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CASE REPORT

Delayed Presentation of Post-Traumatic Arteriovenous Malformation of the Distal Forearm in an Adolescent: A Diagnostic and Therapeutic Challenge

KATIKAREDDY MADHAN MOHAN REDDY[1], RANAJIT NAIK[2], KAPILDEV H[3], DARSHAN D.S[4]

[1]post Graduate, Department of General Surgery, Jawaharlal Nehru Medical College and KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

[2]MBBS, DNB (CTVS), Assistant Professor, Department of CTVS, Jawaharlal Nehru Medical College and KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi

[3]MBBS, MS General Surgery, Associate Professor, Department Of General Surgery,, Department of CTVS, Jawaharlal Nehru Medical College And KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

[4]MS, MCH CTVS, Associate Professor, Department Of CTVS, Jawaharlal Nehru Medical College and KLES, Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi.

*Corresponding Author
Dr. Katikareddy Madhan Mohan Reddy

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Abstract:
Post-traumatic arteriovenous malformations are uncommon vascular lesions that may appear long after the initial trauma. They can be difficult to recognize due to delayed symptoms and atypical presentations. We report a case involving a 17-year-old male who presented with a gradually enlarging, pulsatile swelling on the distal forearm, nearly a year after sustaining blunt trauma from a bicycle fall. Imaging confirmed a high-flow Arteriovenous Malformations between the radial artery and cephalic vein. Surgical excision was carried out with successful resolution of symptoms. This case underscores the importance of clinical suspicion and appropriate imaging in managing post-traumatic Arteriovenous Malformations.

Keywords:Post-traumatic,Arteriovenous malformations, Radial artery, Cephalic vein, Arteriovenous malformation, Vascular trauma, Surgical excision

INTRODUCTION

Arteriovenous malformations are complex, high-flow vascular anomalies formed by a direct connection between arterial and venous channels, effectively bypassing the intervening capillary bed. This aberrant communication disrupts normal hemodynamic regulation, leading to high-pressure arterial flow entering the venous system, often resulting in venous dilation, turbulence, and tissue damage. While most Arteriovenous malformations are congenital in origin, arising from developmental errors during angiogenesis, they can also be acquired secondary to trauma. Traumatic Arteriovenous Malformations, though less common, are important to recognize as they can lead to progressive symptoms and long-term morbidity if left untreated [1,2].

Trauma-induced Arteriovenous malformations typically arise from either penetrating injuries, such as stab wounds, shrapnel, or gunshots, or less frequently, from blunt force trauma. In penetrating trauma, direct injury to adjacent arteries and veins often results in immediate formation of a fistulous tract. However, in blunt trauma, the onset is typically delayed. The pathophysiological mechanism involves vessel wall contusion, micro-vascular rupture, and secondary neo-vascularization, which gradually establishes an abnormal connection between an artery and a vein [3]. These changes may go unnoticed in the acute phase due to the absence of overt signs and symptoms.
tion, hemodynamic flow pattern**,** and clinical symptoms. Small, stable, asymptomatic lesions may be observed

Post-traumatic Arteriovenous malformations of the upper extremity, particularly the distal forearm, are exceedingly rare and tend to present insidiously. The initial trauma may be dismissed as minor, especially when no fractures or visible lacerations are present. Over time, patients may begin to notice a localized swelling that is soft, pulsatile, and possibly compressible. Audible bruits may be heard on auscultation, and some cases present with neurological symptoms, such as tingling, paresthesia, or even motor weakness due to adjacent nerve compression or ischemia[3,4].

Many of these lesions are initially misidentified as benign conditions such as hematomas, ganglion cysts, or soft tissue tumors. As a result, early clinical suspicion**,** guided by the history of trauma and suggestive physical signs like a pulsatile mass**,** becomes pivotal. Once an Arteriovenous Malformations is suspected, imaging plays a critical role. Color Doppler ultrasonography is often the first-line modality, capable of detecting abnormal flow patterns suggestive of arteriovenous shunting. For precise anatomical delineation, contrast-enhanced computed tomography angiography **or** magnetic resonance imaging may be employed to confirm the diagnosis and assess the relationship to surrounding structures [5].

Management of post-traumatic Arteriovenous malformations is dictated by the size, loca

conservatively. However, symptomatic Arteriovenous Malformations that cause pain, neurological deficits,

cosmetic deformity, or risk of rupturetypically warrant active intervention. Therapeutic options include surgical excision**,** endovascular embolization, or a combination of both, depending on lesion accessibility and complexity. Surgical management involves identification and ligation of the fistulous connection while preserving the parent vessels when feasible [6].

The Case report present a rare instance of a post-traumatic arteriovenous malformation of the distal forearm in a young male following blunt trauma sustained during a bicycle fall. The lesion, initially unnoticed, progressively enlarged over time and became symptomatic with sensory complaints. Through a combination of clinical examination and targeted imaging, the diagnosis was established, and surgical correction resulted in complete symptomatic relief. This report emphasizes the need for clinicians to maintain a high index of suspicion for vascular anomalies in patients with a history of limb trauma and delayed-onset swelling.

CASE REPORT

A 17-year-old boy presented with a gradually increasing swelling on the volar side of his left distal forearm. He reported a history of a blunt injury to the same area following a fall from his bicycle about a year earlier. At the time, there were no open wounds or fractures, and no imaging was performed. The injury was managed conservatively at home.

Three months later, he noticed a small, painless lump at the site, which slowly enlarged over several months. It eventually became associated with intermittent tingling in his left hand, particularly while gripping or lifting objects. There were no signs of infection, fever, or weight loss.

Examination Findings: On inspection and palpation, a 2.5 × 3 cm soft, compressible, and pulsatile swelling was noted over the distal radius. A bruit was clearly audible over the lesion. The overlying skin appeared normal. Both radial and ulnar pulses were intact and symmetrical. Mild paresthesia was reported in the median nerve territory, particularly during wrist extension, although motor strength was unaffected.

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Figure 1: Clinical photograph showing soft, pulsatile swelling over the volar aspect of the left distal forearm in a 17-year-old male.

Radiological Evaluation: A Doppler ultrasound was performed initially and demonstrated turbulent, arterialized flow within a superficial venous channel. To delineate the anatomy further, computed tomography was performed, which confirmed the presence of a direct arteriovenous communication between the distal radial artery and the cephalic vein (Figure 2). There was no involvement of deeper vessels or other adjacent structures. Additionally, magnetic resonance imaging of the forearm supported the diagnosis of a high-flow arteriovenous malformation without extension into muscle or deep tissue planes.

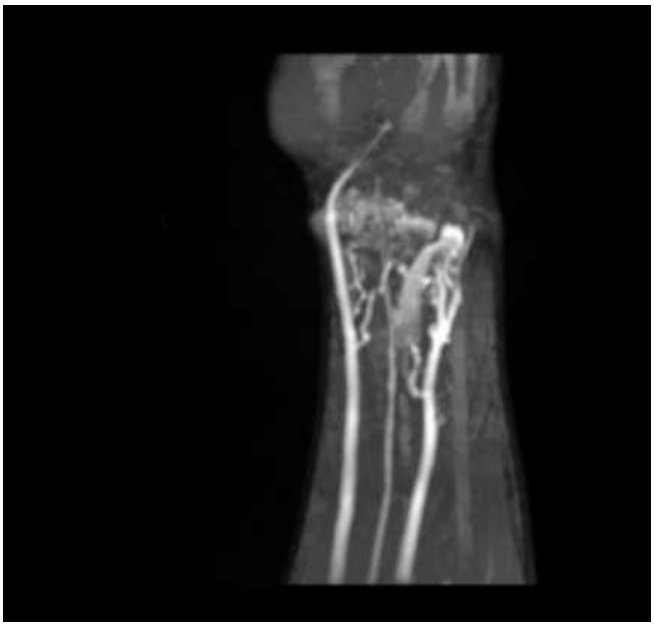

Figure 2: Tuft of vascular channels in the distal radial epiphysis and distal radial metadiaphysis as described above representing arteriovenous malformation.

Surgical Management: Given the lesion's progressive nature and associated sensory symptoms, the patient was taken up for surgical intervention. Under general anesthesia and tourniquet application, a volar S-shaped incision was made. Dissection exposed a well-defined arteriovenous fistula connecting the radial artery to the cephalic vein.

The fistulous connection was ligated and excised. Care was taken to preserve the main radial artery and vein. Adequate hemostasis was achieved, and the surgical field was clean. The wound was closed in layers (Figure 3).

Postoperative Outcome and Follow-up: The patient had an uneventful postoperative period.The patient reported complete relief from paresthesia within one week. At six months, follow-up examination showed no recurrence of symptoms, and Doppler imaging confirmed the absence of any residual Arteriovenous Malformations or abnormal flow.

Figure 3:Post-ligation clean surgical field

DISCUSSION

Traumatic Arteriovenous Malformations, or arteriovenous fistulae, are infrequently encountered in clinical practice and represent a diagnostic pitfall, particularly in cases following minor blunt trauma. The mechanism typically involves simultaneous injury to adjacent arteries and veins, leading to an abnormal communication that results in high-flow shunting of arterial blood into the venous system [2,6] Over time, the affected veins may become dilated and tortuous, and symptoms may arise from local mass effect or distal ischemia.

Delayed presentations, such as in our case, are not uncommon and can mislead clinicians, especially when the initial trauma is perceived as trivial. Bravm et al. noted that subtle vascular injuries can be easily missed following minor upper extremity trauma, increasing the risk of chronic complications such as thrombosis or limb ischemia [4].

Clinical features suggestive of Arteriovenous Malformations include a pulsatile mass, palpable thrill, continuous bruit, and distal paresthesia. The presence of these findings in a post-traumatic setting should prompt evaluation with non-invasive imaging. Doppler ultrasound is a useful first-line tool, but cross-sectional imaging such as Computed Tomography angiography or Magnetic Resonance angiography is necessary to delineate the lesion's anatomy and vascular connections [7].

While some Arteriovenous malformations remain stable and asymptomatic, intervention becomes necessary when there is progression, pain, neurovascular compromise, or cosmetic concern. Various treatment modalities are available, including surgical ligation, resection, and endovascular embolization. The choice depends on lesion location, size, accessibility, and available expertise [5,8].

In the case presented, surgical excision was favored due to the superficial location of the lesion, accessibility, and the desire to preserve native vascular structures. Surgical treatment allows direct visualization and definitive ligation of the abnormal communication. The importance of intraoperative identification of surrounding neurovascular structures cannot be overemphasized, particularly in anatomically complex regions such as the wrist.

Although endovascular options such as embolization are gaining popularity, especially for deep or complex lesions, they may not be ideal in superficial Arteriovenous malformations of the forearm, particularly in young patients with high functional demands. Furthermore, recurrence rates after embolization can be higher when the nidus is not completely occluded [5].

Similar cases have been documented in the literature. Younes et al. reported a radial artery Arteriovenous Fistulae presenting several months after trauma, successfully managed with open surgical repair [6]. Goel et al. also described a traumatic Arteriovenous Fistulae in the forearm treated surgically after a delayed diagnosis [9]. These cases underscore the importance of maintaining suspicion and opting for definitive surgical management when indicated.

CONCLUSION

Post-traumatic Arteriovenous malformations of the distal upper limb are rare and can present with subtle or delayed symptoms. Clinicians should maintain a high index of suspicion in patients presenting with pulsatile swellings following trauma, regardless of the perceived severity. Imaging is essential for diagnosis and surgical planning. Surgical excision remains a definitive and curative option in symptomatic or enlarging lesions. Timely intervention ensures symptom relief and reduces the risk of long-term complications.

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