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Traumatic Pseudoaneurism of the Vertebral and Right Common Carotid Artery Caused by Rare Water Event

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Abstract **Case Report**

Introduction: The pseudoaneurysm of the common carotid artery represents a rare but highly severe clinical entity, particularly when secondary to hydraulic trauma, defined as damage resulting from the impact of high-pressure water, such as that from industrial hoses. This type of trauma is uncommon and often underestimated in its potential to cause significant vascular injuries, including those to vital structures in the neck. ***Clinical Case:*** Forty-one-year-old female patient with no significant medical history who 3 weeks ago suffered a closed hydraulic trauma in the right cervical region (high-pressure water coming out of a hose while she was washing her car). A color and spectral Doppler ultrasound of the neck vessels was performed with a high-frequency linear transducer in B mode, which reported: on the right side: pseudo aneurysmal image with a path to the vertebral artery measuring 27 x 23 mm, with Yin-Yang sign on Doppler. A diagnosis of a pseudoaneurysm with arteriovenous fistula (towards the right internal jugular vein) of the right vertebral artery was made. After an adequate anatomical evaluation and surgical planning, an endovascular treatment was decided to be performed. ***Conclusion:*** The management of common carotid and vertebral artery pseudoaneurysms secondary to hydraulic trauma involves a nuanced approach, integrating advanced diagnostic imaging and tailored treatment strategies. Both open surgical and endovascular approaches have their respective advantages and limitations. Early recognition, appropriate intervention, and rigorous follow-up are essential to optimize patient outcomes and mitigate risks associated with this challenging condition.

Keywords: Vertebral artery, endovascular techniques, false aneurysm, carotid artery injuries.

INTRODUCTION

The pseudoaneurysm of the common carotid artery represents a rare but highly severe clinical entity, particularly when secondary to hydraulic trauma, defined as damage resulting from the impact of high-pressure water, such as that from industrial hoses. This type of trauma is uncommon and often underestimated in its potential to cause significant vascular injuries, including those to vital structures in the neck.

A pseudoaneurysm, or false aneurysm, forms when there is a rupture in the arterial wall, allowing blood to escape and be contained by surrounding tissues rather than the arterial wall itself. This condition can lead to severe complications such as distal embolization, compression of adjacent structures, and massive hemorrhage if not diagnosed and treated appropriately [1].

Hydraulic trauma leading to a pseudoaneurysm of the common carotid artery can occur in occupational accidents, recreational activities, or violent situations where the impact of a high-pressure hose directed at the neck results in soft tissue penetration and arterial damage [2, 3]. The force of hydraulic pressure can compromise the integrity of the carotid artery and the following vertebral artery, facilitating the formation of a pseudoaneurysm [2].

Diagnosing a pseudoaneurysm resulting from hydraulic trauma is clinically challenging due to variable symptom presentation, which may include neck pain, swelling, abnormal pulsations, and neurological

manifestations from nerve compression or cerebral embolization [4]. Advanced imaging tools such as Doppler ultrasound, computed tomography (CT), and magnetic resonance angiography (MRA) are crucial for confirming the diagnosis and planning an effective treatment strategy [5].

Management of the pseudoaneurysm ranges from conservative surveillance to surgical or endovascular interventions, depending on the pseudoaneurysm's size, patient symptomatology, and risk of complications. In selected cases, open surgical repair or endovascular stent placement may be necessary to prevent rupture and other major complications [6, 7]. Open surgical repair, typically involving direct suture repair, patch angioplasty, or interposition grafting, offers definitive treatment. However, it carries risks such as cranial nerve injury, stroke, and infection [8]. Endovascular techniques, including stent-graft placement, provide a minimally invasive alternative with shorter recovery times and reduced procedural risks, although they may necessitate long-term surveillance for complications such as stent thrombosis or migration [9, 10].

In open surgical approaches, results from contemporary series indicate a success rate with low recurrence of pseudoaneurysm but underscore the importance of careful intraoperative management to minimize complications [8]. Endovascular management has demonstrated favorable outcomes, particularly in high-risk surgical patients or those with challenging anatomy, with studies reporting high technical success rates and low procedural morbidity [9, 10].

Early identification and appropriate management of common carotid or vertebral artery pseudoaneurysms secondary to hydraulic trauma are essential for improving clinical outcomes and reducing morbidity and mortality risk. Given the rarity of this condition and the peculiar nature of the traumatic mechanism, maintaining a high index of clinical suspicion and a solid understanding of diagnostic and therapeutic principles is imperative for effectively addressing this pathology [3, 4].

Clinical Case

Forty-one-year-old female patient with no significant medical history who 3 weeks ago suffered a closed hydraulic trauma in the right cervical region (high-pressure water coming out of a hose while she was washing her car), which caused injury to the epidermis and dermis, with bleeding, which resolved with acupressure. A few days after the incident, she developed a pulsating nodule in the aforementioned region. She went to another hospital where they attempted to perform a diagnostic angiography through a subclavicular puncture, without success. Upon arrival at our center, the physical examination revealed the presence of a healed lesion in the right cervical region, with a pulsating nodule of approximately 4 cm in diameter, which presented palpable thrill. The patient reported neck pain, dysphagia and odynophagia. A color and spectral Doppler ultrasound of the neck vessels was performed with a high-frequency linear transducer in B mode, which reported: on the right side: pseudo aneurysmal image with a path to the vertebral artery measuring 27 x 23 mm, with Yin-Yang sign on Doppler. Common, internal and external carotid arteries with smooth and regular walls, with patent flow, without hemodynamically significant lesions. Intima media thickness 0.8 mm. Patent vertebral artery with physiological antegrade flow. On the left side: common, internal and external carotid arteries with smooth and regular walls, with patent flow, without hemodynamically significant lesions. Intima media thickness 0.8 mm. Patent vertebral artery with physiological antegrade flow. The venous study showed no signs of right or left thrombosis.

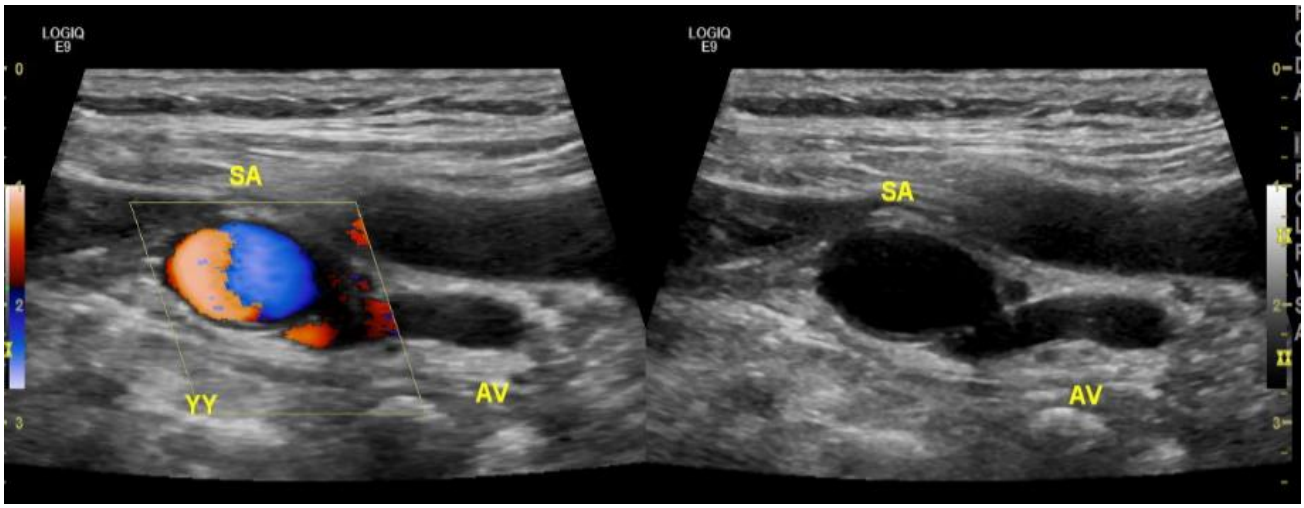

Image 1: Arterial Doppler showing Yin-Yang's sign from the right vertebral artery to the right internal jugular vein

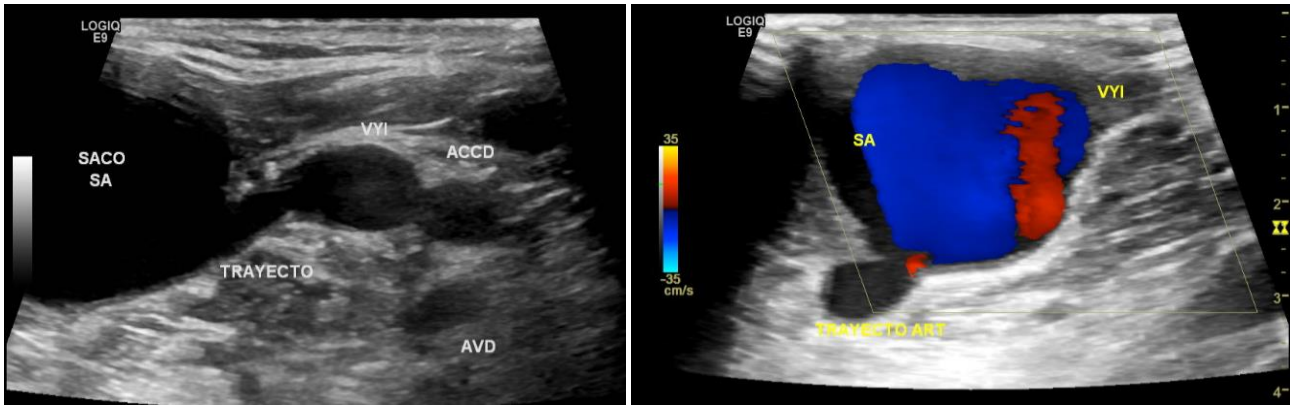

Image 2: Showing arterio-venous trajectory and aneurysm sac from the right vertebral and common carotid arteries. SACO SA: aneurysm sac; TRAYECTO: arterio-venous trajectory; VYI: right internal jugular vein; ACCD: right common carotid artery; AVD: right vertebral artery

Based on the above, a diagnosis of a pseudoaneurysm with arteriovenous fistula (towards the right internal jugular vein) of the right vertebral artery was made. After an adequate anatomical evaluation and surgical planning, an endovascular treatment was decided to be performed. Briefly: access was by echo-guided puncture of the right common femoral artery, a 6 Fr introducer was placed, a hydrophilic guide was passed followed by a 5 Fr vertebral catheter, managing to navigate to the aortic arch. There, the guide was changed to a 0.035 Teflon guide and the introducer was changed to a long 7 Fr one; subsequently, a 5 Fr hydrophilic catheter was passed. A control arteriography was performed showing the pseudoaneurysm with arteriovenous fistula of the right vertebral artery, with good contrast filling on the right carotid artery. The right vertebral artery was catheterized, a 5mm x 56mm balloon stent was introduced, which was subsequently deployed covering the arteriovenous communication; complete closure of the fistula was observed in the control arteriography.

DISCUSSION

Pseudoaneurysms of the common carotid and vertebral artery secondary to hydraulic trauma present a rare yet critical clinical challenge. Hydraulic trauma, induced by high-pressure water jets, can lead to significant vascular damage, which may be difficult to identify and manage promptly due to its uncommon nature.

Diagnosis and Clinical presentation

The clinical presentation of these pseudoaneurysms resulting from hydraulic trauma can be variable and includes symptoms such as localized neck pain, swelling, pulsatile masses, and neurological deficits due to nerve compression or embolization [1]. Diagnosing these injuries often requires a high index of suspicion, especially given the atypical nature of the trauma.

Advanced imaging is crucial for accurate diagnosis and management. Doppler ultrasonography provides an initial evaluation of blood flow and pseudoaneurysm characteristics [2]. However, more definitive imaging techniques such as computed tomography angiography (CTA) and magnetic resonance angiography (MRA) offer superior anatomical detail and are essential for preoperative planning [3]. CTA is particularly valuable for assessing the size and extent of the pseudoaneurysm and for identifying any associated vascular injuries [4]. In this patient, the diagnosis was clear with a Doppler ultrasound, meaning that the high suspicion rate is key to diagnosis, even in low-resource centers.

Treatment modalities and comparative outcomes

Open surgical repair

Open surgical repair has traditionally been the mainstay for treating carotid artery pseudoaneurysms. This approach includes techniques such as direct suture repair, patch angioplasty, and interposition grafting. A comparative study by Kalra et al. demonstrated that open surgical repair had a 10% complication rate, including cranial nerve injury and stroke, but achieved a high long-term success rate with a 5-year patency of 95% for larger pseudoaneurysms [5]. The choice of technique depends on the pseudoaneurysm's size, location, and the extent of arterial damage.

In contrast, Yilmaz *et al*., reported that open surgical repair is associated with a higher incidence of perioperative complications compared to endovascular methods, especially in high-risk patients [8]. Despite this, open repair remains a preferred option for extensive or symptomatic pseudoaneurysms due to its direct approach and definitive nature; however, it is not the case for this patient.

Endovascular techniques

Endovascular repair has emerged as a less invasive alternative, particularly beneficial for patients who are not ideal candidates for open surgery. Techniques such as stent-graft placement offer a minimally invasive option with reduced immediate procedural risks and shorter recovery times [7]. A

systematic review by Faggioli et al. highlighted that endovascular repair had a technical success rate of 93%, with a lower incidence of major complications compared to open surgery [10]. However, long-term follow-up is necessary to monitor for complications such as stent thrombosis or migration.

The comparative effectiveness of endovascular versus open repair has been the subject of multiple studies. A meta-analysis by White *et al*., revealed that while endovascular repair generally offers lower procedural morbidity and shorter hospital stays, open surgical repair provides better long-term outcomes in terms of durability and complete resolution of the pseudoaneurysm [11]. The review emphasized that endovascular techniques are particularly advantageous for patients with comorbidities or those who are considered high surgical risk, like the patient reported in this article.

Long-term outcomes and follow-up

Long-term outcomes for both treatment modalities require careful consideration. Open surgical repair generally ensures definitive resolution of the pseudoaneurysm but comes with a risk of perioperative complications [12]. Endovascular repair, while minimally invasive, requires rigorous long-term surveillance to detect potential late complications such as stent thrombosis or pseudoaneurysm recurrence [13].

A study by Dabus et al. demonstrated that endovascular repair had a recurrence rate of approximately 5% over a 3-year follow-up period, necessitating regular monitoring to ensure sustained success [7]. Conversely, long-term follow-up for open surgical repair shows a lower recurrence rate but highlights the need for careful postoperative management to avoid complications [8].

It is still to determine whether the outcome of this patient remains favorable through the years.

CONCLUSION

The management of common carotid and vertebral artery pseudoaneurysms secondary to hydraulic trauma involves a nuanced approach, integrating advanced diagnostic imaging and tailored treatment strategies. Both open surgical and endovascular approaches have their respective advantages and limitations. Early recognition, appropriate intervention, and rigorous follow-up are essential to optimize patient outcomes and mitigate risks associated with this challenging condition.

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