



# Unusual Intracerebral Hemorrhage Secondary to Delayed Posttraumatic Middle Meningeal Artery Pseudoaneurysm, Successfully Treated by Endovascular N-Butyl Cyanoacrylate Embolization

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Indian J Neurosurg 2024;13:172–175.

## Abstract

Pseudoaneurysm of the middle meningeal artery, presenting as a delayed sequela of trauma, being a rare entity, may sometimes present as an acute intraparenchymal hemorrhage, with a risk of rerupture and mortality. The optimal management in acute settings remains undetermined. We, hereby, report a case of elderly gentleman with a history of a road traffic accident. Noncontrast computed tomography (NCCT) brain was reported to have left parietal hemorrhagic contusion without any mass effect. The patient was managed conservatively without any major neurological deficits. After 7 months, the patient presented with severe headache, altered sensorium, and right hemiparesis. NCCT brain showed acute left thalamocapsular hemorrhage with minimal subarachnoid hemorrhage with associated mass effect and impending herniation. Considering the fall in patient's baseline Glasgow comma scale response, pupillary asymmetry, and CT findings, immediate decompression and hematoma evacuation were advised. In view of atypical morphology, the patient was planned for urgent digital subtraction angiography prior to the surgery to rule out the ruptured aneurysm or pial arterio-venous fistula. Selective angiography of the left external carotid artery demonstrated a dissecting pseudoaneurysm feeding from the middle meningeal artery (MMA), which was embolized using n-butyl cyanoacrylate (NBCA). Postprocedure DynaCT revealed the left temporal bone fracture, indicating this pseudoaneurysm to be most likely posttraumatic delayed sequelae. Postembolization, the patient underwent surgical decompression and excision of hematoma. Patient's neurological status gradually improved and was discharged with the minimal deficit. Our case highlights the importance of awareness of the posttraumatic MMA pseudoaneurysm as an uncommon but treatable entity, which can be easily diagnosed using cerebral angiography and amenable to safe and effective endovascular embolization using NBCA.

## Keywords

- ▶ Intraparenchymal hemorrhage
- ▶ NBCA embolization
- ▶ Posttraumatic middle meningeal artery pseudoaneurysm

article published online  
February 23, 2023

DOI <https://doi.org/10.1055/s-0043-1761602>.  
ISSN 2277-954X.

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## Introduction

Middle meningeal artery pseudoaneurysms are a rare entity. It can either be a true aneurysm associated with high flow states or systemic hypertension or can be a delayed complication of trauma.<sup>1,2</sup> An estimated 85% of traumatic pseudoaneurysms were documented from the temporal region and infrequently from frontal or occipital region and approximately 70 to 90% of traumatic MMA pseudoaneurysms arise due to the temporal bone skull fracture which is an overlying part of the MMA.<sup>3</sup>

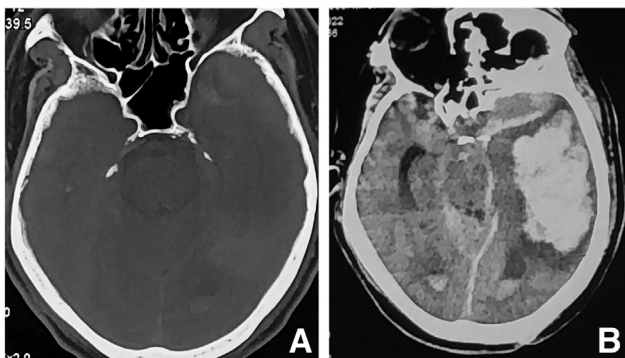
The most frequent complication of posttraumatic pseudoaneurysms is an epidural hemorrhage which can have acute or delayed presentation. Many a times, it may manifest as subdural or subarachnoid hemorrhage. Combined setting of large intraparenchymal with subarachnoid hemorrhage is a rare presentation. N-butyl cyanoacrylate (NBCA) is a routinely utilized liquid embolic agent for cerebral arteriovenous malformations and other peripheral vascular pathologies.<sup>4,5</sup>

Our case report demonstrates endovascular embolization with NBCA is valid and safe treatment option for middle meningeal artery pseudoaneurysm which can present as a delayed posttraumatic complication.

## Case Report

A 64-year elderly gentleman with a history of hypertension and type 2 diabetes mellitus sustained a road traffic accident 7 months back and managed conservatively without any residual neurological deficits. NCCT brain done at that time was suggestive of left parietal hemorrhagic contusion.

Seven months after the accident, the patient arrived at the emergency department with a complaint of acute onset severe headache, vomiting, altered sensorium, and right hemiparesis since the past 8 hours. NCCT brain done at the periphery center showed acute thalamocapsular hemorrhage with a significant mass effect and minimal subarachnoid hemorrhage in left MCA cistern and Sylvian fissures (►Fig. 1A–B). There was also evidence of impending uncal herniation and mild hemorrhage in the fourth ventricle. The Baseline Glasgow coma scale on arrival was E2M4V1. In view of the sudden deterioration in the



**Fig. 1** Computed tomography (CT) done at periphery center prior to admission reveals (A) bone window and (B) parenchymal hemorrhage in the left thalamocapsular region and minimal subarachnoid hemorrhage in the left Sylvian cistern with mass effect.

patient's clinical status and recent CT findings, urgent decompression and hematoma evacuation were considered. To rule out the possibility of a ruptured aneurysm or pial arterio-venous fistula, urgent cerebral angiography was planned prior to the surgery.

Selective catheter angiography of the left external carotid artery showed a fusi-saccular dissecting pseudoaneurysm involving the middle meningeal branch of the left internal maxillary artery, measuring approximately 14.2 × 6.3 mm (►Fig. 2A and B).

In view of lesion complexity and preplanned neurosurgical evacuation of hematoma, NBCA was chosen for embolization followed by surgical decompression. A 6F 70 cm Flexor check long sheath was inserted through the right common femoral artery and navigated into the left CCA. Subsequently, CAT 5 guiding catheter was advanced and placed in the left internal maxillary artery. Selective catheterization of left MMA using marathon 1.5F 165 cm microcatheter and hybrid 008 microguidewire was done. Furthermore, any anatomical variations of MMA and dangerous anastomoses which may predispose to procedure-related morbidity were ruled out.

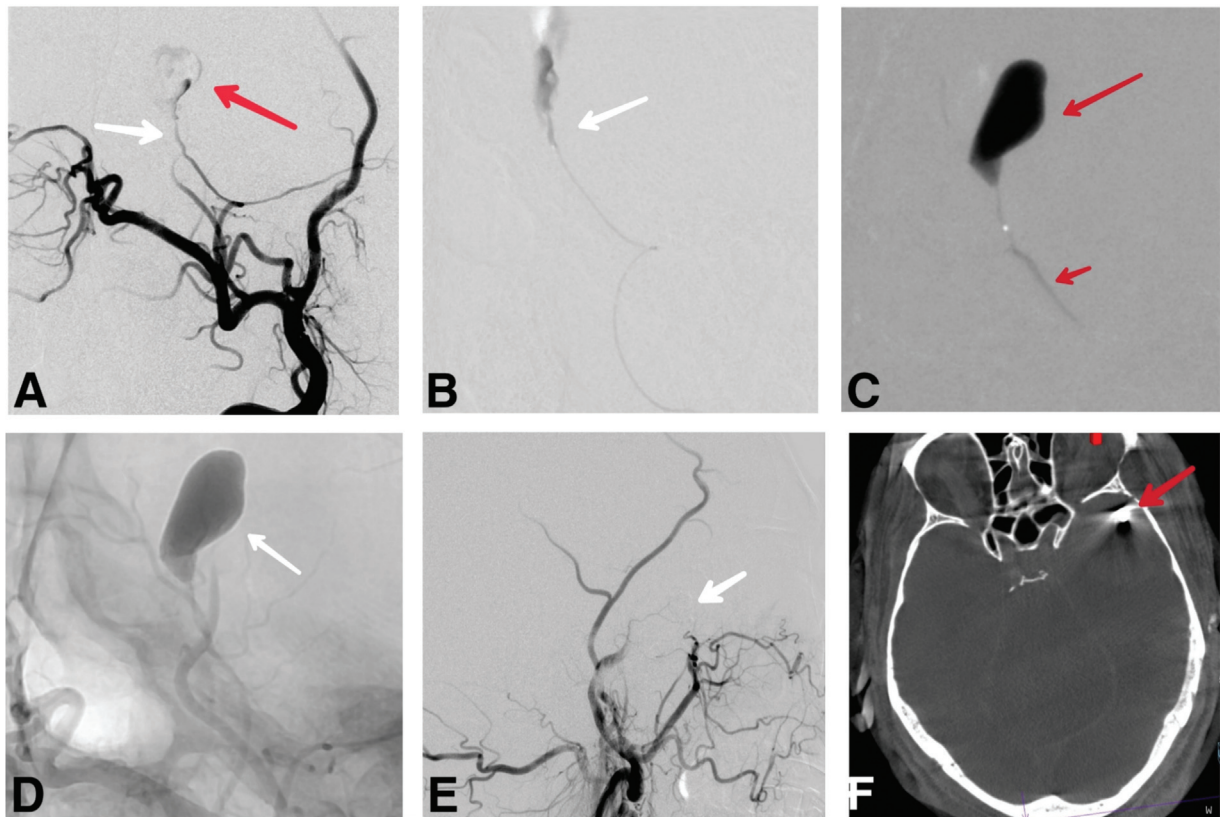
A dilution of 33% concentration of the NBCA mixed with lipiodol was slowly injected under direct vision inside the pseudoaneurysm and the feeding vessel causing parent vessel occlusion. Final check angiogram demonstrated a complete occlusion of pseudoaneurysm with significant stasis, without any evidence of fresh hemorrhage on the postprocedure DynaCT scan (►Fig. 2C–E). Retrospectively analyzing DynaCT, a left anterior squamous temporal bone fracture was noted (►Fig. 2F) which was not initially reported at the peripheral center. The patient was hemodynamically stable and immediately underwent decompression and surgical evacuation. The in-hospital course was uneventful, and postoperative CT (►Fig. 3) revealed hyperdense material in the middle cranial fossa due to NBCA without any fresh evidence of hemorrhage. The patient's neurological status gradually improved over the course in the hospital and was discharged with minimal residual right hemiparesis.

## Discussion

Intracranial pseudoaneurysms account for less than 1% of all intracranial aneurysms and the leading cause is head trauma.<sup>4</sup>

Around 70 to 90% of cases of MMA pseudoaneurysms are due to the fracture of temporal bone overlying the middle meningeal artery or its branches accounting for approximately 20 to 25% of mortality.<sup>3</sup>

Pseudoaneurysm pathogenesis in case of trauma to the middle meningeal artery involves fractured bony rim induced injury of the adventitia and intima followed by the formation of a contained intramural hematoma which undergoes fibrous reorganization. Clot destabilization by the hemodynamic stress of the arterial flow renders the lesion progressively rupture prone.<sup>6</sup> Among few cases, traction of the MMA has been documented in patients without any bony deformity on the same side causing pseudoaneurysms.<sup>7,8</sup>



**Fig. 2** Cerebral angiography of the left external carotid artery (A) showing a pseudoaneurysm (red arrow) feeding from the middle meningeal artery (MMA) (white arrow). (B) Selective contrast injection of middle meningeal artery with marathon microcatheter revealing pseudoaneurysm. (C) Dye stasis noted in the pseudoaneurysm as well as distal MMA segment (red arrow). (D) Postembolization native DSA image (white arrow) demonstrates glue cast with contrast stasis in a pseudoaneurysm and distal MMA. (E) (Postembolization contrast run demonstrating complete occlusion of the pseudoaneurysm with NBCA cast (white arrow)). (F) Postprocedure DynaCT (bone window) demonstrates fracture of the left squamous temporal bone (most likely trauma sequelae).

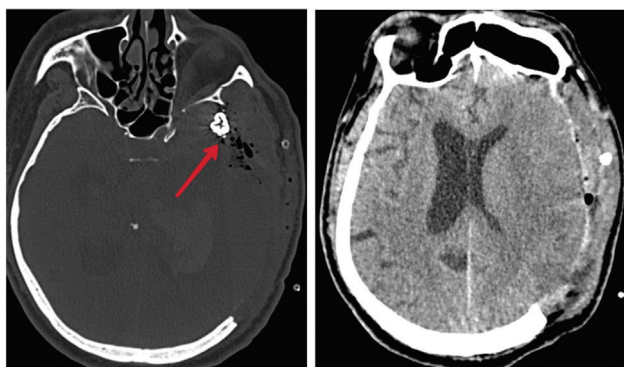
Rumbaugh et al<sup>9</sup> reported an elderly woman with a right temporal hemorrhage and sphenoid region MMA pseudoaneurysm. Also, Montanari et al<sup>7</sup> reported eight cases of previous fractures of the temporal bone with small parenchymal hemorrhage (s) out of which six patients represented delayed parenchymal bleeding due to pseudoaneurysm rupture which occurred 7 days to 11 months after prior head injury.

Our patient had a recent onset spontaneous multicompartment bleed, which routinely raises clinical

suspicion of a ruptured aneurysm or pial fistula. With the background history of trauma, we also included pseudoaneurysm in our differential diagnosis. Urgent neurosurgery was advised considering the deterioration in clinical response and significant mass effect. With these differential diagnoses in our mind, an urgent diagnostic cerebral angiography was planned prior to surgery. Selective contrast run of the internal maxillary artery demonstrated middle meningeal artery pseudoaneurysm.

The most common treatment modalities preferred are neurosurgical resection, ligation of MMA, or coagulation of the vessel. Endovascular embolization with coils or liquid embolic agents like NBCA or onyx provides alternative and safe treatment options. However, there is no general consensus to prefer a specific liquid embolic agent to be used.

Jussen et al<sup>3</sup> reported coil embolization as a safe treatment modality for MMA pseudoaneurysms. However, the small size, friable nature, and irregular morphology may not allow for the accommodation of standard-sized coils. Furthermore, any manipulation with the microcatheter or during coil placement accounts for an increased risk of intraprocedural rupture. On the contrary, occluding the pseudoaneurysm-bearing vessels with coils can pose a challenge. Hence, adequate embolization with parent



**Fig. 3** Postdecompressive surgery computed tomography (CT) shows hyperdense material made by n-butyl-2-cyanoacrylate (red arrow).

vessel occlusion using liquid embolic agents such as NBCA or onyx may be a safer and more effective treatment option.

As the patient was already planned for emergency decompression, a decision to embolize with NBCA was taken. Very few cases document the presence of large intracerebral hematoma secondary to traumatic pseudoaneurysm in which NBCA embolization is considered to be a preferred treatment modality in an acute setting, considering the risk of intraoperative rerupture and hemorrhage due to the friable nature of these pseudoaneurysms. Furthermore, NBCA was chosen in our patient considering its cost-effectiveness when compared to onyx.

Postembolization contrast run demonstrated contrast stasis without any inflow into the pseudoaneurysm. Kim et al<sup>4</sup> reported a large pseudoaneurysm with uncontrollable bleeding and contrast leakage from a ruptured middle meningeal artery which was managed intraoperatively utilizing NBCA.

## Conclusion

Pseudoaneurysm of MMA secondary to trauma is a rare but life-threatening condition. Patients presenting acutely with ICH or SAH with a history of trauma and delayed pseudoaneurysm rupture should be considered a possibility and NBCA embolization as a safe, cost-effective, and alternative treatment option.

### Authors' Contribution

M.G.W. was responsible for overall responsibility. P.O. was responsible for analysis and interpretation. G.G. was responsible for analysis and interpretation. A. D. B.

was responsible for analysis and interpretation. A.M. was responsible for overall responsibility.

### Conflict of Interest

None.

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