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When Neurological Symptoms Hide a Life-Threatening Hemorrhage: A Case Report of Diagnostic Challenges and Management of Hemorrhagic Shock From an Aberrant Radial Artery

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Patient: Female, 66-year-old
Final Diagnosis: Hemorrhage
Symptoms: Coma • hypotension
Clinical Procedure: Embolization • fluid replacement • intubation • vasopressor
Specialty: Critical Care Medicine

Objective: Unusual clinical course
Background: Anatomical variations of the radial artery are present in 10-20% of individuals. Such variations can impact management and clinical outcomes in vascular interventions, trauma, or surgeries. These abnormalities can pose diagnostic and therapeutic challenges, especially in cases of vascular trauma requiring prompt intervention.
Case Report: We present the case of a 66-year-old woman with a history of bilateral lung transplantation, atrial fibrillation on anticoagulation, and prior breast cancer, who developed hemorrhagic shock following a fall. Initially presenting with neurological symptoms, her condition rapidly worsened, leading to unresponsiveness and coma. Initial imaging excluded intracranial pathology, but repeated imaging then revealed a large right chest wall hematoma with active bleeding from an aberrant radial artery originating from the axillary artery. The patient was managed with aggressive fluid resuscitation, blood transfusion, anticoagulation reversal, and ultimately interventional radiology. Radio-embolization allowed successful embolization of the bleeding vessel with preservation of hand perfusion. Further questioning revealed that the bleeding was caused by nursing management and by her complex medical history of steroid intake, lymph node dissection, and radiotherapy.
Conclusions: To the best of our knowledge this is the first description of hemorrhagic shock due to an aberrant radial artery originating from the axillary artery. The case underscores the diagnostic complexity of hemorrhagic shock in patients with abnormal vascular anatomy and significant comorbidities. It highlights the critical role of interventional radiology in managing such cases and the importance of multidisciplinary collaboration to ensure timely diagnosis, effective treatment, and prevention of ischemic complications. We discuss the current literature and management of complex upper-limb vascular trauma.
Keywords: Coma • Hemorrhage • Ulnar Artery • Vasoconstriction
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Introduction

Aberrant arterial anatomy of the upper extremities is relatively common [1], and anatomical variations of the radial artery are reported to occur in approximately 10-20% of the population [2]. Nevertheless, injuries to the subclavian and axillary arteries are relatively rare, accounting for 15-20% of upper-limb vessels lesions, but are associated with high mortality and morbidity [3]. Particularly in cases of trauma, these anatomical variations can significantly delay diagnosis (resulting in limb ischemia), impact clinical decision-making, the choice of the procedure (with the risk of an inappropriate therapeutic approach), and, consequently, outcomes [1,4,5]. The vast majority of these injuries (90%) result from penetrating trauma [3]. Surgery (or open repair [OR]) is the preferred approach [5], but the role of interventional radiology (IR) has recently emerged and may be a viable option [3].

We present a case of a blunt trauma of an aberrant radial artery originating from the axillary artery, highlighting the implications of an unusual vascular anatomy in a patient with a complex medical history and emphasizing the need for in-depth knowledge of vascular anatomic variations. This case also illustrates the potential consequences of trauma to an aberrant artery, particularly in the context of anticoagulation therapy, and the crucial role of interventional radiology in effective management of such complications.

Case Report

A 66-year-old woman was admitted for a routine follow-up 4.5-years after a bilateral lung transplant. Her medical history included atrial fibrillation on anticoagulation therapy (low-molecular-weight heparin [LMWH]) and bilateral mammary carcinoma treated with mastectomy, axillary lymph node dissection, and radiotherapy (15 years prior).

During her hospital stay, she fell in her room, sustaining facial trauma, and within hours she developed progressive neurological impairment, including dizziness, hypomnesia, and altered mental status. The following day, in the absence of neurological improvement, an initial non-contrast brain CT scan revealed no abnormalities. In the morning, laboratory results showed a slight reduction in her hemoglobin level to 9.3 g/dl and a slight increase in serum creatinine to 1.18 mg/dl, with no other abnormal values.

Over the following hours, her Glasgow Coma Scale (GCS) rapidly deteriorated to 4/15, prompting intensive care unit (ICU) admission. Upon admission, she remained unresponsive, hypotensive, and tachycardic, warranting prompt intubation (ketamine 3 mg/kg and rocuronium 1.2 mg/kg) and initiation



Figure 1. CT scan showing the subdivision (arrow) of the axillary artery into an aberrant radial artery and the brachial artery and the presence of contrast in the subcutaneous region in the arm beneath the division.

of vasopressor therapy. Immediately after intubation, the pupils showed fixed mydriasis without any brainstem reflexes (corneal, vestibulo-ocular, pupillary light, and oculo-cardiac), raising concerns about neurological worsening. An additional cerebral contrast-enhanced CT scan was normal and ruled out a structural cause of the coma, specifically massive ischemic stroke or brain herniation. Her hemoglobin level then dropped to 6.3 g/dl along with worsening hemodynamic instability, raising suspicion of active bleeding despite no signs of external bleeding or subcutaneous hematoma after a careful physical examination. Chest X-ray was unremarkable, but a whole-body contrast-enhanced CT scan, performed to look for occult bleeding, revealed a large hematoma involving the right lateral chest wall and arm, with active bleeding evidenced by extravasation of contrast medium (**Figure 1**).

Thereby, a hemorrhagic shock was diagnosed, likely exacerbated by her anticoagulation therapy (LMWH). Aggressive fluid resuscitation was started, including extensive transfusion of packed red blood cells and fresh frozen plasma, along with continuous vasopressor therapy to stabilize hemodynamics. Additionally, LMWH was antagonized with 2500 units of protamine following confirmation of prolonged thrombin time, indicating active heparinization. Angiography revealed an aberrant right radial artery originating from the right axillary artery as the source of bleeding (**Figure 2**). The artery was embolized

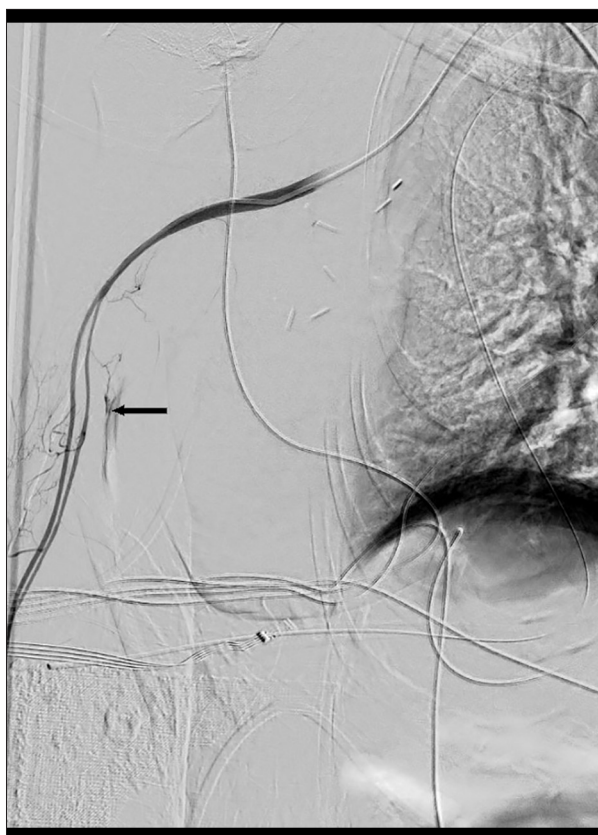


Figure 2. Extravasation of contrast from a branch of the aberrant radial artery originating from the axillary artery (arrow).



Figure 3. Results after successful coiling of the artery (arrow showing the coil and the absence of residual bleeding).



Figure 4. Normal pathway of the ulnar artery, confirming appropriate perfusion of the hand with preservation of palmar arch (arrow showing ulnar artery).

successfully (**Figure 3**) after confirmation of adequate perfusion of the hand via opacification of the ulnar artery and palmar arch (**Figure 4**).

Following the intervention, her hemodynamic status stabilized. During her ICU stay, she developed Kidney Disease Improving Global Outcome (KDIGO) 3 acute kidney injury without the need of renal replacement therapy. Over the next days, she gradually regained consciousness, allowing extubation. She remained closely monitored with hourly Doppler imaging of her ulnar artery and did not develop any ischemic complications of her right hand. She died 2 weeks later from hospital-acquired pneumonia, a complication related to major weakness resulting from her ICU stay and primary neurological impairment.

Further detailed anamnesis from the nurses who witnessed the fall revealed that the patient had fallen on her face and was assisted back into bed by the nursing staff, who lifted her by supporting her under the arms.

Discussion

This case underscores the complexity of managing hemorrhagic shock in patients with multiple comorbidities, including a history of cancer, lung transplantation, and anticoagulation therapy. The presence of an aberrant radial artery originating

from the axillary artery adds a layer of complexity to both the diagnosis process and therapeutic approach.

The diagnostic process was particularly challenging due to the patient's history of axillary lymph node dissection, which resulted in a significant chronic bilateral lymphedema masking the development of the hematoma, and subsequently its detection by a thorough physical examination.

It is likely that the cause of the arterial injury was linked to the mechanical stress exerted when the nurses assisted the patient back into bed by holding her under the armpits. This blunt trauma, while seemingly minor, caused continued bleeding given the therapeutic anticoagulation, ultimately leading to hemorrhagic shock. This highlights the potential risks associated with patient handling techniques, particularly in individuals with altered vascular anatomy and/or on anticoagulation therapy.

The disproportionate severity of the bleeding following what appeared to be a minor trauma could be explained by the long-term use of corticosteroid therapy required by the lung transplant. It likely contributed to the fragility of the blood vessels, since corticosteroids are known to weaken vascular integrity [6,7] by impairing collagen synthesis and reducing the strength of the vessel walls [8-10]. Another explanation for this would be the prior axillary lymph node dissection associated with radiotherapy thinning the layer of soft tissue in the axillary regions, leading to more exposure of the axillary vessels [11]. These factors further exacerbated the risk of bleeding in this patient, complicating her clinical management.

An additional challenge in this case was the atypical presentation of the hemorrhagic shock in our patient, which initially manifested by neurological symptoms, including dizziness, hypomnesia, and, eventually, altered mental status. This unusual presentation diverted clinical attention toward neurological causes, delaying the recognition of hemorrhagic shock as the underlying issue. The fixed mydriasis observed in our patient was probably due to the action of high-dose ketamine (3 mg/kg) used for rapid sequence intubation, as rocuronium usually preserves brainstem reflexes [12]. A mouse study [13] showed that ketamine can decrease activation of pupillary dilation to light. Additionally, a case report by Vide et al found decreased pupillary response to light in a woman undergoing general anesthesia. A possible explanation for this is that ketamine antagonizes N-methyl-D-aspartate receptors in the pupillary reflexes pathway [14].

Finally, the foremost pitfall in this case was the atypical location of the bleeding, which originated from an aberrant radial artery arising from the axillary artery. Injuries to the axillary artery are rare [3], and most (90%) axillary artery lesions

result from a penetrating lesion [3,5]. Injuries resulting from blunt trauma are even less common (5-8% of all injuries) [15]. Studies on penetrating trauma emphasize a surgical approach that involves open repair (OR) using vein or synthetic grafts. Surgical exposure of the axillary artery may necessitate dissection through the pectoralis muscle, followed by its reattachment, potentially adding technical complexity in a trauma setting [16]. As an alternative to surgery, some other studies suggest that interventional radiology (IR) could be beneficial in selected cases, with similar efficacy [17,18] in terms of patency, infection, and vascular complications, particularly in blunt trauma [5,19]. Indeed, IR can effectively control hemorrhage through embolization or stenting of the culprit artery [4]. A crucial consideration when performing embolization of arteries in the upper limb is to ensure adequate hand perfusion to prevent ischemic complications [5,20]. Otherwise, embolization of terminal arteries is formally contra-indicated [9]. The Allen test [21] (or Allen maneuver) ensures the integrity of the palmar arch and that the ulnar artery can adequately compensate for the loss of flow from the radial artery. Another alternative to embolization is placement of a covered stent [4] into the injured artery, although the subclavian-axillary junction is located in a high-mobility joint, which may lead to stent kinking or displacement, eventually limiting the long-term effectiveness of the repair [3,20,22,23]. Recent studies have shown reduced morbidity, ICU stay, and hospital stay associated with endovascular repair (stenting) for subclavian-axillary artery trauma [5,24]. Kim et al showed that endovascular repair can be superior to a surgical approach [25], but a surgical approach might still be necessary in regions of high mobility and flexibility, especially if access for OR is easy.

Finally, the decision to pursue IR or OR is influenced by factors such as anatomical region (surgical accessibility [16,19,20,25] and/or high-mobility areas [20,22,23]), the feasibility of embolization while preserving distal perfusion [19,20], and the type of trauma (blunt or penetrating) [5,20], size of vessel, and type of injury [20]. This decision should be made through a multidisciplinary approach involving radiologists, ICU physicians, orthopedists, and vascular surgeons.

To the best of our knowledge, this is the first reported case of hemorrhagic shock resulting from a lesion on an aberrant radial artery originating from the axillary artery. In our case, injecting contrast into the hand during the angiographic study replaced the Allen's test and provided a visual confirmation of adequate collateral circulation. If the palmar arch could not have been preserved during IR, surgical repair or bypass should have been discussed. In our patient, the decision to pursue IR over surgical repair was influenced by the mechanism of injury, long-term use of corticosteroid therapy, the thin diameter of the vessel, and the massive lymphedema, complicating the surgical approach.

Conclusions

Severe hemorrhagic shock can have unusual presentations, such as initial coma. In addition, the physician must always be vigilant in adapting their diagnosis to new findings. This case report further demonstrates the critical importance of a coordinated approach involving intensive care, radiology, and surgical teams in the management of hemorrhagic complications in a high-risk patient. It also highlights the need for increased vigilance in patients with aberrant vascular anatomy and the benefits of early interventional radiology to achieve hemostasis.

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Patient Consent

The patient's family gave full consent for publication of this report.

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