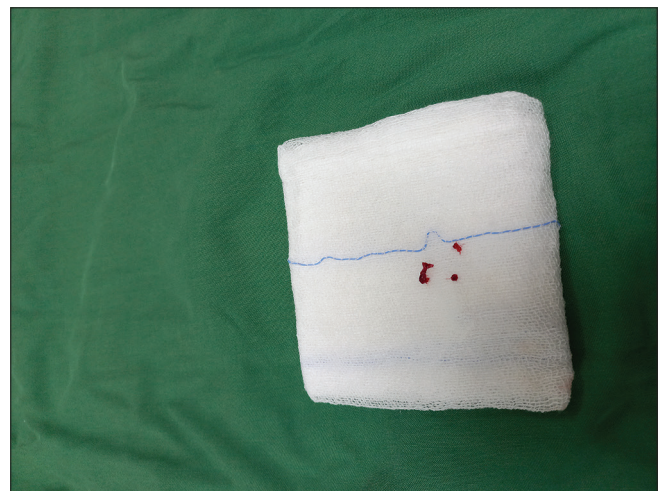


Figure 3: The occlusive thrombus.

and upside-down blood pressure. Follow-up NCCT [Figure 4a] within 24 h following thrombectomy revealed petechial hemorrhage on the infarcted area and massive focal brain edema on the right frontotemporoparietal, resulting in a 13-mm midline shift (MLS).

The patient was treated conservatively initially for his brain edema. After being given conservative treatment for 2 days, the patient was not on sedation but still unconscious with GCS of E2V × M5. He developed anisocoria pupils with diameters of 2 mm and 1 mm, on the right and left pupils, respectively. The diagnosis of MBE was made, and the patient was taken for emergent decompressive craniectomy (DC) to release the intracranial pressure.

Two days following DC, the patient was allowed to awaken to the point where a limited neurologic examination was possible and subsequently extubated. He could move all four extremities on command but still had left hemiparesis, and his pupils were isochor. His NIHSS score was 6 for left hemiparesis and dysarthria. Follow-up NCCT was performed 4 days after DC [Figure 4b] and revealed decreased mass effect to 6 mm MLS. The TPM was changed into permanent pace maker after 7 days of its insertion [Figure 5]. The patient was discharged home on hospitalization day 15. The Modified Rankin scale score was four in 1- and 3-month's follow-up.

DISCUSSION

In AIS, early restoration of blood flow to affected brain tissue has been proven to improve clinical outcomes. Therapeutic reperfusion with EVT is consistently linked to a favorable long-term functional prognosis over standard medical care.^[7] Notably, bridging therapy with IVT administered before thrombectomy improves functional independence in patients with AIS compared to IVT alone.^[2] These findings support the penumbra theory, which posits that early revascularization rescues hypoperfused brain tissue at risk of infarction by preventing infarct growth around the core stroke lesion.^[9]

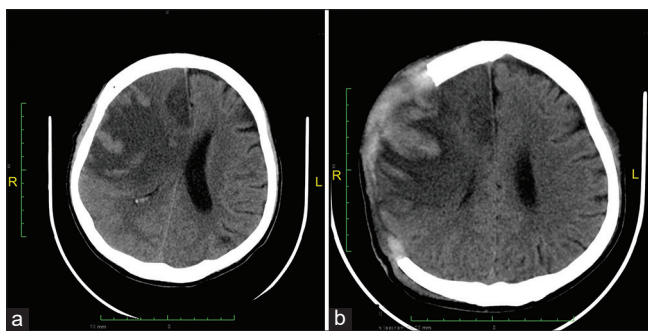


Figure 4: (a) Follow-up head computed tomography scan revealed malignant brain edema with significant midline shift on the right hemisphere and (b) the midline shift reduced after decompressive craniectomy.

Nevertheless, a significant minority of patients do not achieve clinical improvement despite successful recanalization of the occluded artery and reperfusion of the infarcted area.^[16] Some factors that may attribute to this include patient factors (i.e., older age, baseline disability, and chronic brain injury), the collateral flow of the occluded vessel, intraoperative hypotension during thrombectomy, and systemic factors (i.e., hypertension, hyperglycemia, and fever).^[16]

In this case report, the patient had a history of AF but did not take anticoagulation therapy in the past 6 months. Thus, we decided to administer intravenous r-tPA while preparing the patient for urgent TPM insertion and EVT. According to American Heart Association/American Stroke Association (AHA/ASA) Guideline, patients eligible for intravenous r-tPA should receive intravenous r-tPA even if EVTs are being considered.^[15]

MBE after an ischemic stroke is a serious condition that can lead to increased intracranial pressure, rapid neurologic deterioration, and cerebral herniation.^[8] Although EVT for proximal vessel occlusion in the anterior cerebral circulation has been demonstrated to be incredibly effective in selected patients, subsequent brain edema is still a common complication.^[3] Post-ischemic reperfusion edema is one potential form of secondary injury after revascularization and remains present in around half of EVT patients, reducing the beneficial effect of EVT on functional outcomes.^[9,11]

Some studies^[3,8,10,11,18,19] have identified predictors of MBE after mechanical thrombectomy (MT) for AIS. These predictors include a history of hypertension, angiogram findings (i.e., anterior cerebral artery [ICA] occlusion, lower rate of recanalization, a worse collateral score), laboratory findings (i.e., higher levels of admission fasting blood glucose and blood urea nitrogen, early increase in N-terminal pro-

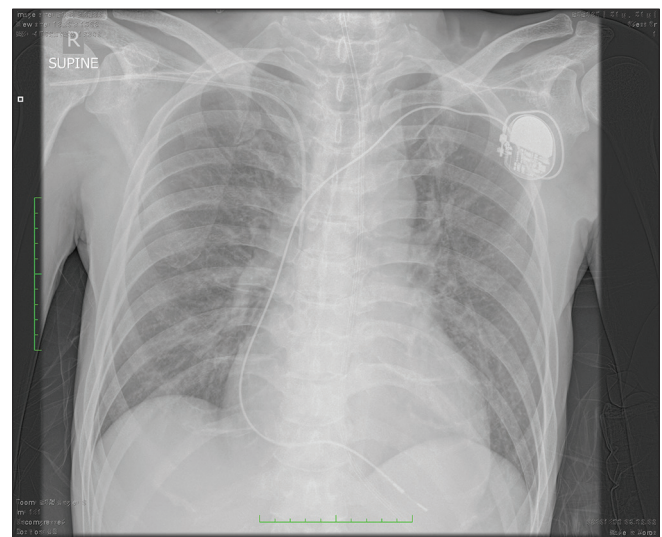


Figure 5: Plain chest X-ray showed permanent pacemaker.

brain natriuretic peptide levels after MT), higher level of NIHSS after MT, and postoperative NCCT evaluation (i.e., extent of contrast enhancement, lower ASPECTS, and cisternal effacement).^[3,8,10,11,18,19]

Studies on the relationship between revascularization and brain edema have shown contradictory results. Pre-clinical rat and primate studies indicated that revascularization may lead to the development of brain edema.^[1,6,14] Human studies, on the other hand, have demonstrated that reperfusion after ischemic stroke is linked to reduced brain edema.^[9,11] In this report, digital subtraction angiography revealed no collateral flow of the occluded artery but successful revascularization was achieved after thrombectomy. Nevertheless, the patient developed petechial hemorrhage and MBE during observation after the procedure.

Huang *et al.* found that the presence of MBE in patients with successful recanalization after MT was associated with localization of occluded vessels (ICA occlusion vs. MCA occlusion: odds ratio [OR] = 3.746; 95% confidence interval [CI] 1.169–12.006; $P = 0.026$) and collateral score (grade 1 vs. grade 0: OR = 0.727; 95% CI 0.192–2.753; $P = 0.638$; grade 2 vs. grade 0: OR = 0.130; 95% CI 0.021–0.819; $P = 0.030$).^[8]

Notably, Du *et al.* developed a nomogram that included collateral circulation to predict MBE in patients undergoing EVT.^[4] In the univariate analysis, a lower degree of collateral circulation (grade 0, 42.3% vs. 13.7%; grade 1, 43.7% vs. 44.1%; grade 2, 14% vs. 42.2%, $P < 0.001$) occurred more frequently in MBE patients.^[4] After adjustment for potential confounders (variables with $P < 0.2$ in the univariate analysis), collateral circulation (grade 1 vs. grade 0: OR: 0.360, 95% CI: 0.176–0.763, $P = 0.005$, grade 2 vs. grade 0: OR: 0.127, 95% CI: 0.051–0.315, $P < 0.001$) was independent predictors for MBE.^[4]

Collateral circulation plays a pivotal role in the pathophysiology of ischemic stroke.^[12] Poor collateral blood vessels are also known to augment the infarct core progression, which is attributed to development of brain edema.^[5,13] Thus, according to those studies aforementioned, in our case, the presumed factor associated with the brain edema was no collateral of the occluded vessel, even though we achieved successful recanalization.

CONCLUSION

MBE after mechanical thrombectomy results in unsatisfactory functional outcomes, even if it has successful revascularization. No collateral in the territory of the occluded vessel in the initial angiogram is one of the predictors of MBE after MT. This case report described that there is a predictor factor of MBE that must be noted by the neurosurgeon regarding planning the management in the future and giving information to the patient's family.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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