Case Report

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Middle Meningeal Artery Embolization for Management of Chronic Subdural Hematoma

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Abstract

Chronic subdural hematomas (cSDH) are a common neurological condition that can cause significant morbidity in the elderly population. Traditionally, surgical options such as burr hole drainage and craniotomy are employed for treatment; however, a novel and minimally invasive intervention has emerged in recent years: middle meningeal artery (MMA) embolization. This technique offers a promising alternative for patients with recurrent cSDH or those who are not candidates for conventional surgery. MMA embolization targets the vascular supply of the hematoma by selectively embolizing the middle meningeal artery, which contributes to abnormal neovascularization within the hematoma capsule. This approach reduces the blood flow to the hematoma, leading to its stabilization and potential resolution without the need for surgical intervention. We present a case of 63-year-old patient with a recurrent cSDH treated successfully with MMA embolization, highlighting the technique's effectiveness, safety, and potential for broader application in managing this condition.

Keywords: Chronic subdural hematomas, middle meningeal artery, embolization, polyvinyl alcohol, minimally invasive

INTRODUCTION

Chronic subdural hematoma (cSDH) is an accumulation of blood between the dura mater and the brain. It is most common in the elderly and those on anticoagulant therapy. The incidence of cSDH has been rising due to an aging population and increased use of antithrombotic medications.[1] Standard treatments include surgical evacuation through burr hole drainage or craniotomy, but rates are notable, and surgery may not be an option for all patients, especially those with comorbidities or poor general health. Middle meningeal artery (MMA) embolization, a relatively new technique, involves the selective occlusion of the MMA, which is thought to be a major source of ongoing bleeding in cSDH.[2] This method has been shown to reduce hematoma rates and provide an alternative to traditional surgical approaches, especially in high-risk patients.

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CASE PRESENTATION

A 63-year-old male with a history of hypertension and heart disease presented with progressive headache. Patient was on dual antiplatelets. Computed tomography (CT) of the brain showed bilateral frontoparietal chronic subdural hematoma with midline shift of 10mm. Patient was treated with burr hole drainage. Despite initial improvement, the patient experienced a of headaches. Repeat Computed tomography (CT) of the brain showed a recurrent left-sided chronic subdural hematoma with a mixed-density appearance suggestive of both old and recent blood products. The hematoma was large enough to exert mass effect on the underlying brain parenchyma. Given the patient's comorbidities, including hypertension, and his high surgical risk due to age and frailty, antiplatelets, surgical re-exploration was considered less favourable. After a multidisciplinary discussion, the decision was made to proceed with MMA embolization as a less invasive option with a potentially lower complication profile.

The procedure was performed under local anaesthesia in the angiography suite. A right femoral artery access was achieved, and a catheter was navigated into the left external carotid artery (ECA). Selective angiography of the MMA was then performed, revealing prominent arterial branches supplying the subdural hematoma. After careful evaluation 150-250 micron Polyvinyl alcohol (PVA) particles were used to occlude the MMA, particularly the anterior and posterior branches.

Post-procedure angiography confirmed complete occlusion of the MMA without any complications. The patient was monitored overnight in the hospital for any neurological deterioration.The patient's postoperative course was uneventful and discharged in stable condition. A follow-up CT scan 2 months after the procedure demonstrated complete resolution of the hematoma. The patient remained symptom-free at the six-month follow-up with no of the subdural hematoma, and he was able to return to his baseline activities.

DISCUSSION

Chronic Subdural Hematomas (cSDH) are a common clinical condition, particularly in elderly individuals and those on anticoagulant therapy. They typically present as a collection of blood between the dura mater and the brain.[3] In cSDH, the bleeding originates from ruptured bridging veins, but as the condition evolves, neovascularization within the hematoma cavity may promote further bleeding. This neovascularization can be influenced by the middle meningeal artery (MMA), which supplies the dura mater and its surrounding structures. The MMA has been identified as a critical artery in the pathogenesis of cSDH because it contributes to the formation of abnormal blood vessels within the hematoma capsule.[4] By embolizing the MMA, the blood supply to the abnormal vessels is reduced, thus limiting further bleeding and promoting the resolution of the hematoma.

The treatment of cSDH has traditionally relied on surgical intervention, particularly burr hole drainage or craniotomy.[5] However, rates can be high, especially in patients with ongoing risk factors such as anticoagulation therapy or the elderly population. MMA embolization offers a promising alternative, particularly for patients who are not candidates for surgical re-exploration or those with recurrent hematomas.

The rationale behind MMA embolization is that the middle meningeal artery supplies the blood flow to the dura mater, and by occluding this vessel, ongoing bleeding into the subdural space is prevented.[6] Several studies have demonstrated the efficacy of this technique in reducing hematoma, with favourable outcomes in high-risk populations.

MMA embolization involves selective catheterization of the middle meningeal artery, followed by the injection of embolic agents, such as coils, polyvinyl alcohol (PVA) particles, or glue, to occlude the vessel.[7] This procedure is typically performed via a catheter inserted into the femoral artery and guided to the MMA through the external carotid artery. The goal is to reduce the blood supply to the hematoma and stabilize the bleeding, leading to gradual resorption of the hematoma.

Benefits of MMA embolization are minimally invasive, reduced risk of, efficacy in symptomatic cases, favourable outcomes in high-risk patients and improved quality of life.[8] Challenges and Limitations of MMA embolization are technical difficulty, not always curative, non-target embolization and limited evidence

In this case, MMA embolization was a viable and successful alternative to surgery. The patient experienced significant recovery, and there was no of the hematoma during the follow-up period. This approach minimizes the risks associated with open surgery and provides a novel treatment for recurrent cSDH, particularly in frail or high-risk patients.[9]

CONCLUSION

Middle meningeal artery embolization is an effective and minimally invasive technique for the management of chronic subdural hematomas, particularly in patients who are not ideal candidates for conventional surgery.[10]While there are still some challenges regarding its technical complexity and the need for further evidence, MMA embolization has demonstrated its potential in reducing hematoma size, preventing, and improving outcomes, particularly for patients who are not ideal candidates for traditional surgical intervention. As evidence accumulates, MMAE may become a more integral part of the therapeutic armamentarium for managing chronic subdural hematomas. Further studies with larger sample sizes and longer follow-up are needed to establish long-term outcomes and optimize patient selection.

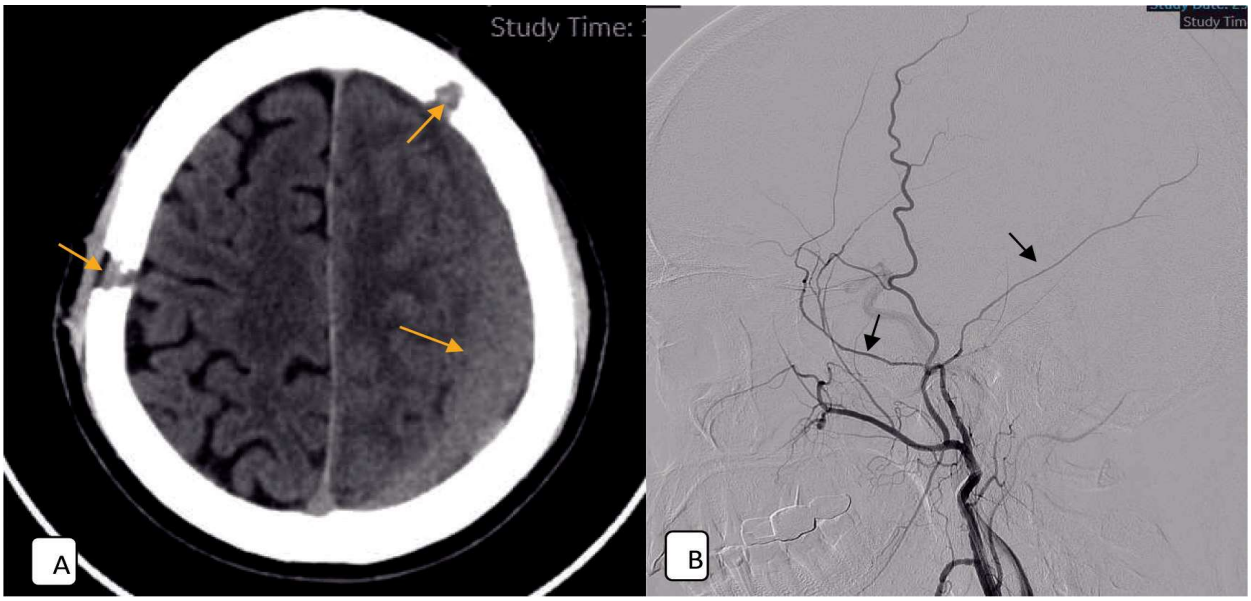

Fig. 1: (A) CT axial image shows subacute to chronic SDH in left frontoparietal region with bilateral craniotomy (B) Left ECA angiogram shows middle meningeal artery

Fig. 2: (A) Selective angiogram from middle meningeal artery (B) Selective angiogram shows meningeal blush

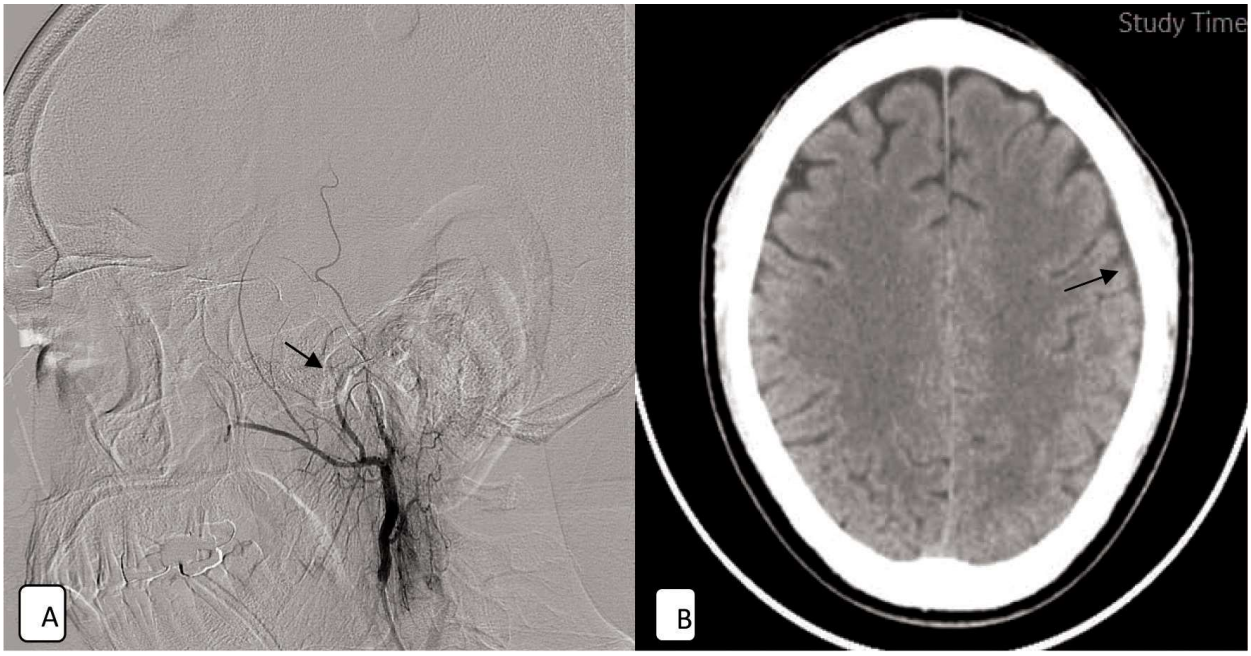

Fig. 3: (A) Post middle meningeal artery embolization angiogram shows no filling of meningeal arteries (B) Follow up CT shows complete resolution of SDH

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Conflicts of interest: No Conflicts of Interest

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