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Endovascular Embolization of a Superficial Temporal Artery Arteriovenous Fistula and Aneurysm

CASE REPORT

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ABSTRACT

The superficial temporal artery (STA), a terminal branch of the external carotid artery, is prone to vascular injury due to its location. We report a case of a 90-year-old male with multiple comorbidities who was incidentally diagnosed with an STA arteriovenous fistula (AVF) and a distal STA aneurysm. Complete endovascular obliteration of both lesions was achieved using Onyx embolization. This case highlights the rare presentation of concurrent STA fistula and aneurysm, emphasizing the efficacy and safety of endovascular embolization as a minimally invasive therapeutic approach, particularly in high-risk surgical candidates.

KEYWORDS

superficial temporal artery, arteriovenous fistula, aneurysm, embolization

INTRODUCTION

STA aneurysms and AVFs are rare vascular pathologies, typically resulting from trauma or iatrogenic injury [1]. While surgical ligation has traditionally been the treatment of choice, endovascular approaches, including coil embolization and liquid embolic agents, emerged as effective alternatives [2,3]. This report presents a case of concurrent post-traumatic STA AVF and aneurysm. This unusual combination was incidentally discovered during a previously planned middle-meningeal artery (MMA) embolization to treat chronic subdural hematoma (SDH). The case underscores the importance of thorough vascular imaging in trauma patients and highlights the role of endovascular techniques in managing extracranial vascular anomalies.

CASE PRESENTATION

A 90-year-old male with multiple comorbidities presented to the emergency department with right foot pain and acute deep vein thrombosis, for which anticoagulation was initiated. On day 4 of hospitalization, he sustained an unwitnessed fall, resulting in a left scalp laceration, located directly over the posterior parietal region. The patient did not complain of pulsatile scalp masses, tinnitus, bruit, or headache. The CT scan of the head without contrast demonstrated chronic right SDH measuring 7 mm and acute on top of chronic left frontoparietal SDH measuring 1.1 cm maximum thickness, exhibiting mild left-to-right mass effect with 1 mm midline shift (Figure 1). No vascular brain imaging (e.g., CTA: computed tomographic angiography) was performed. Anticoagulation was held upon SDH diagnosis.

On day 9 of hospitalization, he presented for MMA embolization, and angiography revealed a direct high-flow left posterior parietal AVF between the left parietal branch of the STA draining toward the left superficial temporal vein (STV) and a distal STA aneurysm measuring approximately 8.3 mm in height, 10 mm in width, and 7.6 mm in depth (Figures 2A and 2B). No dangerous anastomoses or intracranial–extracranial connections were identified.

Using the right common femoral artery access with a 6F, 55 cm sheath, a 6F Envoy XB catheter was advanced over a selection catheter into the left external carotid artery. A Headway Duo 156 cm microcatheter was navigated over a Synchro 2 microwire into the STA aneurysm without difficulty. A total of 2 cc of Onyx 34 was slowly injected into the aneurysm lumen, achieving complete obliteration of both the AVF and aneurysm, as confirmed by post-procedural angiography (Figure 2C and 2D). The total fluoroscopy time was 13.1 min. Plavix was resumed following the procedure in accordance with vascular surgery recommendations, due to the patient's recent right internal carotid artery stenting. The patient recovered uneventfully to baseline.

A one-month follow-up non-contrast CT of the head demonstrated persistent bilateral SDHs, and the presence of an Onyx cast in the left parietal scalp region, adjacent to the mixed-density left SDH (Figure 3). No follow-up vascular brain imaging was performed, in accordance with the family's preference for conservative management. The patient remained asymptomatic, without scalp deformity, alopecia, or embolization-related skin changes.

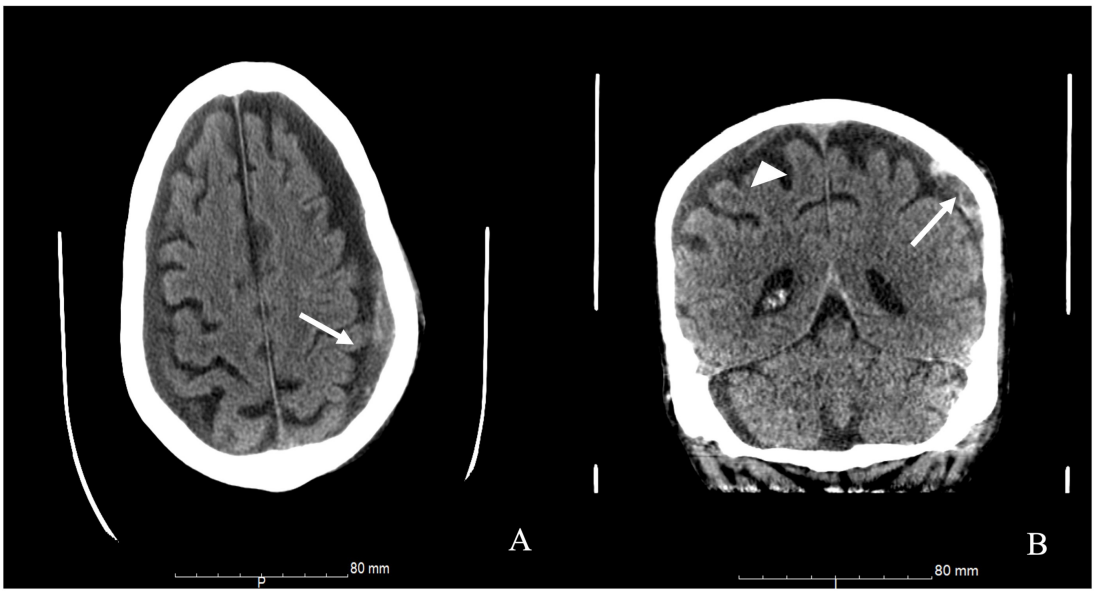

FIGURE 1. Axial (A) and coronal (B) images from CT head/brain without contrast.

The white arrow points to the mixed-density acute on top of chronic left frontoparietal SDH exhibiting mild left-to-right mass effect with midline shift, and the arrowhead in image B points to the chronic right SDH.

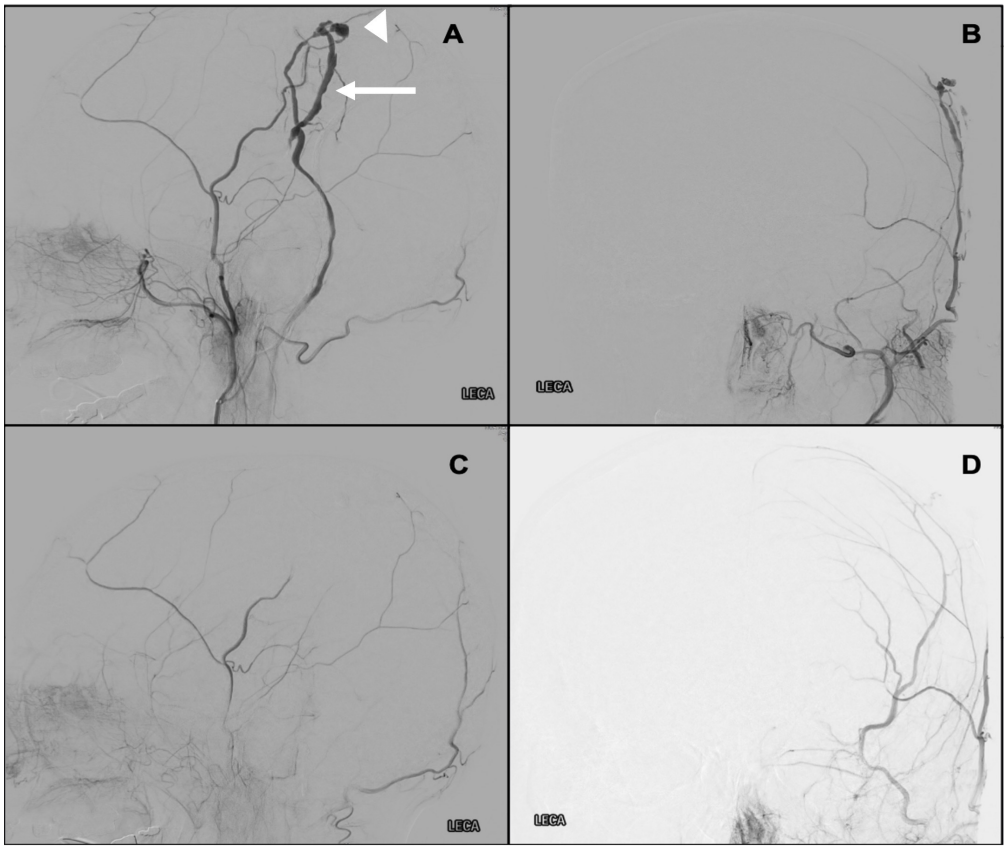

FIGURE 2. Left external carotid artery angiogram.

AP views (A and C) and lateral views (B and D) of the left external carotid artery angiogram. A and B: Pre-embolization angiography demonstrating a STA AVF draining into the STV (white arrow), along with a distal STA aneurysm measuring approximately 8.3 mm in height, 10 mm in width, and 7.6 mm in depth (arrowhead). C and D: Post-embolization angiography confirms the successful obliteration of the STA AVF and the distal STA aneurysm following Onyx embolization. AP: anteroposterior; STA: superficial temporal artery; AVF: arteriovenous; SVT: superficial temporal vein.

FIGURE 3. Axial image from CT head/brain without contrast.
The white arrow points to the Onyx cast in the left parietal scalp region adjacent to the mixed density left SDH (arrowhead). SDH: subdural hematoma.

DISCUSSION

STA AVFs and aneurysms are rare vascular anomalies that most commonly result from blunt or penetrating traumatic injury, iatrogenic injury such as biopsies, craniotomies, hair transplantation, and surgical interventions, and less commonly are spontaneous or congenital in origin [1,2,4,5]. Blunt trauma to the STA may cause both aneurysm and AVF, and the combination of both post-traumatic STA AVF and aneurysm is extremely rare, with only a few published articles similar to our patient reporting such rare concurrence [1,2,6]. The incidence of STA AVF is lower than that of aneurysms, with a ratio of 23:131 [5], and only 36 STA AVF cases have been reported as of 2007 [3], with a few more reports published since then [2,6–17].

The pathogenesis of an STA AVF involves direct communication between the arterial and venous systems, bypassing the capillary bed [18]. The natural history of STA AVFs remains incompletely defined and varies widely; however, trauma-related lesions may develop either acutely within days or over weeks and is explained by two theories: the laceration theory, where simultaneous arterial and venous injury creates an immediate fistula, and the disruption theory, which suggests that damage to the vasa vasorum triggers endothelial proliferation, forming new vascular channels that connect to adjacent veins [3,8,14,15]. Similarly, STA aneurysms typically arise due to arterial wall weakening following trauma. These aneurysms may be true (involving all three arterial wall layers) or pseudoaneurysms, where the arterial wall is disrupted, and blood collects in the surrounding tissue, forming a pulsatile mass [1,4]. In our patient, based on the angiographic appearance, the aneurysm was consistent with a true aneurysm, though definitive differentiation from a pseudoaneurysm was not possible without histopathological confirmation. The proximity of the traumatic scalp laceration to the vascular lesion, combined with a 5-day interval between trauma and angiographic discovery, supports a posttraumatic etiology. This timeline aligns with the literature, which describes lesions forming within days to weeks after injury [1,2,6].

STA AVF and aneurysm may remain asymptomatic for extended periods (years) or progressively enlarge, causing symptoms such as pulsatile scalp masses, bruit, tinnitus, headache, local pain, or cosmetic deformities [3,4,7–9,19]. If left untreated, they may lead to complications such as rupture, hemorrhage, neurological deficits, thrombosis, cosmetic deformities, and skin necrosis or ulceration due to prolonged soft tissue compression or erosion [4,8,14–16,20]. The potential for lesion progression and complications reinforces the need for prompt medical evaluation and treatment, even for incidentally discovered asymptomatic lesions. Careful assessment for vascular injuries is crucial, particularly in trauma patients, where minor and initially asymptomatic lesions may be overlooked but can evolve into clinically significant pathologies over time. This is especially important in individuals receiving anticoagulation therapy, as demonstrated by case reports describing the development of STV vascular anomalies after minor trauma in anticoagulated patients, underscoring the heightened risk of vascular injuries in this population [21,22].

In addition to clinical presentation and physical examination, imaging modalities can be used to diagnose and confirm STA AVFs and aneurysms. Ultrasound Doppler imaging and CT or MR angiography may aid in preoperative evaluation when in doubt by demonstrating arterial dilation, flow abnormalities, and aneurysmal sac formation [3,4,14,15]. The gold standard for diagnosing is digital subtraction angiography, which provides high-resolution visualization of the vascular architecture and allows for real-time assessment of feeding arteries, draining veins, and shunting patterns, which are critical for treatment planning [14,15].

Traditionally, STA vascular lesions were managed surgically via ligation or excision. While surgery remains a viable option, particularly for large or complex lesions, endovascular embolization has gained prominence due to its effectiveness and minimally invasive nature, particularly in patients with multiple comorbidities or high surgical risk [9,14]. Endovascular therapy can be performed by transarterial, transvenous, or percutaneous access, and obliteration can be achieved by liquid embolic agents [e.g., isobutyl 1-2-cyanoacrylate, Onyx, n-butyl cyanoacrylate (n-BCA), or SQUID], absolute alcohol, or coil embolization [1,2,9,14,17]. The choice among these agents depends on several factors, including lesion morphology, vessel size, flow dynamics, and access route [17,23]. Compared to other embolic agents, such as coils and n-BCA, Onyx 34, due to its higher viscosity, allows for slower and more controlled injection, which can be advantageous in managing high-flow AVFs [23]. Coils provide mechanical occlusion and are effective when accurate placement is possible and vessel sacrifice is acceptable, but may pose cosmetic concerns in superficial locations and are less suited for diffuse or high-flow lesions without adjunctive materials [24,25]. Skin complications, such as necrosis, alopecia, and discoloration, have been reported after embolization of scalp AVFs with liquid embolic agents, particularly when the embolic material extends into superficial dermal vessels or is used in excessive volume [17,25]. Endovascular embolization has demonstrated high efficacy in treating STA AVFs, with multiple reports confirming complete occlusion and no recurrence on follow-up imaging or clinical assessment. It also offers several advantages over open surgery, including a shorter recovery time, lower risk of cosmetic deformity, and precise occlusion with real-time imaging guidance [9,14,15,19]. Long-term follow-up is recommended to detect potential residual shunting and monitor for rare delayed progression or recurrence [1,16,19].

Despite the growing use of endovascular techniques for STA AVFs and aneurysms, comparative studies evaluating the long-term efficacy, recurrence rates, and complication profiles of different embolic agents remain limited. This highlights the need for further research to optimize treatment selection and follow-up strategies.

CONCLUSION

We report a rare case of concurrent STA AVF and aneurysm, incidentally diagnosed in an elderly trauma patient and successfully managed with Onyx endovascular embolization. This case highlights endovascular embolization as a safe, minimally invasive, and effective treatment option, particularly for high-surgical-risk patients.

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Patient consent

Informed consent was obtained from the patient for participation in this case report and for the publication of their case details.

Contributors

All authors have contributed substantially to the conception, design, and execution of this case report. All authors have reviewed and approved the final version of the manuscript for submission. Rime Ezzeldin (RE): literature review, and manuscript drafting. Anusha Putta (AP): acquisition of clinical data and critical revisions for important intellectual content. Naaemah Saleem (NS): editing and revising the final version of the manuscript. Mohamad Ezzeldin (ME) was involved in the care of this patient, assisted in the interpretation of angiographic findings, provided insights into the endovascular treatment approach, and provided oversight and critical revision of the manuscript to ensure scientific accuracy and clarity.

Competing Interests

Mohamad Ezzeldin: Speaker/Consultant for Viz AI., Stryker, and Imperative care. Small investment in Galaxy. All other authors declare no competing interests.

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