

DECODING THE MANAGEMENT OF ARTERIOVENOUS MALFORMATIONS: A 360° APPROACH TO TREATMENT

Plastic Surgery

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ABSTRACT

Introduction: Arteriovenous malformations (AVMs) are rare, complex vascular lesions that require individualized management. While their exact pathogenesis remains unclear, AVMs often cause significant functional, cosmetic, and life-threatening complications. The primary treatment modality is complete surgical excision, with immediate reconstruction when necessary. This study presents our experience in managing AVMs using a multidisciplinary approach. **Materials And Methods:** We reviewed 26 patients diagnosed with AVMs from January 2018 to January 2024. Patient data, including sex, age, clinical presentation, anatomical location, diagnostic workup, treatment modality, and postoperative outcomes, were collected. Diagnostic imaging, including MRI and CT angiography, was used to assess the extent of the AVM and plan treatment. Treatment options, including observation, surgical excision, embolization, and palliative procedures, were tailored to each patient's clinical presentation. **Results:** The cohort included 26 patients (13 males, 13 females), with a mean age of 29 years (range: 3–88 years). AVMs were most commonly located in the head and neck region (n=17), followed by the upper limbs (n=6) and lower limbs (n=2). Swelling and occasional pain were the most common presenting symptoms. Of the 26 patients, 20 underwent definitive surgical excision, 3 patients had debulking post-sclerotherapy, and 2 patients required palliative procedures. The recurrence rate was 8.7%, with no major postoperative complications in the excision group. **Conclusion:** Our study underscores the importance of a multidisciplinary approach in managing AVMs. While surgical excision remains the gold standard, palliative care and embolization may be necessary in certain cases, especially when complete excision is not feasible. Proper preoperative imaging and reconstruction are essential for achieving optimal outcomes. Further research is needed to refine treatment protocols and improve long-term management strategies for AVM patients.

KEYWORDS

AVM, vascular, sclerotherapy, embolization

INTRODUCTION

Arteriovenous malformations (AVMs) are rare, yet clinically significant vascular anomalies characterized by abnormal connections between arteries and veins, bypassing the normal capillary network. This results in a direct high-pressure blood flow from the arteries into the veins, which can lead to severe complications such as haemorrhage, ischemia, and functional impairment. AVMs can occur anywhere in the body but are most commonly found in the head and neck region, where their size and location can cause considerable cosmetic and functional deformities¹. The precise pathogenesis of AVMs remains poorly understood, with most cases believed to arise from developmental errors during embryogenesis². However, many patients do not present until later in life, complicating early detection and intervention³.

While AVMs are typically congenital, they can remain asymptomatic for years or even decades. As a result, they may not be diagnosed until they reach a size that leads to symptomatic complications. Hormonal changes, such as those occurring during puberty or pregnancy, have been implicated as potential triggers for the growth or expansion of these lesions⁴. This unpredictable nature of AVM progression requires personalized treatment plans, as the clinical presentation, extent of the lesion, and associated complications can vary significantly from patient to patient⁵.

The management of AVMs presents a unique challenge due to the complexity and heterogeneity of these vascular lesions. The gold standard for treatment is complete surgical excision, which is often complicated by the involvement of adjacent structures and the need for reconstructive techniques to address the excision defects⁶. However, not all AVMs are amenable to complete excision, particularly in cases where the lesion is extensive or involves critical structures. In such instances, a palliative approach may be adopted to reduce life-threatening complications, such as bleeding or ischemia, without attempting full eradication of the lesion⁷.

A multidisciplinary approach, involving vascular surgeons, plastic surgeons, radiologists, and other specialists, is essential for the

successful management of AVMs⁸. Preoperative imaging, including MRI and CT angiography, plays a crucial role in assessing the size, location, and vascular supply of the malformation, aiding in surgical planning and decision-making⁹. Furthermore, preoperative embolization can sometimes be used to reduce blood flow to the AVM, facilitating safer excision¹⁰.

This study aims to provide an in-depth analysis of our experience in managing AVMs, focusing on the various treatment modalities employed, the challenges encountered, and the outcomes achieved in a cohort of 26 patients. By sharing our insights, we hope to contribute to a more nuanced understanding of AVM management, emphasizing the importance of a tailored, multidisciplinary approach¹¹.

MATERIALS AND METHODS

This study included 26 patients diagnosed with AVM between January 2018 and January 2024. Patient data were collected prospectively and included sex, age at presentation, anatomical location of the AVM, presenting symptoms, diagnostic modalities, treatment approach, and postoperative outcomes. All patients were assessed and followed by a multidisciplinary team.

Diagnosis

The diagnosis of AVM was made primarily based on clinical examination, supplemented by radiological investigations. Magnetic resonance imaging (MRI) was performed to evaluate the extent of the AVM and the involved tissue planes. A CT angiogram was used to identify the feeding arteries and draining veins, crucial for planning treatment.

Treatment Approach

Treatment options were discussed with each patient, including observation, definitive surgical excision, or a palliative approach. In cases where complete excision was not feasible due to the extent of the lesion or high surgical risk, patients were offered palliative surgery aimed at preventing life-threatening complications (e.g., haemorrhage). Preoperative embolization was performed in certain cases to reduce blood flow to the AVM, facilitating safer surgical

resection. Surgical reconstruction was performed where necessary to close defects resulting from excision. The treatment outcome was assessed based on clinical findings and postoperative recovery.

RESULTS

Demographics and Clinical Presentation

A total of 26 patients diagnosed with arteriovenous malformations (AVMs) were included in this study, comprising 13 males and 13 females. The mean age at presentation was 29 years, with a wide range from 3 to 88 years. The patients were classified into age groups as follows: 3 patients were under 10 years old, 6 patients were between 10 and 20 years, 12 patients were between 20 and 50 years, and 5 patients were over 50 years. This broad age range underscores the diverse clinical presentation of AVMs, which can manifest at any age, despite being congenital in nature.

The most common anatomical site of AVM involvement in our cohort was the head and neck region, accounting for 17 of the 26 cases (65%). Among these, the scalp was the most frequent site of involvement, with 9 patients affected. Other head and neck sub-sites included the cheek (3 patients), ear (1 patient), and lip (2 patients). The remaining 9 patients had AVMs in the upper limbs (6 patients) and lower limbs (2 patients), with one case each in the thigh and hip.

Patients presented with a variety of symptoms, with the most common being swelling (present in 21 patients) and pain (reported by 7 patients). Swelling was often progressive in nature, increasing in size over time, and causing significant cosmetic concern for many patients. In 4 cases, the swelling was associated with functional impairment, such as difficulty in limb movement or limitations in facial mobility. One patient, a 34-year-old male, presented with a swelling in the scalp that had progressively increased in size over several years, leading to discomfort and emotional distress due to its visible appearance.

In addition to swelling, pain was a significant symptom in some patients. Typically, the pain was localized to the site of the AVM and was described as a dull ache or intermittent sharp pain. Some patients reported exacerbation of pain during physical activity or minor trauma. Bleeding was another presenting symptom in one case, where a 24-year-old female presented with spontaneous bleeding from an AVM located on the scalp, triggered by minimal trauma. Fortunately, this bleeding was controlled with conservative management.

Other clinical manifestations included ulceration, bleeding and ischemia. One 22-year-old female patient presented with an ulcerated, bleeding lesion over the scalp that had become progressively more painful and disfiguring. This patient had noted rapid enlargement of the lesion during pregnancy, highlighting the potential role of hormonal changes in AVM growth. Functional impairment, including difficulty in moving the affected limb or facial weakness, was reported by patients with AVMs in the upper and lower limbs, often due to compression of adjacent nerves or tissues.

Diagnostic Modalities

The diagnosis of AVM was primarily clinical, based on the characteristic appearance of the lesion and its typical symptoms. However, magnetic resonance imaging (MRI) and CT angiography were used to confirm the diagnosis and assess the extent of the AVM. MRI was instrumental in visualizing the size, depth, and involvement of surrounding tissues, particularly in cases of head and neck AVMs. CT angiography provided critical information about the AVM's vascular supply, allowing for precise identification of feeding arteries and draining veins. These imaging techniques were also used to determine the involvement of deep or critical structures, helping to plan the surgical approach and minimizing the risk of complications during excision.

In some cases, embolization was performed preoperatively to reduce the blood flow to the AVM and facilitate safer excision. This was particularly useful in cases where the AVM was large or located in areas with abundant vascular supply. Preoperative embolization was performed in 4 patients and was successful in reducing bleeding during surgery. However, in one case, despite preoperative embolization, the patient's AVM (located on the left side of the face) had extensive vascularization, and surgery was abandoned due to uncontrollable intraoperative bleeding. This highlights the potential risks of AVM surgery, especially in cases where embolization does not sufficiently reduce blood flow.

Treatment and Surgical Management

The treatment approach for each patient was tailored to the location, size, and clinical presentation of the AVM, as well as the patient's overall health status. In our cohort, the primary treatment strategy was surgical excision, which was performed in 20 patients (76.9%). The goal of surgery was complete excision of the AVM, with immediate reconstruction when necessary to close any resulting defects. The remaining 6 patients underwent alternative treatment approaches, including debulking or palliative surgery.

Definitive Surgical Excision

Surgical excision was successfully performed in 20 patients, with a mean duration of surgery ranging from 90 to 180 minutes, depending on the size and location of the AVM. Postoperative recovery was uneventful in most cases, with patients experiencing minimal complications. For example, a 32-year-old male patient with a large AVM on the scalp underwent complete excision, and the resulting defect was closed with an O-S flap. His recovery was uneventful, and the cosmetic outcome was satisfactory as shown in Figure 1. Similarly, a 2-year-old female patient with a small scalp AVM underwent excision followed by primary closure, and she experienced no postoperative complications, as shown in Figure 2.

Another case with a 32 year old male patient who presented with swelling over occipital region which was evaluated with MRI and found to be an AVM, patient underwent complete excision and primary closure, as shown in Figure 3.

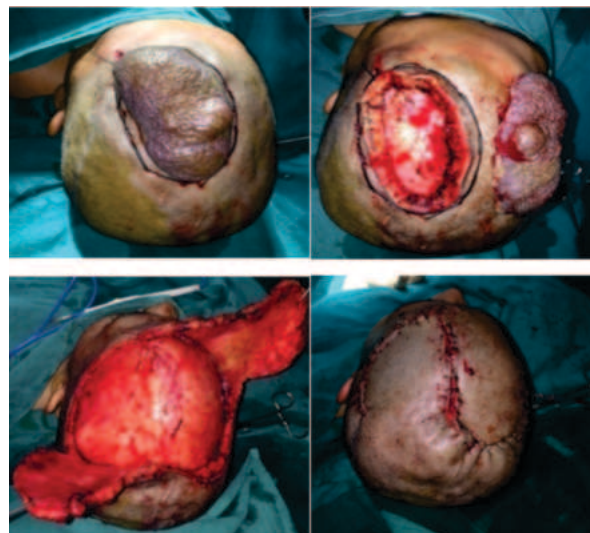


Figure 1: Large AVM on the scalp with complete excision and O-S flap reconstruction



Figure 2: A small scalp AVM managed by excision and primary closure



Figure 3: AVM over occiput managed by excision and primary closure

Debulking Surgery

In 3 patients, a debulking approach was used after sclerotherapy, which was effective in reducing the size of the lesion prior to excision. A 15-year-old female with an AVM of the upper lip underwent sclerotherapy followed by excision, with no complications, as shown in Figure 4. Another 15-year-old female with an AVM on the left cheek also underwent sclerotherapy followed by excision, with similarly favorable outcomes, as shown in Figure 5. These patients demonstrated that debulking can be a useful adjunct to excision, particularly in larger lesions where complete resection in one stage may be challenging.



Figure 4: Pre operative and Post operative image of upper lip AVM managed by sclerotherapy followed by excision



Figure 5: Pre operative, immediate and late Post operative image of upper lip AVM managed by sclerotherapy followed by excision respectively

Palliative Surgery

In cases where complete excision was not possible due to the size, location, or vascular complexity of the AVM, a palliative approach was adopted. Two patients underwent palliative surgery aimed at reducing the risk of life-threatening complications, such as hemorrhage or infection, rather than attempting complete eradication. For instance, a 22-year-old female with an ulcerated, bleeding AVM over the scalp underwent debulking surgery and skin grafting to manage her symptoms. This is shown in Figure 6. The procedure was performed with careful monitoring of the vascular anatomy, and the patient recovered well, although the lesion could not be fully excised. A 25-year-old male with an AVM of the face underwent arterial embolization followed by debulking, with a favourable clinical outcome, although complete excision was not attempted due to the complexity of the lesion.

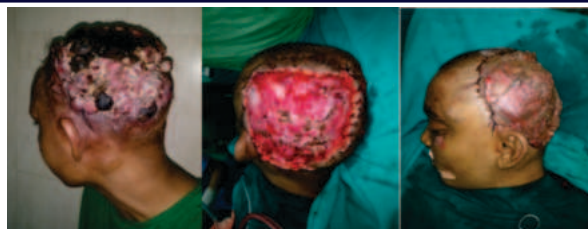


Figure 6: Ulcerated, bleeding AVM over the scalp underwent debulking surgery and skin grafting

Conservative Management

One patient amongst the 26 was managed conservatively. 38-year-old male, had a large, asymptomatic AVM of the face and scalp and was not offered surgery due to the high risk of complications. This patient was monitored over time, with regular imaging to assess any changes in the lesion's size or behaviour. He has remained asymptomatic, as shown in figure 7, demonstrating that some AVMs may be stable and manageable without intervention.



Figure 7: AVM of the face and scalp managed conservatively with a 6 year follow up

Postoperative Complications and Follow-up

Overall, the postoperative outcomes were positive, with most patients showing no major complications. The recurrence rate in our cohort was 8.7%, which is relatively low compared to other studies, where recurrence rates can range from 40–75%. The recurrence occurred in two patients, both of whom had AVMs in the head and neck region. One patient, a 34-year-old male with an AVM of the scalp, developed a small recurrence at the excision site 12 months postoperatively. He underwent a second, less extensive excision with good results. The second recurrence occurred in a 26-year-old female who had an AVM in the cheek. She required additional debulking surgery after 18 months due to regrowth of the lesion.

DISCUSSION

Our study highlights the importance of a multidisciplinary approach in the management of AVMs. The most common location for AVMs in our cohort was the head and neck region, particularly the scalp, which aligns with previous studies. While AVMs are thought to originate during embryologic development, they may remain asymptomatic or unnoticed until adulthood. Hormonal changes, such as those occurring during puberty or pregnancy, can lead to the growth and expansion of AVMs.

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The goal of AVM treatment is complete surgical excision, followed by reconstruction when necessary. In our cohort, the recurrence rate was 8.7%, significantly lower than the 40–50% recurrence rate reported in older studies¹³. This improvement may be attributed to advances in preoperative imaging, surgical techniques, and post-operative management¹². However, complete excision is not always feasible, particularly in cases where the AVM is large or involves critical structures. In these cases, a palliative approach may be adopted, focusing on reducing symptoms and preventing complications like bleeding or ulceration¹¹.

CONCLUSION

In summary, our experience in the management of AVMs highlights the importance of a tailored, multidisciplinary approach. Surgical excision remains the gold standard, and in cases of extensive or complex AVMs, preoperative embolization and reconstructive surgery play critical roles in achieving optimal outcomes. Although the recurrence rate was low in our cohort, close follow-up is essential to detect any potential regrowth or complications. Our findings suggest that, with appropriate treatment and careful monitoring, AVMs can be effectively managed, even in challenging cases.

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