

Use of Purse-String Suturing in Concordance With Surgical Excision for a Congenital Arteriovenous Malformation Over the Scalp

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Abstract: An arteriovenous malformation (AVM) over the scalp is a rare vascular lesion, and its pathogenesis is ill-defined. Its origin can be congenital, traumatic, inflammatory, and/or familial. Despite the infrequency of occurrence, we encountered a case of a young man with a congenital swelling over the left frontal and adjacent parietal region of the scalp. Selective angiography and other radiological examinations were performed to better diagnose the condition. Surgical excision is the most effective treatment. In this case report, we discuss the presenting clinical features, methods of evaluation, and management of an AVM over the scalp.

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Introduction

An arteriovenous malformation (AVM) occurs when a bundle of blood vessels in the brain or on its surface bypass normal brain tissue and directly divert blood from the arteries to the veins. The draining veins can dilate and cause an aesthetic problem.¹ An AVM of the scalp is seen in less than 1% of the general population, making it an extremely rare condition. Patients usually present with headache, local pain, weakness, seizures, a pulsatile mass, tinnitus, and visual and speech problems. If left untreated, an AVM can lead to massive hemorrhages due to dryness of the overlying skin and injuries.¹ Management of an AVM over the scalp is difficult due to high shunt flow, complex vascular anatomy, and possible cosmetic complications.² Numerous treatment options are available, such as surgical excision, endovascular occlusion, direct percutaneous injection of sclerosing agents, and electrothrombosis.^{3,4} The most widely adopted treatment is surgical excision.⁵ In this case report, we describe the clinical features and management of an AVM over the scalp in a young man. More specifically, we recount the use of purse-string suturing during the surgical excision procedure.

Case Report

An 18-year-old man presented with a history of chronic headache for the past 12 months. It was perceived in the frontotemporal and parietal region and was unrelenting but stable during this time. The headache did not radiate, pulsate, or fluctuate in severity during this time. A large external bulge was present in the left frontal and adjacent parietal region (**Figure 1**). The mass was nonpulsatile with no signs of bruit or active hemorrhage. It was classified as Stage 1 according to the Schobinger staging system (**Table 1**). There was no

Table 1. Schobinger staging system of arteriovenous malformations.

Stage 1	Warm, pink-blue stain
Stage 2	Stage 1 + enlargement, pulsatile, bruit, thrill
Stage 3	Stage 1 + ulceration, pain, necrosis
Stage 4	Stage 3 + heart failure



Figure 1. A large external bulge present in the left frontal and adjacent parietal region.

history of trauma nor were there any systemic abnormalities. There was no relevant medical or family history.

Computed tomography angiography indicated large tufts of variable-sized tortuous vessels along the scalp on the left frontal and adjacent parietal regions, predominantly extending into

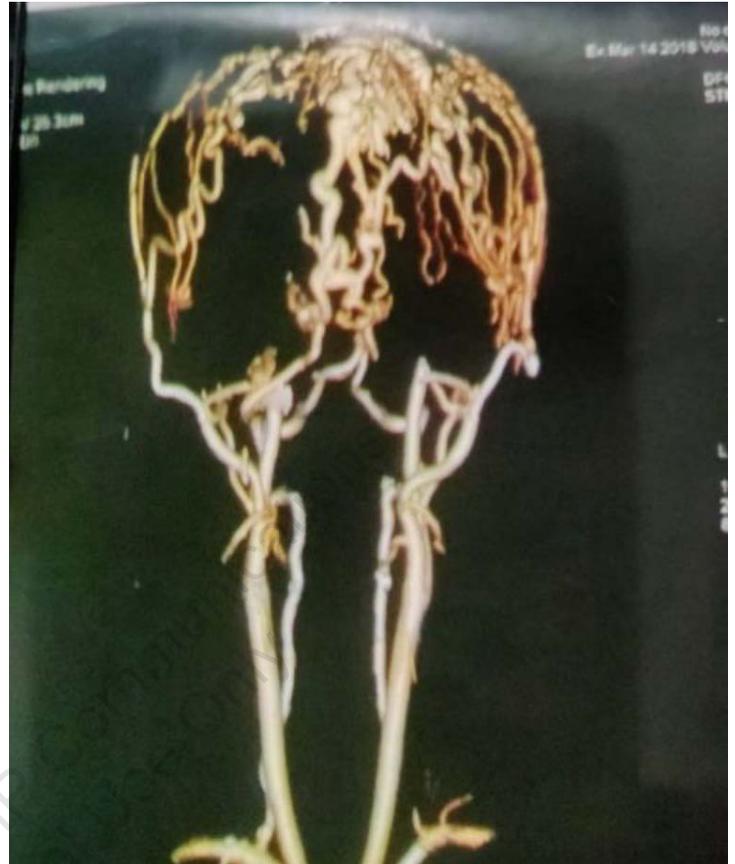
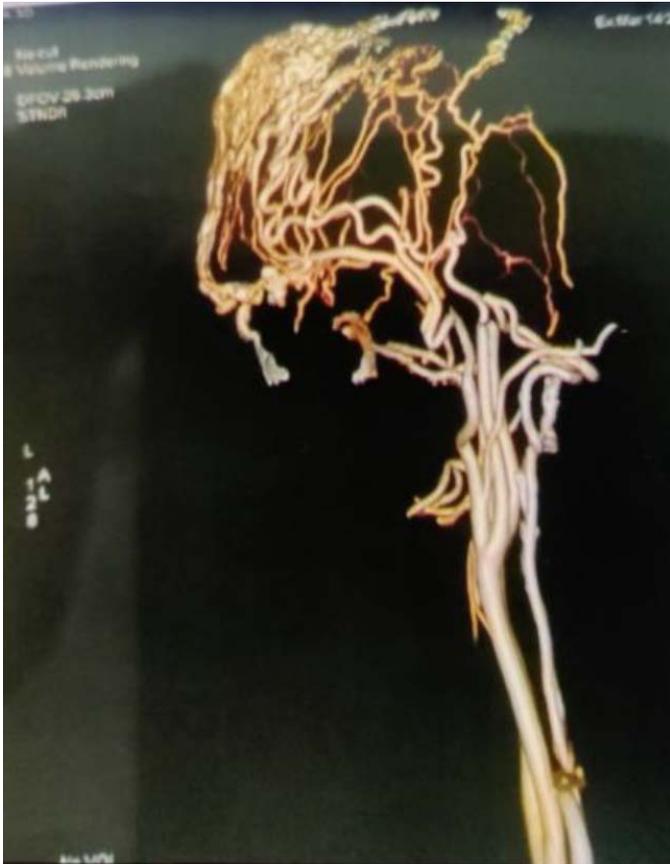


Figure 2. Computed tomography angiography indicated large tufts of variable-sized tortuous vessels along the scalp on the left frontal and adjacent parietal regions, predominantly extending into the deep layer of the scalp with extension into the subcutaneous layer.

the deep layer of the scalp with extension into the subcutaneous layer as well (**Figure 2**). The involved blood vessels were branches of bilateral superficial temporal arteries and bilateral maxillary arteries, which are the internal branches of external carotid arteries. They drain mainly through tributaries of bilateral angular veins, which ultimately drain into bilateral internal jugular veins. All other vessels showed good contrast opacification and smooth walled margins.

The patient was subsequently taken to the operation theatre for surgical excision. He was positioned supine with a 30-degree elevation of the cranial end to reduce venous engorgement. To prevent severe bleeding from feeding arteries, purse-string sutures were taken 4 to 5 cm from the mass using silk-1 sutures (**Figure 3**). The feeders were marked using a duplex ultrasound scan in a view of robust blood supply to the AVM. A scalp flap was made according to the anatomy of the AVM, with two-thirds in the parietal region while the base of the flap was in the temporal region, where one-third of the AVM was present (**Figure 4**). The flap extended from the epidermis to the periosteum. During the formation of the flap, hemostatic forceps achieved hemostasis while bleeding from the bone was controlled with monopolar diathermy. The feeding arteries were identified and traced distally toward the nidus of the malformation, being ligated and/or coagulated



Figure 3. Purse-string sutures were taken 4 to 5 cm from the mass using silk-1 sutures.

in the process. The AVM was completely removed and sent for biopsy. The dimensions of the nidus measured 5.29 cm anteroposteriorly x 1.81 cm superoinferiorly x 3.75 cm medio-laterally (**Figure 5**). The purse-string sutures were removed



Figure 4. A scalp flap was made according to the anatomy of the arteriovenous malformation (AVM) with two-thirds in the parietal region, while the base of the flap was in the temporal region where one-third of the AVM was present.

and hemostasis was achieved. A negative suction drain was kept beneath the flap and the scalp closed in layers.

The excisional biopsy taken during the operation revealed that the section consisted of a mixture of malformed, ectatic, and congestive blood vessels of various calibers, comprised of capillaries, arteries, and veins. A thickened intima was seen in a few arteries and a few thrombosed vessels were also seen. Post-op management was routine, and the drain was removed after 48 hours. Injection antibiotics were prescribed for 5 days, and the patient was discharged in 7 days. Skin sutures were removed on day 16. A 3-month follow-up revealed an adequate recovery.

Discussion

As mentioned previously, AVMs are a rare phenomenon with an unclear origin. About 10% to 20% of scalp AVMs develop after trauma, while a majority are designated as idiopathic or congenital.⁷ Distinguishing between congenital and idiopathic can be difficult because scalp AVMs usually become clinically evident in the second or third decade of life.⁸ Likewise, patients usually present with headache, pulsatile swelling, and hemorrhage, while neurologic deficits are rare. If not treated promptly, the AVM may worsen and eventually cause scalp necrosis, cardiac failure, and intellectual disability. Usually with this decline, Schobinger staging is needed for further management, along with imaging (**Table 1**).⁶



Figure 5. The dimensions of the nidus measured 5.29 cm antero-posteriorly x 1.81 cm superoinferiorly x 3.75 cm mediolaterally.

Subsequently, endovascular embolization, percutaneous intranasal injection of sclerosing agents, or surgical resection is needed to treat the AVM. Management with embolization has its advantages and disadvantages. While it can be cost-effective and used to manage large or diffuse aneurysms, there is a risk of occlusion of unintended vessels, local inflammation, significant edema, skin necrosis, and nerve damage.^{6,9} Moreover, endovascular embolization alone can be unsuccessful in about 10% of cases.¹⁰ In contrast, surgical resection is the most efficacious treatment plan, with a final cure reported in more than 90% of cases. The complications that follow this procedure are similar to any surgical resection, including infection in 4.5% of patients and skin necrosis in 4.5% (usually in more advanced cases of AVM).⁷ The combination of treatments has been adopted by some institutions to reduce the risk for complications, but the reduction is minimal.

In this case, we amended the surgical resection with the utilization of purse-string sutures. Purse-string sutures have been used in a plethora of other procedures including gastrointestinal defect closures, but a majority of the literature indicates the use of purse-string sutures for improving healing of cutaneous surgical wounds. Specifically, they have been used after percutaneous transluminal angioplasties, post-chest drain

removal following catheter ablation procedures, and dermatologic procedures.¹¹⁻¹⁵ Some literature mentions the advantages and complications of purse-string sutures, but only regarding surgical wound healing. The procedure was easily learned and simple to perform, benefited older patients, and promoted greater hemostasis. Although rare, detrimental effects include alopecia, suture line erythema, hypertrophic scarring, and allergic contact dermatitis.^{16,17} Taking everything into consideration, we implemented purse-string sutures primarily for hemostasis of the AVM and the surrounding area. We believed this technique would increase the hemostatic effect while at the same time reduce recovery time and complications post-operatively. As mentioned before, the patient recovered well without any signs of complications.

We find this case particularly significant because literature was scant when mentioning purse-string sutures for hemostasis during a surgical resection of a scalp AVM. The aim was to shed some light on this topic, hopefully bringing improvement to both the procedure and patient outcomes. By sharing this information we hope to develop even better techniques in the future.

While this case is seminal, it has its limitations. This was only a single case of this modified procedure being successful. More research and additional subjects are needed before wide adaptation. Having more patients would show more of a pattern as well as highlight potential problems. Likewise, a more objective evaluation could have been utilized to indicate an improved outcome compared with a simple surgical excision. By using a standardized postoperative evaluation, these results could be compared to novel research. Moreover, a recent article accepted by the *European Journal of Vascular and Endovascular Surgery* mentioned using the double row purse-string suture technique.¹⁸ Whether it is advantageous compared with a single row purse-string suture technique needs further analysis. It is also important to note that if the AVM was at a higher stage in the Schobinger staging system or if the AVM was invasive and involved the cranial vault, purse-string sutures may not have achieved adequate hemostasis. Further studies are needed before broad adaptation.

Conclusion

Scalp AVMs are uncommon lesions of proliferated, entangled blood vessels coalesced into a mass. Of the many treatment options, surgical excisions are the most widely used due to the lowest chance of recurrence. We modified the steps by adding purse-string sutures before beginning the procedure for enhanced hemostasis. By doing so, we believe it led to a better outcome for the patient. ■

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