Treatment of Iatrogenic Pseudoaneurysm of the Brachial Artery: Case Report and Literature Review

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Abstract: Iatrogenic pseudoaneurysms of the brachial artery are emergent complications. Rare in the past, their incidence has recently increased due to the evolution and wide diffusion of endovascular interventions. Many treatment options are now available that they take into consideration the size, location, and pathogenesis of the iatrogenic pseudoaneurysm. Herein, we report the case of a belatedly diagnosed false aneurysm of the brachial artery in an 89-year-old patient, following an accidental arterial injury during venipuncture for blood tests. A comprehensive review of the literature was performed in order to elucidate incidence, clinical details, and the results of conventional open or endovascular repair, and minimally invasive treatment options for this emergent disease.

Key words: pseudoaneurysm, false aneurysm, brachial artery pseudoaneurysm

Pseudoaneurysms, or false aneurysms, are pulsatile masses, consisting of an anomalous communication between a ruptured vessel and the surrounding soft tissues, encircled by a fibrous capsule.1,2

Anecdotally, the rate of iatrogenic pseudoaneurysms has increased because of the widespread use of endovascular peripheral arterial procedures. Arterial catheterization during arterial blood gas analysis or invasive monitoring, endovascular diagnostics, therapeutic procedures, and unsuccessful puncture of hemodialysis vascular access are the most common causes of iatrogenic injury at this site. Pseudoaneurysms of the brachial artery after venipuncture are described in pediatric patients, but they remain extremely rare in the adult population. Pseudoaneurysms of the brachial artery mostly occur in the vessels of lower limbs.2 Even though brachial artery access seems to be less invasive, it is still burdened by pseudoaneurysm formation and other complications, such as arteriovenous fistulas and nerve injuries.3

Even if uncommon, the slow development of pseudoaneurysms can lead to a delayed diagnosis and possible serious complications. In fact, at every access site, pseudoaneurysms can evolve into rupture and hemorrhage, neurological deficits by compression, or local skin ischemia or infection.4

We report the case of a patient presenting with a pseudoaneurysm of the brachial artery caused by a belatedly diagnosed iatrogenic injury. A literature review from 2000 to 2018 was conducted using Medline using the key words “pseudoaneurysm,” “false aneurysm,” and “brachial artery pseudoaneurysm” in order to determine incidence and currently available treatment techniques. We elected to limit the search to the last 18 years because we postulated that after 2000, the use of brachial artery endovascular approaches was widespread.

Case Report

An 89-year-old Caucasian woman was admitted to the emergency department of our hospital in October 2018 because of a...
painful indurated mass of the right upper limb. Her past medical history was remarkable for a previous ischemic cerebrovascular accident without sequelae, arrhythmia without any medical treatment, hypertension, and scoliosis. Upon physical examination, her vital signs were within the normal range, and the patient complained of pain and function loss of the right upper limb that had progressively worsened in the last 30 days. The patient also presented with a non-pulsatile mass, without murmur or thrill, of about 5 cm maximum diameter at the right cubital fossa. No previous local trauma was described by the patient, except for a venipuncture performed 30 days prior in order to collect peripheral blood for laboratory analysis.

A Doppler ultrasound revealed a brachial artery pseudoaneurysm surrounded by a soft tissue mass with circulating blood flow and thrombus, and the integrity of radial and ulnar arteries and the adjacent venous vessels (Figure 1A-C). An urgent contrast-enhanced computed tomography angiography was eventually performed and revealed a pseudoaneurysm of 5.8 cm maximum diameter at the level of the right brachial artery, 2 cm above the arterial bifurcation with a surrounding hematoma (Figure 1D).

After taking into account clinical signs, symptoms, and imaging findings, the patient was referred for surgical repair. Surgical intervention was performed under locoregional anesthesia, after the placement of a pneumatic tourniquet just below the armpit (Figure 2). The pseudoaneurysm was evacuated, and the right brachial artery was surgically exposed. The dissection of the artery and median nerve was performed. No venous lesions were detected, and hemostasis was easily achieved by 6/0 Prolene stitches at the arterial puncture site.

The patient experienced an uneventful recovery, and she was discharged in good clinical condition on the first postoperative day, with no residual deficit or impairment of her right upper limb (Figure 3). The one-month postoperative ultrasound control confirmed the brachial artery integrity and the complete removal of the pseudoaneurysm (Figure 4).

**DISCUSSION**

Brachial artery pseudoaneurysms are rare diseases represented by a contained arterial rupture. Their etiology can be linked to various congenital conditions (Ehlers-Danlos syndrome, Kawasaki disease, polyarthritis nodosa, Behçet disease, osteochondromas, and Menkes disease) or to post-traumatic causes (as a consequence of arterial injuries in bone fractures or joint dislocation, drug abuse, and penetrating stab wounds).2 4

A review of the literature from 2000 to 2018 undertaken on PubMed showed that in the past, overall incidence of brachial artery pseudoaneurysms was about 0.04%.5 As a result of the broad diffusion of endovascular techniques, more recent papers report an increase in their iatrogenic incidence ranging from 0.3% to

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**Figure 2.** The surgical repair of the brachial artery pseudoaneurysm was performed under locoregional anesthesia, after the placement of a pneumatic tourniquet just below the armpit. The pseudoaneurysm was evacuated, the right brachial artery was surgically exposed, and hemostasis was easily achieved by 6/0 Prolene stitches.

**Figure 3.** Postoperative surgical scar. The patient experienced an uneventful recovery and was discharged on the first postoperative day in good clinical condition. There was no residual deficit or impairment.

**Figure 4.** The one-month postoperative Doppler ultrasound shows the complete removal of the pseudoaneurysm, and the brachial artery and vein integrity.
0.7%, according to different series and depending on the site of access, type of procedure, size of the sheath used, patient risk factors, and the operator’s experience.3,6

Pseudoaneurysms are more often detected in the vessels of the lower limbs, with a less than 2% overall risk of major complications. The development of arterial pseudoaneurysms mostly occurs as a result of technical failure from a faulty puncture technique, the use of a large size sheath (>7 French), a long procedure time, and/or a brief manual compression or difficulty with compressing the puncture site after sheath removal.7,8

Conversely, the risk of complications from upper extremity artery catheterization seems to be higher (2% to 24%) because of the smaller caliber of axillary or brachial arteries, and the difficulty in compressing the puncture site as a result of suboptimal bony support at this level.3,7 Brachial artery pseudoaneurysms are predominantly an iatrogenic complication after vascular procedures or bone fractures, and the risk of their development is increased by some comorbidities and conditions such as obesity, heavily calcified arteries in diabetes mellitus or hemodialysis for renal failure, hypertension, anticoagulation, and antiplatelet therapies.

Ultrasound guidance for arterial cannulation has been shown to be advantageous compared with palpation technique, particularly for cannulation of deep and small caliber vessels, in obese patients, and in patients receiving anticoagulation, where success at first attempt is fundamental. In fact, the use of ultrasound guidance enables the operator to directly identify the needle puncture and visualize the artery and its luminal atherosclerotic or calcified plaques.

The degree of operator experience significantly influences complication rates, but overall, ultrasound use reduces the number of access attempts, and avoids or at least limits local hematoma and traumatic complications resulting from accidental puncture of adjacent veins and nerves.

Data regarding use of ultrasound at the brachial site are poorly reported in literature, so the exact rate of lesions of adjacent structures and neurological compromise is not yet understood. At the femoral site though, the overall complication rate, arteriovenous fistula formation, and pain levels are significantly lower with this approach.8,9

Our case displays the consequences of a brachial artery injury following a venipuncture that is an extremely uncommon iatrogenic cause for the formation of brachial artery pseudoaneurysms. It is often described in the pediatric population, but it remains rare in adults, and, to our knowledge, no other cases are reported in literature.

Usually brachial artery pseudoaneurysms grow slowly, as in the present case, in which delayed diagnosis led to the development of a large and symptomatic pseudoaneurysm. Generally, upon physical examination, a palpable pulsatile mass in a patient experiencing pain or limb swelling, neuropathy or limb claudication, venous thrombosis, local skin ischemia or necrosis, and infection, invites clinical suspicion. Diagnosis can be confirmed by arterial Doppler ultrasonography, contrast-enhanced computed tomography angiography, and contrasted magnetic resonance imaging (MRI).1,2 Ultrasound guidance enables the operator to directly identify the needle puncture and visualize the artery and its luminal atherosclerotic or calcified plaques.

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Table 1: Treatment Options According to Clinical Aspects and Anatomical Features of Arterial Pseudoaneurysms

<table>
<thead>
<tr>
<th>Clinical observation/manual compression/compression device/ultrasound compression</th>
<th>Percutaneous thrombin injection under ultrasound guidance</th>
<th>Endovascular stent graft/coils embolization</th>
<th>Surgical repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small pseudoaneurysm (&lt;1.8 cm - 2.0 cm)</td>
<td>Small pseudoaneurysm (&lt;1.8 cm - 2.0 cm)</td>
<td>Small, distal pseudoaneurysms</td>
<td>Large size (&gt;2 cm) without tract</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>No prior exposure to bovine thrombin</td>
<td>Sufficient collateral circulation</td>
<td>Infected pseudoaneurysm</td>
</tr>
<tr>
<td>No concomitant anticoagulation or antiplatelet medications</td>
<td>Failure of initial conservative measures</td>
<td>Suitable anatomy</td>
<td>Rapid expansion or compressive syndrome (neuropathy, limb impairment or claudication, critical limb ischemia, venous thrombosis, skin necrosis)</td>
</tr>
<tr>
<td>Presence of a tract</td>
<td></td>
<td></td>
<td>Failure of other therapies</td>
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Many different techniques have been described in the management of this emergent disease. In principle, the size, location, and pathogenesis of pseudoaneurysms should be considered for making management decisions (Table 1). Normally, in the absence of severe pain, impairment, or local complications, the clinical observation alone of small pseudoaneurysms (< 1.8 cm - 2.0 cm) is reasonable, because they might thrombose spontaneously. Concomitant anticoagulation or antiplatelet medications can lead to a failure in conservative treatment.11,12

Small pseudoaneurysms (<2 cm) can be managed by manual compression, Femostop (Abbott) devices, ultrasound-guided compression by transducer (successful obliteration in 75% to 85% of cases)5,10,13 or percutaneous thrombin injection under ultrasound guidance. This technique consists of using real-time ultrasound to guide 21- to 22-gauge needle insertion into the pseudoaneurysm sac in order to inject bovine thrombin (100 – 1000 units/mL) into the lesion over a 5- to 10-second time frame. Clot formation is monitored with color Doppler, and successful treatment of the pseudoaneurysm is achieved in up to 90% of cases.14-19 Despite the excellent results, it should be considered that this technique can lead to complications such as distal embolization, anaphylaxis, abscess formation, and pseudoaneurysm rupture.16-20
If collateral circulation is sufficient, endovascular techniques have also been described in treatment of small, distal pseudoaneurysms, by stent-graft implantation or embolization by coil insertion (success rate, 88.3%) or fibrin glues. Nevertheless, open surgery should be always performed in rapidly expanding or infected pseudoaneurysms, large hematomas with impending compartment syndrome, limb or skin ischemia, neuropathy caused by local compression or in case of unsuitable anatomy, and in failure of percutaneous treatment. Normally, a single small pseudoaneurysm can be ligated, but surgical removal and arterial reconstruction by end-to-end anastomosis, or venous or prosthetic interposition graft is the gold-standard treatment.

In Table 1, we have reported a summary of all treatment options according to the type of lesion detected, and take into consideration clinical presentation and anatomical features.

In the case herein, we referred our patient to open surgical repair due to the rapid expansion of the pseudoaneurysm, which caused compression of the brachial artery and led to the functional impairment of the upper right limb. We also made this recommendation as a result of the absence of a tract with a brachial artery pseudoaneurysm chamber directly connected to the brachial artery. In addition, the site of the lesion at the joint level was not eligible for an endovascular repair, after taking into consideration the risk of degradation and folding with consequent thrombosis of a stent placed at this level.

Instead, open surgical evacuation of the pseudoaneurysm and hematoma led to the immediate decompression of adjacent structures, to the easy and efficacious repair of vascular damage, and to rapid pain relief.

Despite the infrequency of brachial artery pseudoaneurysms, it is worth considering attentively monitoring patients undergoing invasive procedures in the hospital setting in order to guarantee a prompt diagnosis of this type of lesion, and avoid misdiagnosis or mismanagement. Pseudoaneurysms can evolve into conditions such as hemorrhagic rupture (the risk is related to size > 3 cm, symptoms, and large hematoma and continued growth of the sac), compression of the nerves and venous system, edema formation, reduction in radial and ulnar perfusion, or local skin necrosis from the enlargement of the lesion.

Although most post-catheterization pseudoaneurysms are sterile, infection significantly increases the risk of rupture as well as the risk of developing septic emboli. Our patient had received a delayed diagnosis, but she did not experience any complications in the short- and mid-term follow-up. Nevertheless, patients should be carefully informed about the possibility of the late occurrence of a brachial artery pseudoaneurysm. Enhanced patient education will enable patients to report symptoms to their treating physician and facilitate rapid and appropriate treatment of delayed presentations of iatrogenic brachial artery pseudoaneurysms.

**CONCLUSIONS**

The incidence of brachial artery pseudoaneurysms is increasing rapidly due to the widespread use of endovascular techniques and arterial catheterization. Knowledge of this type of complication is essential not only to physicians and health care professionals, but also to patients themselves, in order to avoid delayed diagnosis. Surgical repair is associated with good early- and mid-term results. Surgery is rarely necessary but is indicated in patients who exhibit rapid expansion, infection, or compression syndrome, or in the case of the failure of minimally invasive management.

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