

# Post-traumatic bilateral pseudoaneurysms of the middle meningeal artery. A case report

## Pseudoaneurismas bilaterales postraumáticos de la arteria meníngea media. Presentación de caso

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https://doi.org/10.53903/01212095.276

**Key words (MeSH)**

Aneurysm, false
Meningeal arteries
Cerebrovascular traumatism

**Palabras clave (DeCS)**

Aneurisma falso
Arterias meníngeas
Traumas cerebrovasculares

**Glosary**

MMA: Middle meningeal artery

SAH: Subarachnoid hemorrhage

CT: Computed tomography

n-BCA: n-butyl cyanoacrylate

## Summary

***Introduction:*** Pseudoaneurysms of the middle meningeal artery (MMA) are a pathology that represents less than 1% of intracranial aneurysms. In this article, we present a patient with bilateral traumatic MMA pseudoaneurysms. ***Case report:*** A 67 year old patient was admitted due to orbital trauma who underwent a cerebral digital subtraction angiography, identifying a pseudoaneurysm of the right MMA. Eight days later, on angiography control, a second pseudoaneurysm was found in the left MMA. ***Discussion:*** The mortality rate has been reported between 20 and 50%. Our literature review showed that the presentation of this pathology bilaterally is even less frequent, as described in our clinical case. ***Conclusion:*** Bilateral pseudoaneurysms are uncommon. Because its natural history is under discussion and its mortality is high in case of rupture, it is essential to perform an early diagnosis and timely treatment to prevent a catastrophic outcome.

## Resumen

***Introducción:*** Los pseudoaneurismas de la arteria meníngea media (AMM) son una patología que representa menos del 1% de los aneurismas intracraneales. En este artículo se presenta un paciente con pseudoaneurismas traumáticos bilaterales de la AMM. ***Caso clínico:*** Paciente de 67 años de edad, ingresado por traumatismo orbitario a quien se le practica una angiografía cerebral por sustracción digital en la que se identifica un pseudoaneurisma de la AMM derecha. Ocho días después, en el control angiográfico, se identifica un segundo pseudoaneurisma en la AMM izquierda. ***Discusión:*** La tasa de mortalidad para esta patología se ha descrito entre el 20% y el 50%. La revisión bibliográfica mostró que la presentación de forma bilateral es aún menos frecuente, tal y como se describe en este caso clínico. ***Conclusiones:*** Los pseudoaneurismas bilaterales son infrecuentes. Debido a que su historia natural está en discusión y su mortalidad es alta en caso de ruptura, es importante realizar un diagnóstico precoz y un tratamiento oportuno para prevenir un desenlace catastrófico.

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## Introduction

Pseudoaneurysms of the middle meningeal artery (MMA) are a rare condition, accounting for less than 1% of all intracranial aneurysms. Most are associated with a history of head trauma. Ninety-two percent of cases are associated with a skull fracture in the temporal region (1). Due to their rarity, the natural history of this disease remains a subject of debate. These pseudoaneurysms may resolve spontaneously or increase in size, increasing the risk of rupture (2). The most common early or late presentation is an epidural hematoma; however, they can also manifest as subdural hematoma and subarachnoid hemorrhage (SAH). Treatment must be individualized for each patient and can be approached through decompressive surgery or an endovascular approach (1-3).

There are few cases described in the scientific literature on endovascular treatment. This article presents a patient with bilateral traumatic pseudoaneurysms of the MMA; one on the right side associated with a

fracture of the squamous portion of the right temporal bone and the second pseudoaneurysm in the left MMA, without associated fracture, probably due to a blow-and-counterblow injury mechanism. The procedures followed the ethical principles of the Human Experimentation Committee (institutional or regional) and complied with the 1975 Declaration of Helsinki. The institution's ethics committee approved the study (007492/2023).

## Case presentation

A 60-year-old patient with no relevant medical history presented to the emergency department after sustaining a right temporal and orbital trauma. Neurological examination revealed drowsiness, temporal-spatial disorientation, normo-reactive isochoric pupils, and retrograde amnesia of the event, with no motor deficit.

A plain computed tomography (CT) scan of the skull revealed right frontotemporal SAH, temporal intraparenchymal hemorrhage, and fracture of the squamous portion of the temporal bone (Figure 1). In addition, a CT angiography of the head and neck was performed with no findings suggestive of intracranial aneurysms.

The patient underwent digital subtraction cerebral angiography. During the procedure, a pseudoaneurysm of the right MMA was identified. Endovascular embolization was performed with two coils (7 mm × 30 cm Concerto Helix Coil and 5 mm × 15 cm Concerto Helix Coil, Medtronic, Inc., Irvine, CA), and complete occlusion of the pseudoaneurysm was achieved without complications during the procedure (Figure 2).

The patient's postoperative clinical course was favorable. However, given that traumatic pseudoaneurysm is a rare condition, a second follow-up cerebral angiography was performed eight days after treatment to look for another cause of intracranial hemorrhage. The images revealed a second pseudoaneurysm in the left MMA, which was not identified in the first angiography because the left external carotid artery was not selectively injected (Figure 3). The second pseudoaneurysm was embolized with a dilution of one 0.5 mL ampoule of Histoacryl® Clear & Blue (N-butyl-2-cyanoacrylate) and 2 mL of Lipiodol® (Ethiodized Oil) to achieve a Histoacryl concentration of 20%, resulting in complete and satisfactory occlusion (Figure 4). Over the following days, the patient continued to progress favorably and was discharged.

## Discussion

Aneurysms can be classified as true and false and/or pseudoaneurysms. They are differentiated histologically by the composition of their walls. The wall of true aneurysms contains the three layers of blood vessels, while that of pseudoaneurysms is formed only by fibrous connective tissue. Fibroconnective tissue forms when there is a tear in the layers of the vessel wall, resulting in the formation of a clot, which becomes more fragile fibrous tissue. Because of this, it has been considered more susceptible to enlargement and/or rupture (4). However, its natural history is not yet well documented due to its low incidence. Progressive growth of pseudoaneurysms has been described in follow-up cerebral angiography, as well as thrombosis, decrease in size, spontaneous resolution, and rupture. The mortality rate for this injury has been reported to be between 20% and 25% and up to 50% when it occurs with intracranial hematoma and acute neurological deterioration (5).

Approximately 40 cases of post-traumatic MMA aneurysms have been described in the literature. Most cases (92%) are associated with a fracture of the temporal bone or sphenoid bone in the MMA region (3).

Rupture of MMA pseudoaneurysms usually presents with extradural hematoma (70%) (6-9). By 2023, approximately twelve cases had been described in which it manifested with acute or delayed intracerebral hemorrhage (10), most of them accompanied by SAH. Bilateral presentation of this pathology is even less common. As documented in this clinical case, the pseudoaneurysm of the right MMA was secondary to direct trauma and temporal fracture, and that of the left MMA was probably caused by a contusion. The patient under study reported no history of previous head trauma. In another case, a 68-year-old patient consulted three days after a mechanical fall with head trauma. A non-contrast head CT scan revealed bilateral acute non-surgical subdural hematomas without significant midline shift. The patient was managed conservatively, but a follow-up CT scan showed progression of the right subdural hemorrhage with midline shift without skull fractures. Elective embolization of the middle meningeal artery was planned to prevent progression. During digital subtraction angiography (DSA), three aneurysmal dilations were found in the proximal posterior branch of the right MMA, which were embolized with n-butyl cyanoacrylate (n-BCA) with successful occlusion of the pseudoaneurysms (11). Similarly, another patient was found to have two traumatic pseudoaneurysms in the distal MMA located in different branches (12).

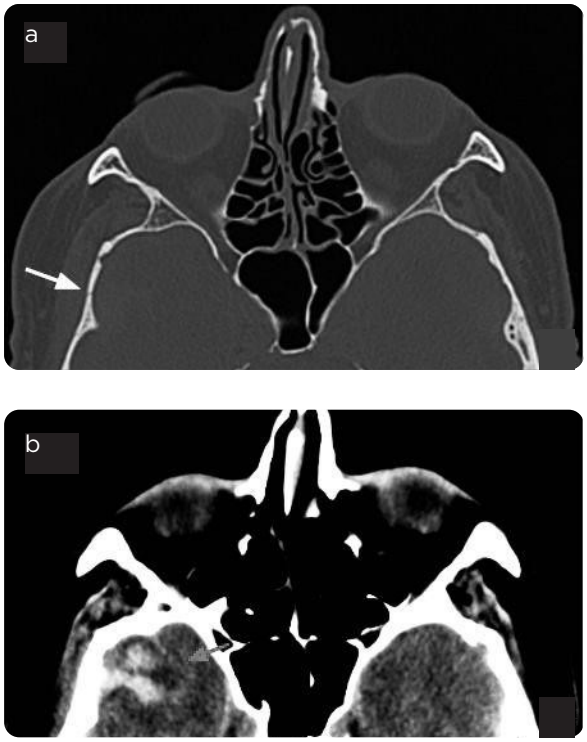



Figure 1. Plain brain CT scan. a) Fracture of the squamous portion of the temporal bone. b) Right temporal intraparenchymal hemorrhage.

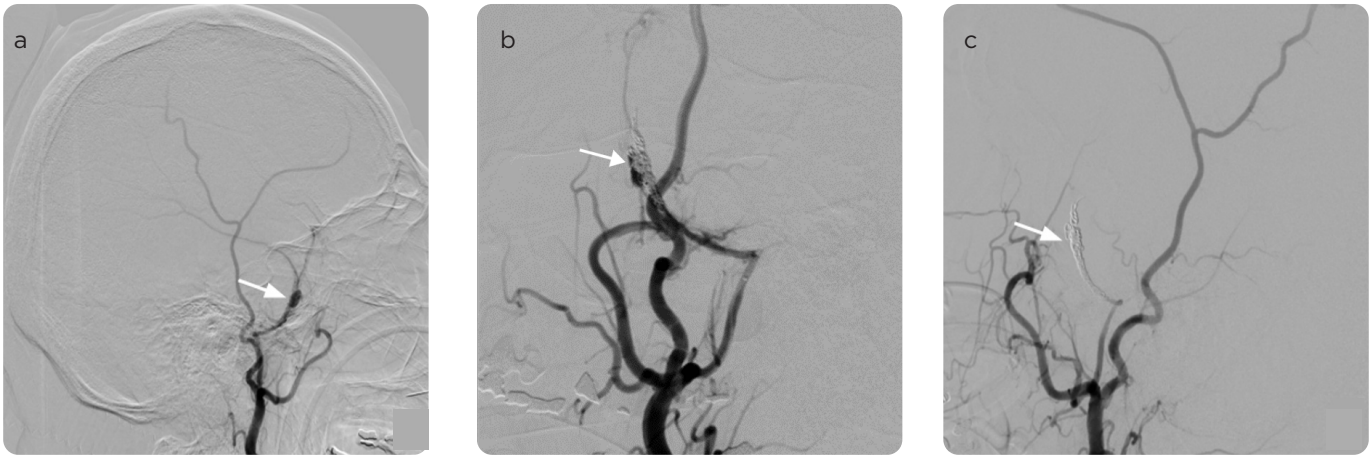



Figure 2. a) Digital subtraction angiography, injection of the right external carotid artery showing pseudoaneurysm of the proximal right middle meningeal artery (MMA) (white arrow). b) and c). Digital subtraction angiography, magnified lateral projection after endovascular embolization treatment with two coils (7 mm × 30 cm Concerto Helix Coil and 5 mm × 15 cm Concerto Helix Coil) revealing occlusion.

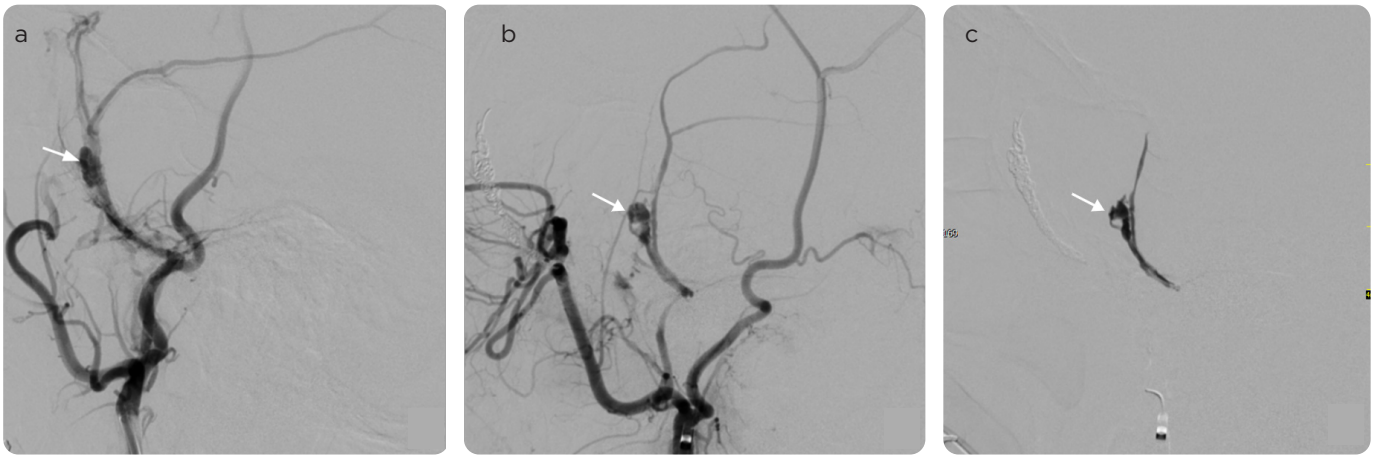



Figure 3. Digital subtraction angiography, left lateral projection. a) Injection of the left external carotid artery showing pseudoaneurysm in the left MMA (white arrow) b). Injection of the external carotid artery showing pseudoaneurysm in the left MMA and left meningeal branch. c) Supraselective microcatheter injection from the left MMA.

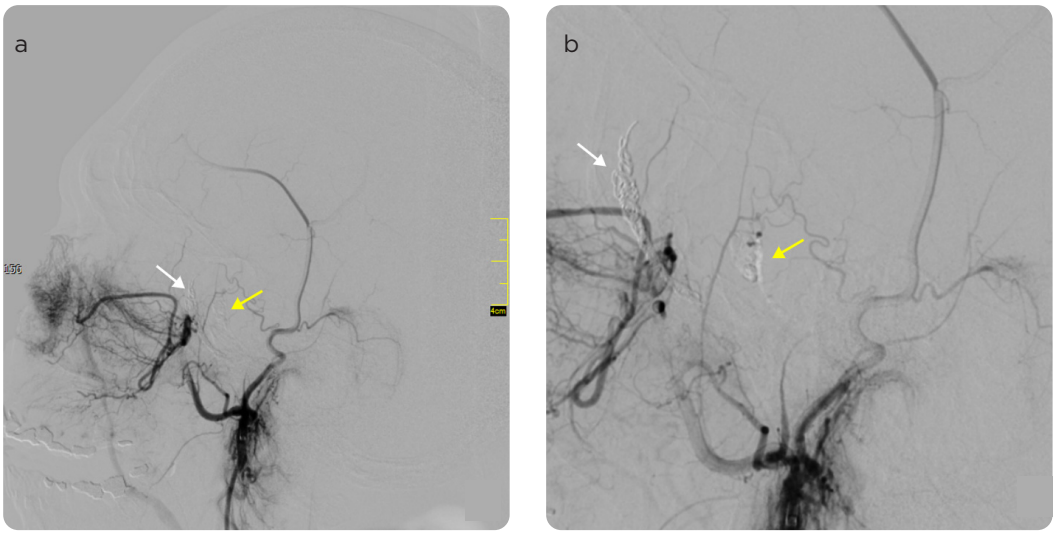



Figure 4. a) Selective post-embolization control angiography from the left external carotid artery in lateral projection, showing endovascular embolization material (20% Histoacryl) of the left MMA pseudoaneurysm for 100% occlusion (yellow arrow). b) Previous contralateral treatment with coils is visible (white arrow). Digital subtraction angiography, magnified lateral projection.

Image identification of MMA pseudoaneurysms and a high level of suspicion are essential for diagnosis. Likewise, because this pathology can occur bilaterally, it is important to evaluate the circulation of the bilateral external carotid artery. In the case documented here, angiographic examination of both external carotid arteries and their branches was performed, and no vascular pathology dependent on the artery was found.

Noteworthy characteristics include irregularity in the vessel wall, extravasation of contrast medium in the arterial phase that remains stable in the venous phase, fractures of the squamous portion of the adjacent temporal bone, and intracranial hemorrhage.

Given the low frequency of this condition, treatment and prognosis are controversial. Treatment options range from conservative management with follow-up to surgical treatment or endovascular treatment. The most commonly used is endovascular embolization with embolizing agents such as coils, Onyx®: composed of a mixture of ethylene-vinyl alcohol copolymer (EVOH), dimethyl sulfoxide (DMSO), and tantalum (Medtronic, Minneapolis, MN) and histoacryl (1, 13). The published literature suggests that MMA embolization is a generally well-tolerated procedure, but with a low risk of significant complications, including stroke, seizures, blindness, and facial paralysis (14), caused by the proximal segments of the MMA, either due to anastomosis with the ocular circulation or proximity to the petro-squamous branch proximal to the bifurcation, since the use of embolizing fluids in segments close to this branch can result in reflux and ischemic complications of the facial nerve.

Currently, there is no general agreement on the choice of embolic agent or its superiority, since all available information comes from clinical case reports; however, when detected incidentally, patients would benefit from endovascular treatment.

The surgical and/or endovascular approach must be individualized for each patient according to their condition and clinical judgment. Currently, there is no consensus on the superiority of either treatment; however, surgical treatment by craniotomy with ligation of the MMA and evacuation of the epidural or subdural hematoma is associated with a higher risk of intraoperative rupture of the pseudoaneurysm (15). Therefore, endovascular treatment is considered the first-line treatment for pseudoaneurysms in the absence of a significant mass effect, as it is associated with fewer complications (16).

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Received for evaluation: October 10, 2023
Accepted for publication: November 11, 2023