

# Stand-alone middle meningeal artery embolization in chronic subdural hematoma patient presenting cognitive decline: a case report

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#### ABSTRACT

Chronic subdural hematoma (cSDH) is a neurological disorder that commonly occurs in the elderly with high morbidity and mortality. Current treatment for cSDH consists of conservative therapy, surgical evacuation, and endovascular therapy, or a combination of all the methods. Endovascular therapy for cSDH management involving middle meningeal artery embolization (MMAE) has become a promising therapeutic option for clinicians as it offers a minimally invasive, safe, and effective choice with a low recurrence rate. MMAE using particles can also be performed in frail elderly patients who cannot undergo large craniotomy procedures. We presented a case of a subdural hematoma patient with cognitive decline using a therapeutic strategy of stand-alone MMAE, which resulted in cognitive function improvement.

**KEYWORDS** chronic subdural hematoma, cognitive impairment, MMA embolization

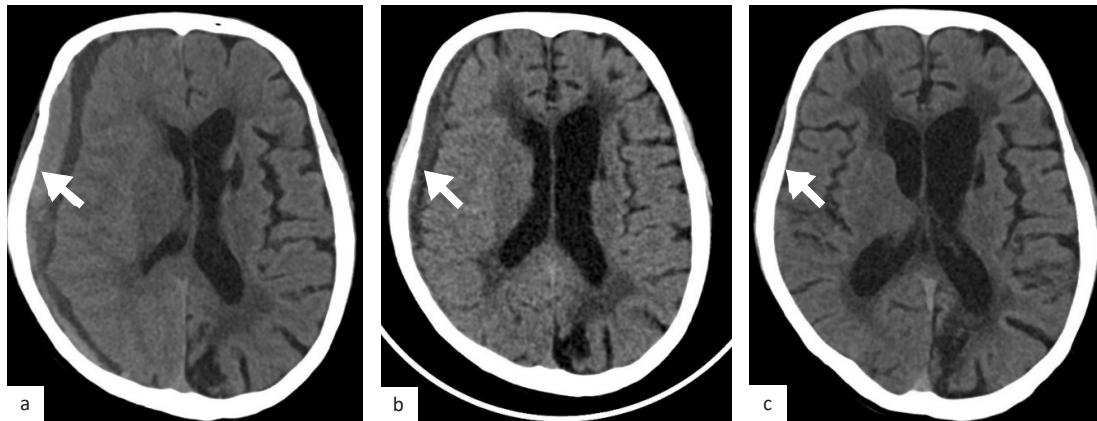
Chronic subdural hematoma (cSDH) is a collection of blood, fluid, and blood degradation products encapsulated in the space between the subdural space and arachnoid matter. cSDH is one of the most common neurological disorders, with an incidence ranging from 1.72 to 20.6 per 100,000 people/year.<sup>1,2</sup> The increased risk of cSDH in old age is due to increased life expectancy and the use of antithrombotic medications.<sup>3</sup>

The clinical features of cSDH include headaches, weakness, walking disturbances, and cognitive decline. Increased intracranial pressure often occurs in younger patients, whereas cognitive decline is more frequent in older patients. Cognitive impairment in patients with cSDH is mostly reversible, including improvement in neuropsychiatric function, with the help of appropriate treatment such as hematoma evacuation and middle meningeal artery embolization (MMAE).<sup>4-6</sup> MMAE has a low recurrence rate (<5%) compared with hematoma evacuation (10–25%),<sup>7-9</sup>

making it a safe treatment option with very low complication and failure rates in cases of stand-alone treatment.<sup>10,11</sup> A study found no complications associated with MMAE using polyvinyl alcohol (PVA), along with lower treatment failure compared to conservative treatment.<sup>12</sup> This case report aimed to illustrate the effectiveness of MMAE therapy through neuroimaging and clinical improvement.

## CASE REPORT

A 63-year-old male was admitted to a tertiary stroke center with chief complaints of progressive headaches that had worsened over the past 3 months, frequent forgetfulness, balance problems when walking, slurred speech, weakness in half of his limbs, and slanted mouth. He denied having seizures. He had a medical history of hypertension, heart disease, hypercholesterolemia, and hyperuricemia, and



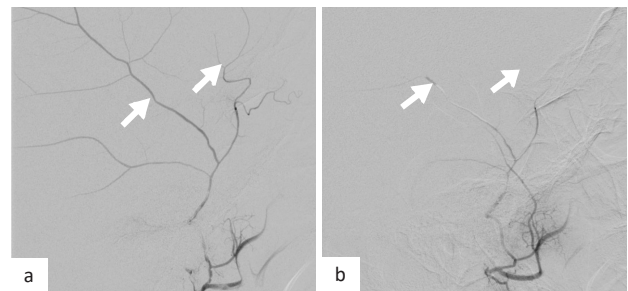
**Figure 1.** Serial head CT scan examination. (a) Preoperative revealed both acute and chronic hemorrhage (arrow) with a leftward midline shift of 5 mm; (b) 5 weeks after embolization showed cSDH reduction with a disappearing hyperdense (arrow); (c) post-embolization 6 months later showed resolved subdural hematoma (arrow). cSDH=chronic subdural hematoma; CT=computed tomography

routinely used antiplatelets and antihypertensives for cardiovascular medications. Cognitive examination revealed severe cognitive decline, with a mini-mental state examination (MMSE) score of 10/30.

Computed tomography (CT) revealed a cSDH (Figure 1a). A slightly hyperdense lesion (40–50 Hounsfield unit [HU]) that was partially biconvex and crescent-shaped, as well as a hypodense lesion (20–30 HU) that was crescent-shaped on its medial side were present in the right frontoparietotemporal region, suggesting a subacute cSDH. These lesions compressed and narrowed the sulci of the right frontoparietal lobe and right lateral ventricle, causing a midline shift to the left by 5 mm.

The patient was diagnosed with a subacute cSDH with Markwalder grade 1 and underwent MMAE without surgical evacuation. All procedures were performed under general anesthesia. A right femoral 6-French sheath was used. The JR-3.5 6-French guiding catheter (Boston Scientific, USA) was placed in the right external carotid artery. Digital subtraction angiography indicated that the middle meningeal artery (MMA) was an arterial feeder (Figure 2a). Under roadmap guidance, the microcatheter and microwire were maneuvered towards the petrosquamous branch. Embolization was performed using PVA with small particle sizes (45–150 µm), and embolic penetration without reflux into the frontoparietal branch of the MMA was seen (Figure 2b). No postoperative complications were observed.

Head CT showed a decrease in the subdural hematoma in the right frontoparietal lobe region



**Figure 2.** Angiogram of MMAE. (a) MMA pre-embolization was observed as the arterial feeder on the cerebral angiogram (arrows); (b) post-embolization angiogram with PVA particles showed a completely occluded right MMA (arrows). MMA=middle meningeal artery; MMAE=middle meningeal artery embolization; PVA=polyvinyl alcohol

5 weeks after embolization (Figure 1b), followed by complete resolution 6 months later (Figure 1c). Additionally, the patient showed improvement in gait, left-sided weakness, as well as speech and cognition (MMSE score: 16/30).

## DISCUSSION

This case report demonstrated that MMAE without hematoma evacuation is an effective and safe treatment for cSDHs. MMAE aims to block the vascularization of the subdural membrane and stop microbleeding from reappearing; hematoma expansion will stop, and spontaneous reabsorption will occur.<sup>13</sup> The Markwalder Grading Scale (MGS) can be used to assess prognosis and inform the selection of the most appropriate treatment. MMAE can be performed as a primary intervention instead

of conservative treatment in patients with cSDH with a low MGS score between 1 (in our case) and 2.<sup>14</sup> In this case, endovascular embolization therapy was performed from the MMA as a stand-alone intervention to prevent expansion of the bleeding area and as a prophylactic therapy to prevent recurrence, given the patient's low MGS score. This patient had a history of antiplatelet drug use, which increased the risk of complications if craniotomy was performed.

The MMAE method involves navigating a microcatheter and microwire into the MMA circulation and injecting an embolization agent using PVA to occlude distal vascularization of the MMA. However, several factors must be considered when performing embolization. First, the MMA is usually very small in older patients, resulting in the need to use a very small microcatheter and a small volume of liquid embolism to limit distal penetration. Second, PVA is radio-opaque, requiring liquid embolic agents with contrast substances for visualization.<sup>15</sup> Both liquid and particle embolisms are equally effective and safe for patients undergoing MMAE.<sup>16</sup>

A 92% success rate was achieved in patients with cSDH who underwent MMAE after 6 months of follow-up.<sup>17</sup> MMAE results in cSDH did not differ distally, proximally, or simultaneously between sites, but embolization in more than one branch could not improve clinical outcomes.<sup>18</sup> In this case, the patient who underwent embolization on several MMA artery branches showed improved clinical results in cognitive function, gait pattern, weakness of limbs, and headaches within a few months.

Overall, MMAE is a safe treatment with a low complication rate (2.3%).<sup>19</sup> However, as an invasive procedure, it carries the potential for complications, including cerebral infarct, intracerebral hemorrhage, seizure, and tension pneumocephalus, which may necessitate a short hospital stay.<sup>20</sup> Embolization causes brain ischemia, and bleeding can occur due to perforation by the microcatheter.<sup>7,10</sup> In this case, no clinical or imaging complications were observed.

In conclusion, this case demonstrates that MMAE is an effective and safe treatment for cSDH, serving as a viable alternative to surgery, with higher recurrence rates and complications. This treatment can be used as a stand-alone procedure to treat cSDH with significant clinical improvement.

#### Conflict of interest

The authors affirm no conflict of interest in this study.

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