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Case Report

N-butyl cyanoacrylate embolization of a traumatic pseudoaneurysm and arteriovenous fistula of the middle meningeal artery

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ABSTRACT

We report a case of combined traumatic pseudoaneurysm and arteriovenous fistula of the middle meningeal artery, which presented clinically 1 year after initial head trauma. A 39-year-old male presented with seizure activity after a closed head injury from a fall. He was hospitalized for multiple intraparenchymal hemorrhages and ultimately discharged 2 weeks later without neurologic deficits. One year later, he presented with a new right anterior temporal intraparenchymal hemorrhage after a syncopal event. Selective angiography of the right external carotid artery demonstrated a chronic appearing traumatic laceration of the proximal middle meningeal artery with a 6 × 10 mm pseudoaneurysm and a single fistula with venous varix draining into the lateral pterygoid veins. The pseudoaneurysm and arteriovenous fistula were successfully embolized with n-butyl cyanoacrylate.

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Introduction

N-butyl cyanoacrylate (NBCA) is a commonly used liquid embolic agent in the endovascular treatment of cerebrovascular and peripheral vascular pathologies [1]. Although NBCA is

most commonly known as an endovascular treatment option for cerebral arteriovenous malformations, neurointerventionalists have recently begun to utilize cyanoacrylate glues for various other pathologies of the cerebrovasculature [1–3]. For example, Shah et al used NBCA to embolize a traumatic pseudoaneurysm of a distal cortical branch of the middle cerebral

Abbreviations: NBCA, n-butyl cyanoacrylate; CT, computer tomography; CTA, computer tomography angiography.

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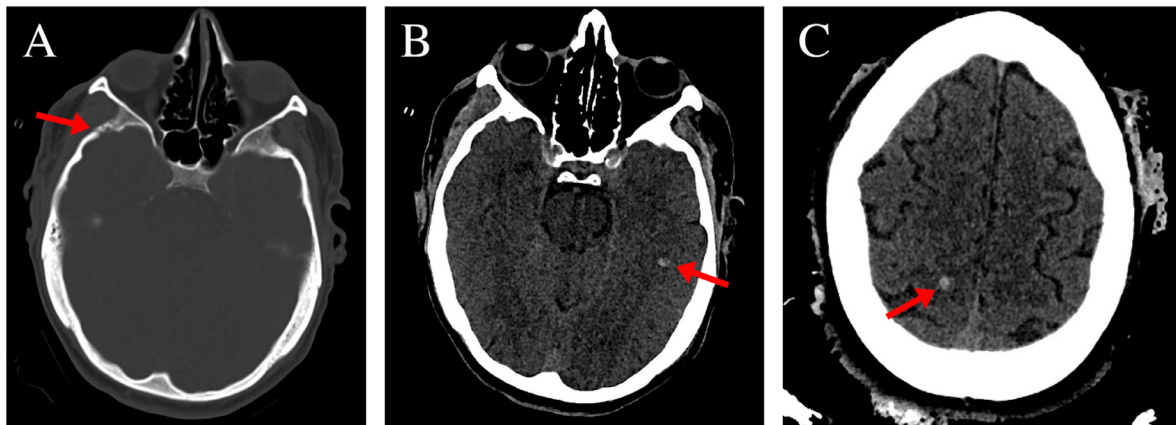


Fig. 1. – Initial CT Head. (a) Non-depressed fracture involving the squamous portion of the right temporal bone (arrow). (b) Small left posterior temporal lobe intraparenchymal contusion (arrow). (c) Small right parietal lobe intraparenchymal contusion (arrow).

artery [2]. Moreover, Kim et al utilized intraoperative NBCA embolization to occlude a large pseudoaneurysm and contrast leakage from a ruptured middle meningeal artery in a case with uncontrollable bleeding from the middle cranial fossa [3]. Combined traumatic pseudoaneurysm and arteriovenous fistula of the middle meningeal artery is an exceedingly rare complication of head trauma [4,5]. We report a case of combined traumatic pseudoaneurysm and arteriovenous fistula of the middle meningeal artery presenting 1 year after a closed head injury from a fall. Angiography demonstrated a chronic appearing traumatic laceration of the proximal middle meningeal artery with a 6×10 mm pseudoaneurysm and a single fistula with venous varix draining into the lateral pterygoid veins. Due to the complexity of the lesion architecture, NBCA was chosen rather than metallic coils to embolize the lesion complex. The pseudoaneurysm and arteriovenous fistula of the middle meningeal artery were obliterated utilizing NBCA embolization. This case demonstrates NBCA embolization is a valid and safe alternative endovascular treatment compared to endovascular trapping with coils for cases of combined pseudoaneurysm and arteriovenous fistula of the middle meningeal artery.

Case report

A 39-year-old male initially presented to our institution with seizure activity after a closed head injury from a fall. The patient was intubated in the field by an emergency medical service team. Neurologic examination upon presentation revealed a Glasgow Coma Scale of 8T (Eyes 2, Verbal 1T, Motor 5). Computer tomography (CT) scan demonstrated a right-sided nondepressed temporal bone fracture and 2 small focal regions of intraparenchymal hemorrhagic contusions involving the posterior left temporal lobe and right parietal lobe without evidence of hydrocephalus or ventricular shift (Fig. 1) Computer tomography angiography (CTA) of the head and neck demonstrated no evidence of cerebrovascular pathology.

An external ventricular drain was placed, which revealed an intracranial pressure within normal limits. The patient was managed nonoperatively. He was ultimately extubated and discharged to a rehabilitation facility 2 weeks later without neurologic deficit. One year later, the patient represented to the hospital after a syncopal event. Repeat CT head revealed an acute right anterior temporal intraparenchymal contusion in proximity to the prior right temporal bone fracture (Fig. 2). CTA demonstrated 2 new enlarged vessels extending directly into the right temporal lobe hemorrhage (Fig. 3). These findings in relation to their proximity to the temporal bone fracture raised suspicion for pseudoaneurysm formation and rupture as a cause for the new intraparenchymal hemorrhage.

Cerebral angiography was performed via a transfemoral approach, via 6 French arterial sheath, under generalized anesthesia. Selective angiography of the right external carotid artery demonstrated a chronic appearing traumatic laceration of the proximal middle meningeal artery with a 6×10 mm pseudoaneurysm and a single fistula with venous varix draining into lateral pterygoid veins with persistent flow into the distal branches of the middle meningeal artery (Fig. 4A-B). Angiography of the remaining cerebrovasculature revealed no additional pathology including aneurysms, arteriovenous shunting or hemodynamically significant stenosis. NBCA mixture (50%) was injected through a microcatheter, occluding the inflow and outflow of the pseudoaneurysm and fistula vein as well as filling the pseudoaneurysm itself. Postembolization angiography revealed no evidence of residual pseudoaneurysm or filling of the arteriovenous fistula (Fig. 4C-D). The patient was without any neurologic deficits after the procedure. Follow up CTA 1 year later demonstrated total obliteration of the pseudoaneurysm and arteriovenous fistula.

Discussion

Traumatic pseudoaneurysm of the middle meningeal artery and arteriovenous fistula formation are rare complications of

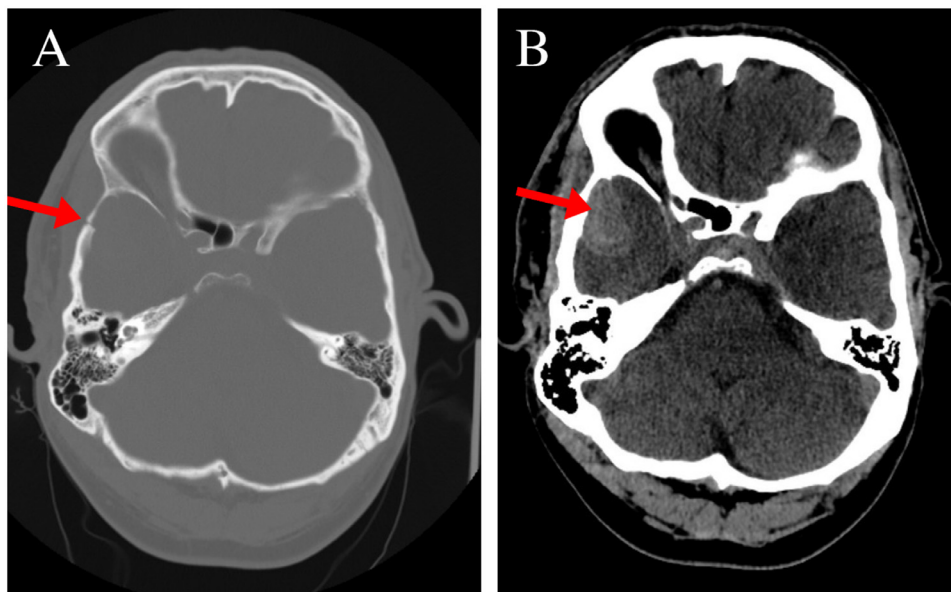


Fig. 2. – Repeat CT Head 1-year from initial trauma. (a) Redemonstration of the known nondepressed fracture involving the squamous portion of the right temporal bone (arrow). (b) Acute right anterior temporal lobe intraparenchymal contusion overlying the prior fracture (arrow).

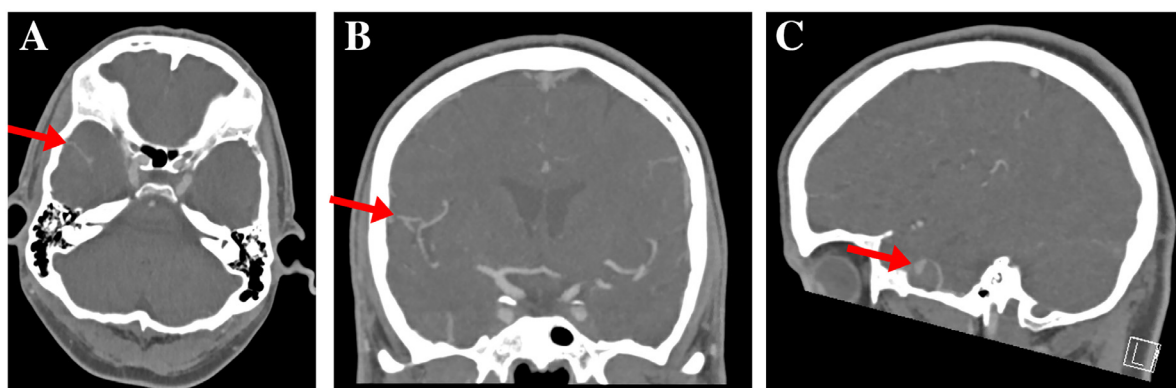


Fig. 3. – CT angiography revealed 2 new enlarged vessels extending directly into the right temporal lobe hemorrhage (arrows). (a) Axial view. (b) Coronal view. (c) Sagittal view.

head trauma. Pseudoaneurysms represent less than 1% of all intracranial aneurysms: the majority of which affect the internal carotid artery [6]. Moreover, approximately 70%-90% of cases of middle meningeal artery pseudoaneurysms are associated with a temporal bone fracture adjacent to the middle meningeal artery or 1 of its 2 branches [7]. Arteriovenous fistula formation has been reported to occur in 1.8% of cases of traumatic middle meningeal artery injury [8]. The etiology of both lesions has been suggested to result from tearing of the arterial wall from a skull fracture or via separation of the dura mater and underlying bone [9]. However, despite a similar etiologic mechanism, the coexistence of these pathologies has been reported to account for only 5% of cases where a pseudoaneurysm of the middle meningeal artery was found [5].

The most common presentation of a pseudoaneurysm of the middle meningeal artery is an epidural hemorrhage,

occurring in approximately 70% of cases [10]. However, other sequelae of pseudoaneurysm rupture have been reported including subdural hemorrhage, subarachnoid hemorrhage, or intraparenchymal hemorrhage [11–13]. Our patient was found to have an isolated acute intraparenchymal hemorrhage in proximity to the known temporal bone fracture and newly diagnosed pseudoaneurysm 1 year after initial head trauma. The delayed presentation of our patient's pseudoaneurysm may have given the lesion ample time to erode the inner layer of the dura and rupture into the brain parenchyma. Montanari et al retrospectively found that in 8 cases of prior temporal bone fractures and small intraparenchymal hemorrhage(s) nearby, 6 patients represented with a delayed parenchymal bleed due to pseudoaneurysm rupture occurring 7 days – 11 months after initial head trauma [13]. The present case and prior reports emphasize that middle meningeal artery

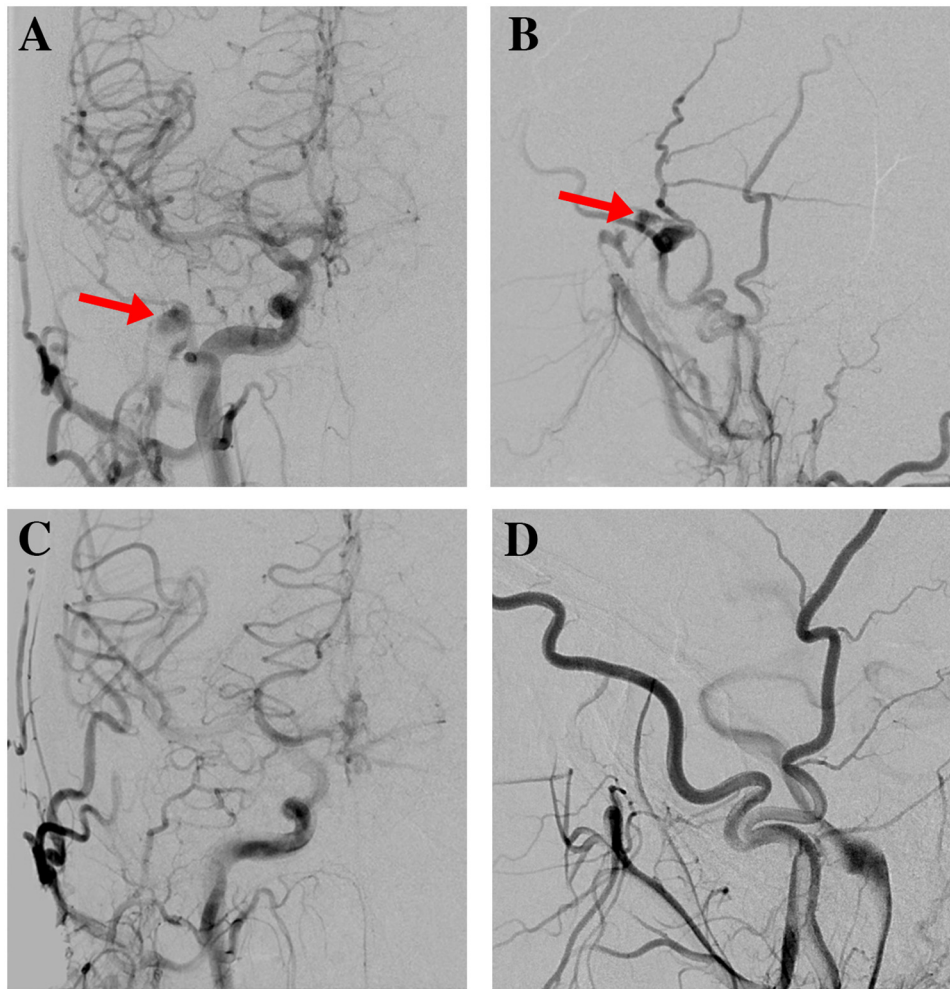


Fig. 4. – Cerebral angiography. (a) and (b) Selective angiography of the right external carotid artery in the anteroposterior and lateral views demonstrated a chronic appearing traumatic laceration of the proximal middle meningeal artery with a 6 × 10 mm pseudoaneurysm and a single fistula with venous varix draining into lateral pterygoid veins with persistent flow into the distal branches of the middle meningeal artery (arrows). (c) and (d) Post-embolization angiography of the right external carotid artery in the anteroposterior and lateral views demonstrated no evidence of residual pseudoaneurysm or filling of the arteriovenous fistula.

pseudoaneurysm rupture should remain on the differential diagnosis for intraparenchymal hemorrhages that occur in the vicinity of a prior temporal bone fracture.

Intracranial pseudoaneurysms can be treated via direct neurosurgical resection or trapping the aneurysm and parent vessels endovascularly [14]. However, optimal treatments for cases of combined pseudoaneurysm and arteriovenous fistula remain unclear. Due to the complexity of the lesion architecture, we chose NBCA rather than metallic coils to embolize the lesion complex. Ko et al utilized coil embolization to occlude the proximal aspect of a middle meningeal artery pseudoaneurysm and arteriovenous fistula; however, immediate post-operation angiography demonstrated complete occlusion of the fistula but with retrograde flow into the distal aspect of the pseudoaneurysm via collateral meningeal arteries [4]. Follow-up angiogram 3 months postembolization demonstrated complete disappearance of both lesions. Similarly, Tsutsumi et al reported treatment of both lesions via endovascular trap-

ping using microcoils. Immediate postoperation angiography demonstrated complete obliteration of both lesions [5].

Conclusions

The present case describes total obliteration of a pseudoaneurysm and arteriovenous fistula of the middle meningeal artery using NBCA embolization. NBCA embolization should be considered as an alternative treatment option for these lesions.

Ethics Statement

The patient described in this report provided written informed consent for its publication.

Author Contributions

All authors have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted.

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