

Ruptured pseudoaneurysm of the middle meningeal artery presenting with a temporal lobe hematoma and a contralateral subdural hematoma

Eric Marvin, Lindsay Hilken Laws, Jeroen Raymond Coppens

Department of Neurosurgery, St. Louis University, St. Louis, Missouri, USA

E-mail: Eric Marvin - marvin.eric@gmail.com; Lindsay Hilken Laws - lhilken@slu.edu; *Jeroen Raymond Coppens - coppensj@slu.edu

*Corresponding author

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Abstract

Background: Traumatic pseudoaneurysms of the middle meningeal artery (MMA) are rare, associated with skull fractures, and have a high mortality rate. When they rupture, MMA pseudoaneurysms frequently cause epidural hematomas and occasionally ipsilateral subdural or subarachnoid hemorrhage. Isolated intraparenchymal hemorrhage has also been reported.

Case Description: A 54-year-old female who suffered a loss of consciousness resulting in a fall presented with a Glasgow Coma Scale of 7t. Imaging demonstrated a right subdural hematoma (SDH) with midline shift, left skull fracture overlying the left MMA, and left temporal lobe intraparenchymal hematoma extending to the surface. The patient underwent a right craniectomy with evacuation of the SDH, and the preoperative computed tomographic angiography revealed abnormal dilation of the left MMA consistent with a pseudoaneurysm. The pseudoaneurysm was treated with endovascular treatment, and the intraparenchymal hematoma was treated conservatively. Her recovery was uneventful, and she received a cranioplasty 3 months after the decompression.

Conclusions: The presence of a fracture over the MMA and intraparenchymal hematoma should prompt suspicion for a traumatic pseudoaneurysm. Pseudoaneurysms of the MMA can cause catastrophic bleeding, and prompt treatment is necessary. Endovascular embolization is an effective method that decreases the hemorrhage risk of MMA pseudoaneurysms.

Key Words: Intraparenchymal hemorrhage, subdural hematoma, traumatic pseudoaneurysm

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INTRODUCTION

Traumatic pseudoaneurysms of the middle meningeal artery (MMA) are uncommon. They are often associated with skull fractures^[4] and carry a high mortality rate.^[4,8] When ruptured, they most commonly lead to epidural hematomas.^[3,4,23,30] Infrequently, rupture of an MMA pseudoaneurysm can cause a subdural or subarachnoid hemorrhage. The association of traumatic MMA pseudoaneurysm rupture with an isolated intraparenchymal hemorrhage (IPH) is rare but has been reported.^[3,4,26] We present a case of a spontaneously ruptured pseudoaneurysm of the left MMA associated

with an IPH and a right-sided subdural hematoma (SDH) requiring decompression.

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CASE REPORT

Fifty-four-year-old female transferred from an outside facility after a fall stairs secondary to an episode of loss of consciousness. She presented with a Glasgow Coma Scale of 7t. She was purposeful but not following commands or opening her eyes. Computed tomography (CT) demonstrated a right-sided 0.8 cm thick SDH, with 6 mm of the right-to-left shift, along with a left-sided temporal lobe IPH measuring 8 cm by 2 cm by 1.5 cm [Figure 1]. In addition, there was a left-sided temporal bone fracture. Prior to surgical evacuation, a CT Angiogram (CTA) was performed due to the presence of the temporal lobe hematoma. The CTA demonstrated some dilatation of the left MMA suspicious for a pseudoaneurysm near the fracture site [Figure 2]. Given the significant SDH and midline shift, a right-sided craniectomy was performed with evacuation of the SDH and placement of an ICP

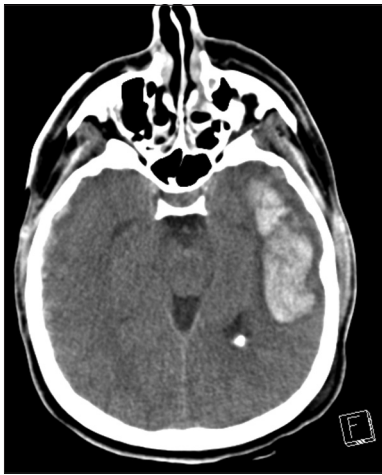


Figure 1: Preoperative computed tomography, axial view, showing left-sided temporal intracerebral hemorrhage, right subdural hematoma



Figure 3: Cerebral angiogram, lateral view of external carotid artery injection, showing left middle meningeal artery pseudoaneurysm with an irregular neck (arrow)

monitor. Her left temporal IPH was monitored with serial imaging. Her postoperative course was favorable, and a postoperative CT showed resolution of her midline shift. A six-vessel cerebral angiogram was performed on the postoperative day 1 [Figure 3], which confirmed the presence of a traumatic pseudoaneurysm of the left MMA, which was treated with Onyx® embolization. She recovered uneventfully and had a Glasgow Outcome Scale of 5. The patient had an uncomplicated cranioplasty at 3 months, and an angiogram confirmed obliteration of the left MMA [Figure 4], without recurrence of her pseudoaneurysm at 3 months. Follow-up CTA at 15 months confirms the lack of recurrence of the pseudoaneurysm.

DISCUSSION

True aneurysms consist of a focal dilation of an artery that contains all normal layers of an arterial wall and an intact adventitia. In contrast, a pseudoaneurysm, also known as a false aneurysm, is usually the consequence of a vascular injury that results in disruption of all layers of the artery. The formation of a hematoma occurs on the outside of the arterial wall. Histologically, the wall of a pseudoaneurysm does not contain normal arterial wall structures, and the hematoma is usually contained by adventitia or surrounding perivascular soft tissue. Schulze first described traumatic MMA pseudoaneurysms

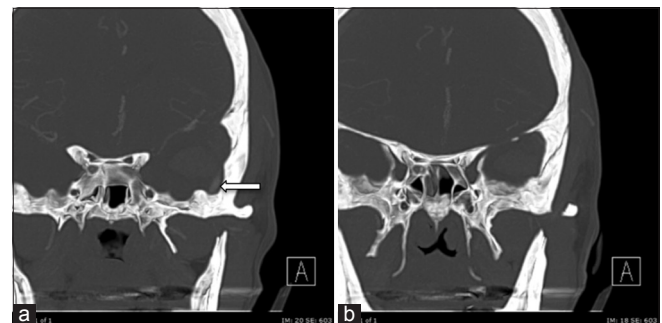


Figure 2: Preoperative computed tomography angiogram, coronal reconstruction, demonstrating a left temporal skull fracture (a and b) with a left middle meningeal artery pseudoaneurysm (a, arrow)

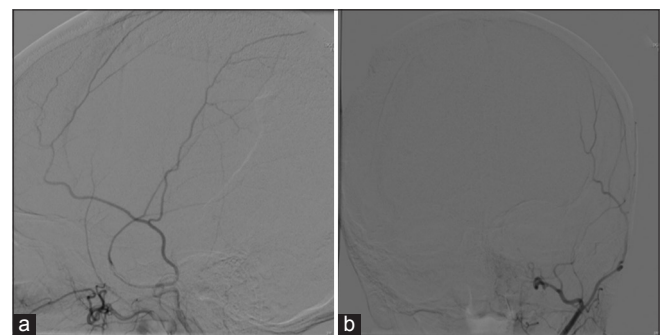


Figure 4: Three-month postembolization angiogram demonstrating complete obliteration of the pseudoaneurysm and middle meningeal artery both in a lateral view (a) and an anterior-posterior view (b)

in 1957,^[24] yet the natural history of meningeal pseudoaneurysms is still not well understood. Because of the poor support of the aneurysm wall, it is thought that there may be a faster growth rate of pseudoaneurysms, a higher risk of rupture and mortality that may be as high as 20%.^[2,4,8] True aneurysms of the MMA have been reported but are distinct by their associated pathologies.^[4]

The most frequent presentation of an MMA pseudoaneurysm is an epidural hematoma, occurring in up to 70% of cases.^[23] Other presentations can include a combination of subdural, subarachnoid, and IPHs ipsilateral to the pseudoaneurysm. This is likely the result of the dural anatomy, which is often thought of as containing three distinct layers. The outer layer is the thinnest layer at 2 μm in thickness. The inner layer is 8 μm thick and adherent to the arachnoid trabeculae. The middle, vascular layer, in which the MMA runs within, varies in thickness.^[13,21,28] In traumatic epidural hematoma related to a skull fracture, the laceration of the MMA occurs as a result of the dural approximation to the bone edge. Ninety-two percentage of MMA pseudoaneurysms are associated with skull fractures.^[4]

There have been several case reports describing delayed hemorrhages and neurological deterioration related to pseudoaneurysm rupture in patients that had recovered from their initial head injury.^[4,14,26]

Delayed presentation seems more common in the cases of IPH.^[4,26] While the delayed nature of a pseudoaneurysm growing through, or thinning the inner layer of the dura may conceivably lead to an SDH or IPH, the acute presentation of an IPH attributable to an MMA pseudoaneurysm has not yet been fully explained. Case reports have described an intradural course of the proximal MMA, in which injury could cause IPH.^[13]

Radiographic identification of a pseudoaneurysm of the meningeal vessels may be difficult. There often needs to be a high index of suspicion to diagnose an MMA

pseudoaneurysm. Epidural hematomas, for example, rarely require angiographic evaluation because hematomas that are associated with MMA injuries requiring surgical evacuation can be easily treated at the time of surgery. However, arterial injury in patients with nonsurgical epidural hematomas and underlying skull fractures may be underestimated. Active contrast extravasation was found in 71%,^[5] and pseudoaneurysms were found in 29% of these patients.^[5,19] Another study, angiographically, identified MMA injuries in 4% of patients with head trauma, and MMA arterial-venous fistulas in 1.8%.^[6] Radiographic characteristics of pseudoaneurysms are often different than those of true aneurysms. They are often peripherally located and found at a distance to branch points. They often demonstrate poorly defined necks, have irregular sacs, and demonstrates very slow filling in which the pre- and post-aneurysmal segments do not opacify at the same time.^[4] This feature explains why some pseudoaneurysms are usually visible only in the late injection stages of selective external carotid injection.^[7] CTA has also shown to identify some cases of ruptured MMA pseudoaneurysms as described in this case report.^[17]

Of reported ruptured MMA pseudoaneurysm, it is estimated that 10% present with an IPH.^[4] A total of nine cases have been reported describing the rupture of a traumatic MMA pseudoaneurysm in association with an IPH.^[1,3,4,14,15,17,20,22,26] Most cases show an association of the IPH with an underlying subarachnoid hemorrhage involving the basal cisterns leading to a high suspicion for a vascular study leading to the diagnosis.^[1,14,26] Only three cases described presented acutely with an isolated IPH on the side of the MMA pseudoaneurysm as presented here.^[3,4,26] This is the first case report of an isolated IPH with an ipsilateral skull fracture [Table 1]. All other cases presented with an episode of loss of consciousness as described here. In the case reports by Singh *et al.*, the patient had an admission for a closed head injury 11 months prior to the presentation, and the case presented by Bruneau *et al.* suggest the presence of

Table 1: Comparison of cases of isolated IPH

Case report	Age (years)/gender	Presentation	Prior closed head injury	Presentation	Location of IPH	Skull fracture	Imaging study to detect pseudoaneurysm	Treatment	Glasgow outcome scale
Bruneau <i>et al.</i> (2002)	64 female	Loss of consciousness and fall	None	GCS 3t	Right temporal	No	Angiography	Coagulation	1
Singh <i>et al.</i> (2005)	30 male	Seizure	11 months prior	GCS 14	Right frontal	No	Angiography	Embolization	5
Bozzetto-Ambrosi <i>et al.</i> (2006)	39 male	Loss of consciousness and fall	None	GCS 12	Right parietal	No	Angiography	Embolization	5
Present case	54 female	Loss of consciousness and fall	None	GCS 7t	Left temporal	Left temporal	CTA	Endovascular embolization	5

IPH: Intraparenchymal hemorrhage, GCS: Glasgow Coma Scale, CTA: Computed tomography angiogram

a prior healed skull fracture along the MMA groove suggesting a prior traumatic event.^[4,26] All other cases were diagnosed with angiography, which was performed preoperatively in two cases because of the location of the IPH and its relationship to the sylvian fissure.^[4,26] All the cases described had an IPH, which was superficial to the cortical surface and in close proximity to the ruptured MMA pseudoaneurysm.^[3,4,26] Seen the lack of clear history of a prior closed head injury in this population, a diagnosis of a ruptured MMA pseudoaneurysm should be entertained in the differential diagnosis of a superficially located lobar IPH.

Because MMA pseudoaneurysms are rare, the prognosis and treatment guidelines are somewhat controversial. The risk of re-hemorrhage in a previously ruptured traumatic pseudoaneurysm is unknown, and these lesions are characteristically unpredictable. Case reports have described spontaneous resolution/thrombosis of MMA pseudoaneurysms^[16,25,27] while others have ruptured several years after the suspected initial injury.^[10,14,26]

Traumatic MMA pseudoaneurysms can be treated through surgical resection or by endovascular means. The most common treatment modality used is endovascular embolization with tissue adhesive or hydrogel agents,^[3,9,11,14,18] followed by endovascular coiling^[10-12] and surgical clipping or excision.^[17,26,29] A large portion of patients undergoing embolization or surgery require a decompressive craniectomy for trauma-related hemorrhage, as seen in this case.^[3,10,12,14]

CONCLUSIONS

Despite the unknown natural history of traumatic pseudoaneurysms, the potential for catastrophic bleeding exists, and treatment must be considered when discovered. A high index of suspicion should be maintained in the presence of a fracture overlying the MMA with an underlying IPH. CTA may suffice for screening, but in case of high suspicion, angiography should be considered. Surgical ligation of the MMA can be performed easily if hematoma evacuation is necessitated, but endovascular embolization is a safe and effective method for eliminating the hemorrhage risk in the presence of an MMA pseudoaneurysm if it is felt that surgical decompression is not mandatory.

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Conflicts of interest

There are no conflicts of interest.

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