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Case Report

An off-label use of flow-diverter stent as a successful treatment of a postoperative middle cerebral artery pseudoaneurysm [☆]

Anastasia Theocharidou, MD*, Aikaterini Spanou, MD, Maria Alexandratou, MD, Vasileios Michas, MD, Viktoria Lamprou, MD, Elisavet Psoma, MD, PhD, Stephanos Finitzis, MD, PhD

Department of Radiology, University Hospital of Thessaloniki AHEPA, Agiou Dimitriou 98, 54631, Thessaloniki, Greece

ARTICLE INFO

Article history:

Received 13 January 2023

Revised 24 February 2023

Accepted 7 March 2023

Keywords:

Intracranial pseudoaneurysms

Flow diverter stent

Embolization

Middle cerebral artery

Iatrogenic pseudoaneurysms

Interventional neuroradiology

ABSTRACT

A pseudoaneurysm or false aneurysm is the result of the disruption of the vessel wall and the formation of a hematoma in communication with the vascular lumen, restrained by perivascular connective tissue. Intracranial pseudoaneurysms represent a rare entity mainly because of trauma, iatrogenic causes, infectious disease, radiation exposure, connective tissue disease and sometimes spontaneous occurrence. We present a 35-year-old female patient with a history of multiple low-grade glioma debulking surgeries. During the last procedure, laceration of the left middle cerebral artery (MCA) occurred with diffuse sub-arachnoid hemorrhage. Imaging studies showed the formation of a pseudoaneurysm of the left MCA which was successfully treated with the implantation of a flow diverter across the lesion neck and excellent mid- to long- term results. Flow diverter implantation may be a promising technique for the therapeutic management of cerebral pseudoaneurysms.

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Introduction

Intracranial pseudoaneurysms are rare, representing 1% of all intracranial aneurysms and may result from direct trauma, iatrogenic injury, radiation therapy, spontaneous arterial dissection or infection [1]. Pseudoaneurysms are not true aneurysms and consist in the complete disruption of all three layers of the arterial wall (intima, media, adventitia) with restriction

of the resulting hematoma by the surrounding connective tissue [2].

The most common cause of intracranial pseudoaneurysms is traumatic, either by an open or closed head injury, followed by iatrogenic causes. Iatrogenic pseudoaneurysms may be secondary to intravascular manipulations, such as mechanical thrombectomy, stent placement or endovascular reconstructions, or may occur following extravascular manipula-

[☆] Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

* Corresponding author.

E-mail address: angtheoch@gmail.com (A. Theocharidou).

<https://doi.org/10.1016/j.radcr.2023.03.020>

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Fig. 1 – Postoperative computed tomography scan shows diffuse subarachnoid hemorrhage at the level of left Sylvian fissure (arrows).

tions like direct penetration or scraping of the vessel wall [1]. Less commonly, a pseudoaneurysm may be formed after radiation therapy [3]. The internal carotid artery is the most common site of occurrence, especially after sphenoidectomy or transphenoidal surgery. Less common sites include the middle cerebral artery (MCA), the anterior cerebral artery, the posterior circulation and the basilar artery [1,4]. In everyday clinical setting, the etiology of a pseudoaneurysm can be unclear

or a combination of multiple causes as often patients have complex medical histories and overlapping pathologies.

Management of intracranial pseudoaneurysms consists in either microsurgical or endovascular treatment. In the last decades, endovascular flow-diverting stent placement has emerged a promising alternative for the management of intracranial pseudoaneurysms [4–6]. We hereby present a case of an intracranial pseudoaneurysm in a young woman successfully treated with the implantation of a flow diverter.

Case

A 35-year-old woman was admitted in the hospital for surgical debulking of a middle-grade glioma. The patient had a history of a recurrent middle-grade glioma located in the left temporal lobe, treated with surgery and radiotherapy. The last debulking procedure had been performed 2 years prior to the current admission. The patient's pre-operative neuroimaging examinations showed no intracranial vascular lesion. Her clinical examination showed verbal memory and speech disturbances and right-sided hemiparesis. During surgery, laceration of the left middle cerebral artery was noted and treated with wrapping. The post-operative computed tomography (CT) scan showed diffuse subarachnoid hemorrhage centered at the level of the left Sylvian fissure (Fig. 1). The patient was admitted in the intensive care unit for monitoring. She was weaned from the ventilator and extubated after 24h. Her neurological status was the same as baseline. Postoperative (day 2) magnetic resonance angiography (MRA) showed a focal irregularity of the left M1 segment (Fig. 2). On day 7, CT angiography depicted a saccular pseudoaneurysm of 5 mm at the same level, considered to be of iatrogenic etiology (Fig. 3). The

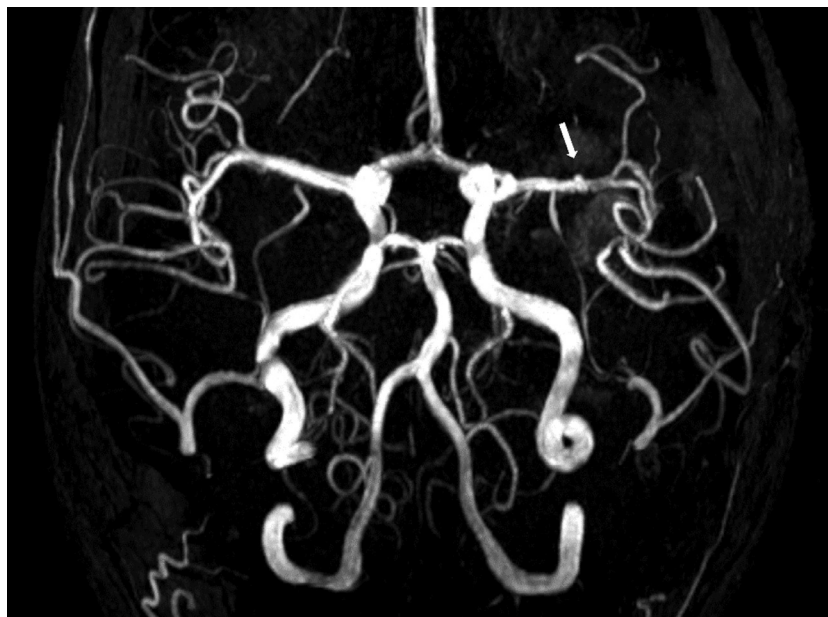


Fig. 2 – Magnetic resonance imaging on day 2. The 3-dimensional time of flight sequence shows an irregularity of the M1 segment (white arrow).

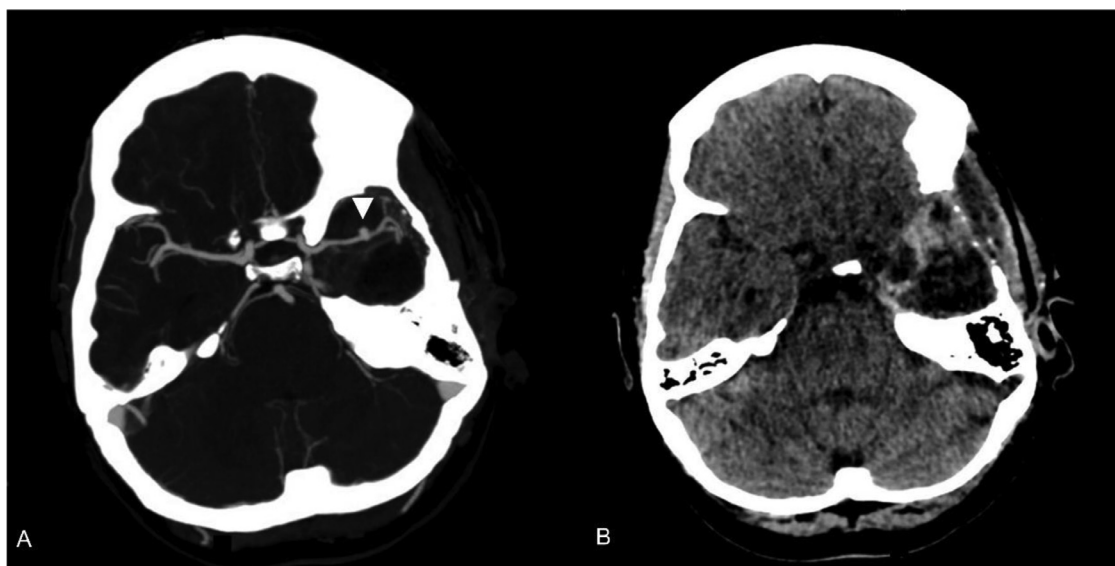


Fig. 3 – Computed tomography on day 7 with (A) and without (B) contrast agent. Presence of a saccular pseudoaneurysm (white arrowhead) of M1 segment of left middle cerebral artery (A) and blood in the left Sylvian fissure (B).



Fig. 4 – 3D digital subtraction angiography shows an increase in the size of the pseudoaneurysm now measuring 7 mm in its larger diameter (white arrows).

patient was referred for embolization of the pseudoaneurysm the following day during which, the digital subtraction angiography (DSA) demonstrated an increase in size of the pseudoaneurysm that had now a maximum diameter of 7 mm (Fig. 4). An 8 × 2.5 mm P48 HPC Phenox flow diverter (Germany) was placed across the aneurysm neck after a loading dose of Ticagrelor (90 mg × 2) and 300 mg aspirin (Fig. 5). Control DSA showed no intraoperative complications. The patient was kept on Ticagrelor (90 mg × 2) and aspirin (100 mg × 1) daily. The 6-month follow up DSA evaluation demonstrated complete radiographic resolution of the pseudoaneurysm, adequate stent

expansion, and normal left MCA blood flow (Fig. 6). The anti-aggregation treatment was discontinued.

Discussion

Pseudoaneurysms are prone to rupture and the mortality rate for patients that receive no treatment may be as high as 50% [1,7]. The lack of a true wall makes clipping or wrapping of the pseudoaneurysm a difficult and high-risk procedure with a considerable risk of intraoperative rupture [5]. Another method of open surgical management of intracranial pseudoaneurysms is the occlusion of the parent artery with or without bypass. This requires careful selection of patients with adequate collateral circulation and a good general condition for an open surgical approach [4,8]. The evolution of embolization techniques and embolic material technology has led to increased popularity of parent vessel preserving patency methods as the preferred therapeutic strategy [4,8]. Endovascular management is considered less invasive including stent-assisted coiling, use of liquid embolic agents or placement of covered stents. Even though these techniques may allow immediate aneurysmal sac occlusion, they may be associated with a high rate of recurrence, or, in the case of covered stents, endoleaks [8].

Recently, several studies and case reports showcased the use of flow-diverting stents as a viable, off-label, alternative for intracranial pseudoaneurysms management [1,4–6,9–11]. Flow-diverting stents are vessel reconstruction devices that promote the reduction of blood flow inside the aneurysm, resulting in gradual thrombosis while preserving the flow in the parent artery. The stent also acts as a cast for the reformation of the vessel wall through the endothelialization of the aneurysmal neck [9]. Changes in hemodynamics and the fact that there is no manipulation of the aneurysmal sac during the procedure reduce the risk of intraoperative rupture [8]. Addi-

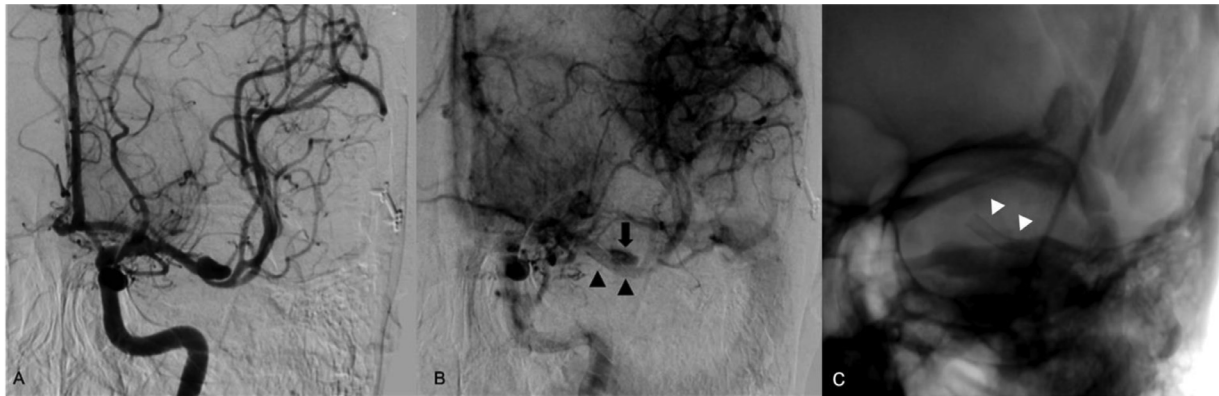


Fig. 5 – Digital subtraction angiography before (A) and after (B) the placement of flow-diverting device (black arrowheads). After the placement there is contrast stasis inside the sac of the pseudoaneurysm (black arrow) (B). Digital fluoroscopy shows the flow-diverting device in full expansion (white arrowheads) (C).



Fig. 6 – The 6-month follow-up digital subtraction angiography (A) and 3D reconstruction (B) shows complete resolution of the pseudoaneurysm and the normal blood flow in the left middle cerebral artery (white arrowheads).

tionally, flow-diverting stents effectively preserve the patency of adjacent branches [6,12].

In the presented case, considering the location of the pseudoaneurysm (MCA) and the young age of the patient, parent artery patency and preservation of side branches was crucial. Implantation of a flow-diverter was chosen as the most likely option to reduce the risk of ischemic infarcts and bleeding in a patient with a history of multiple surgeries, radiotherapy and an already impaired neurological status. Complete exclusion of the pseudoaneurysm was achieved and the preservation of the blood flow of the left MCA was successful.

Flow-diverting stent implantation is not considered the first line option for pseudoaneurysm management mainly because of the prolonged time of thrombosis that may result in a high likelihood of rupture. Additionally, another major argument against the use of flow-diverting stents is the need

for double antiplatelet therapy to prevent in-stent thrombosis that may increase the risk of rupture [4,6,8,12]. In our case, because of the complicated history of the patient, implantation of a flow-diverter was judged as the option with the best benefit/risk ratio with an excellent anatomical and clinical outcome. The present report adds to the existing literature on the successful use of flow-diverting stents for the managements of intracranial pseudoaneurysms in selected patients. Further studies are needed to assess the efficacy, complication rate and long-term results of this technique.

Conclusion

Endovascular placement of a flow-diverting device represents an effective strategy for the treatment of intracranial pseu-

doaneurysms and may achieve complete occlusion while preserving parent artery patency. The technique may be considered as an alternative to wrapping or bypass surgery in cases with a complex medical history.

Patient consent

Written informed consent has been obtained from the patient to publish this paper.

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