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A rare case of median nerve intraneural hematoma after stenting of right iliac artery: a case report

Rijedak slučaj intraneuralnog hematoma medijanog živca nakon stentiranja desne ilijačne arterije: prikaz slučaja

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Abstract. ***Aim:*** Brachial artery access is an alternative approach to endovascular interventions when access to the femoral, radial, or ulnar arteries is not feasible, but it carries higher risk of periprocedural complications than other approaches, including median nerve injury. Nerve injuries can occur by direct puncture or by compression, with hematoma being the most common cause. Sometimes the compartment syndrome can accompany the direct nerve injury, masking the signs of a nerve dysfunction. ***Case report:*** We present a patient with a false aneurysm of brachial artery, surrounding soft tissue hematoma with volar arm and forearm compartment syndrome and a simultaneous median nerve intraneural hematoma caused by a direct punction. The combination of injuries occurred after brachial artery access for endovascular treatment of bilateral iliac artery steno-occlusive disease. The patient was successfully treated by fasciotomy, arterial sutures, and nerve decompression via paraneuriotomy. ***Conclusions:*** Intraneural hematoma caused by direct puncture can be masked by concomitant compartment syndrome. Emphasis should be put on prevention, early recognition, and timely surgical treatment of intraneural hematomas, especially those accompanied by fascial compartment syndrome after endovascular interventions.

Key words: aneurysm, false; brachial artery; compartment syndromes; hematoma; median nerve

Sažetak. ***Cilj:*** Pristup brahijalnoj arteriji alternativni je pristup endovaskularnim intervencijama kada pristup femoralnoj, radijalnoj ili ulnarnoj arteriji nije izvediv, ali nosi veći rizik od periproceduralnih komplikacija nego drugi pristupi, što uključuje i ozljede medijanog živca. Ozljede živca mogu nastati izravnom punkcijom ili kompresijom, pri čemu je najčešći uzrok hematom. Ponekad sindrom mišićnih odjeljaka može pratiti izravnu ozljedu živca, prikrivajući znakove živčane lezije. ***Prikaz slučaja:*** Predstavljamo bolesnicu s lažnom aneurizmom brahijalne arterije, okolnim hematomom mekih tkiva, sindromom volarnog mišićnog odjeljka nadlaktice i podlaktice te s istodobnim intraneuralnim hematomom medijalnog živca koji je bio uzrokovan izravnom punkcijom. Ove udružene ozljede nastale su nakon punkcije brahijalne arterije u sklopu endovaskularnog liječenja bilateralne stenookluzivne bolesti ilijačne arterije. Pacijentica je bila uspješno liječena fasciotomijom, izravnim šavom arterije i dekompresijom živca (paraneuriotomijom). ***Zaključci:*** Intraneuralni hematom uzrokovan izravnom punkcijom može biti prikriven znakovima pratećeg sindroma mišićnih odjeljaka. Stoga treba staviti naglasak na prevenciju, rano prepoznavanje i pravodobno kirurško liječenje intraneuralnih hematoma, osobito onih popraćenih sindromom mišićnog odjeljka nakon endovaskularnih intervencija.

Ključne riječi: brahijalna arterija; hematom; lažna aneurizma; medijani živac; sindrom mišićnih odjeljaka

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INTRODUCTION

Brachial or axillary artery access are alternative approaches to endovascular interventions when access to the femoral, radial, or ulnar arteries is not feasible. However, the combined risk of neurologic complications with these approaches is higher (9%) than with access to the femoral artery (0.04%)[1]. Moreover, brachial artery access may particularly be complicated by transient or permanent median nerve dysfunction. An atraumatic technique and precise hemostasis are therefore crucial to safely use the brachial artery approach and minimize the number of complications[2, 3]. Nerve injuries can occur by direct puncture or by compression, either intrinsic (compartment syndrome, hematoma, or a false aneurysm) or extrinsic (manual or device-based), with hematoma being the most common cause[3, 4]. According to de Ruiter et al., intraneural hematomas can be classified into subparaneurial, subepineurial, intrafascicular, and multicompartmental, depending on the affected layers of peripheral nerves[4]. Apart from inadvertent puncture during brachial artery access, nerve injury can occur even as a complication of peripheral cubital venous access[5]. As opposed to direct puncture, compression[6] may result in apparently intact nerve on the outside, with disruption that is evident only upon opening the outer nerve layers, and severity of nerve injury is not proportional to the size of hematoma. A rare cause of nerve injury is distension[7], and even spontaneously occurring hematomas[8] have been sporadically described. Sometimes the compartment syndrome can accompany the direct nerve injury, being caused by the same iatrogenic trauma. In these cases, the direct nerve injury may be masked by signs of compartment syndrome.

Proper interventional technique, ultrasound guidance, as well as appropriate usage of vascular compression and closure devices can reduce the number of inadvertent punctions and neurologic and other complications after endovascular interventions.

Here we present a case of a patient with a false aneurysm of brachial artery, surrounding soft tissue hematoma with volar arm and forearm compartment syndrome and a simultaneous median nerve subparaneurial hematoma after brachial artery access for endovascular treatment of bilateral iliac artery steno-occlusive disease.

CASE REPORT

A 66-year-old female patient was admitted to the Department of Cardiovascular Diseases for an arranged endovascular intervention on iliac arteries, due to intermittent claudications with severely restricted walking distance. The patient was referred to us from a regional hospital after the multidetector computed tomography angiography (MDCTA) had shown near-occlusion of the right common iliac artery, occlusion of the left external iliac artery and bilateral multiple stenoses of the superficial femoral arteries.

The patient's past medical history revealed arterial hypertension, diabetes mellitus, hyperlipoproteinemia and asthma. She was also a heavy smoker (52 pack-years). The patient's main complaint was a progressive shortening of walking distance with cramping pains in the buttocks and legs after 30-40 meters of walking distance. Occasionally, she felt tingling sensations and feet coldness. Upon admission, the patient's previous therapy was continued, including acetylsalicylic acid, metformin, gliclazide, montelukast, lisinopril, bisoprolol, simvastatin and fluticasone-salmeterol inhaler. Dual antiplatelet therapy was started one day before the endovascular procedure, by introducing clopidogrel.

The physical examination revealed high blood pressure (170/75 mmHg), heart rate of 66 beats per minute, attenuated pulsations of femoral arteries, and bilateral absence of distal pulsations. Laboratory findings at admission included leucocyte count 9.0 $\times 10^9$/L, thrombocyte count 268 $\times 10^9$/L, hemoglobin 144 g/L, urea 4.9 mmol/L, creatinine 78 µmol/L, sodium 144 mmol/L, potassium 3.8 mmol/L and prothrombin time 0.93. The ankle-brachial index was 0.21 on the right and 0.14 on the left side, with severely reduced blood flow from iliofemoral segments as detected by plethysmography. Electrocardiogram

demonstrated sinus rhythm without signs of myocardial ischemia.

Percutaneous transluminal angioplasty (PTA) of iliac arteries was performed using the left brachial artery approach. Arterial puncture was performed using the „first layer" approach and Seldinger's technique with a 7 cm long angiographic puncture needle (18 G), and manual fixation of the brachial artery against the humerus and surrounding muscles. The puncture was not performed under ultrasound guidance, due to the unavailability of the device in the intervention room, and prominent and easily palpable arterial pulsations. Therefore, as well as due to the mobility of the brachial artery despite manual fixation, four puncture attempts had to be performed. A 6F, 90 cm long introducer guide was used, which provided a safe working channel for a successful diagnostic and intervention procedure. For the precise stent placement, a road map technique on a DSA imaging device was used before the stent shaft filled the working channel. The recanalization of the left external iliac artery, with the implantation of a self-expandable stent, was done first; followed by a dilatation of the right external iliac artery, with the implantation of a balloon-expandable stent. A bolus of heparin (5000 IU) was given during the PTA. The puncture site was manually compressed and compression bandaging was applied. Shortly afterwards, the patient reported pain, numbness, and tingling, radiating from the left brachial region to the fingers of the left hand. Physical examination revealed a huge, indurated hematoma on the volar aspect of the left upper arm, including proximal half of the forearm, with non-pitting oedema and tightness in the aforementioned areas. Neurological deficit included anesthesia from the thumb to the radial aspect of the ring finger, as well as the loss of hand grip strength. A Duplex ultrasound identified hematoma and a false aneurysm of the brachial artery. MDCTA demonstrated active extravasation from the puncture site in the distal third of the brachial artery, forming a spindle-shaped false aneurysm with a diameter of 30 x 14 mm and a longitudinal protrusion of contrast extending cranially, parallel to the brachial artery (Figure 1). The patient

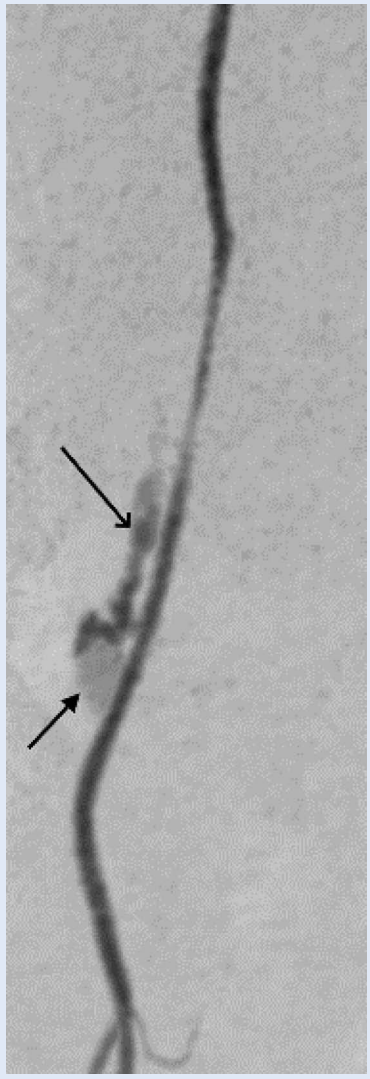

Figure 1. MDCTA, multiplanar reconstruction, demonstrating a spindle-shaped false aneurysm of the brachial artery (filled arrow) and a longitudinal contrast protrusion (open arrow) extending cranially, parallel to the brachial artery.

was immediately transferred to the Department of Vascular Surgery where she underwent urgent surgical exploration by incision over the medial bicipital sulcus, opening the medial brachial compartment and extending via the "lazy-S" incision in the cubital fossa further distally into standard volar forearm fasciotomy.

After establishing proximal and distal vascular control, a hematoma, permeating subcutaneous tissues and muscles of the front upper arm compartment, and a laceration of the brachial artery in the distal upper arm, were identified. A subparaneurial hematoma alongside the median

nerve in the upper arm was also evident (Figure 2), that corresponded to the longitudinal protrusion of the extravasated contrast demonstrated previously on the MDCTA. The arterial laceration was taken care of with two lateral sutures, followed by the evacuation of the free part of the soft tissue hematoma, while the median nerve was decompressed by longitudinal paraneuriotomy and evacuation of subparaneurial hematoma (Figure 3). Lacertus fibrosus was further resected, extending the incision into a volar forearm fasciotomy, where muscles, partially permeated with livid spots, and the patent radial artery, were identified. The operation was concluded with loose skin sutures, two contact drains and immobilization of the upper and the lower arm.

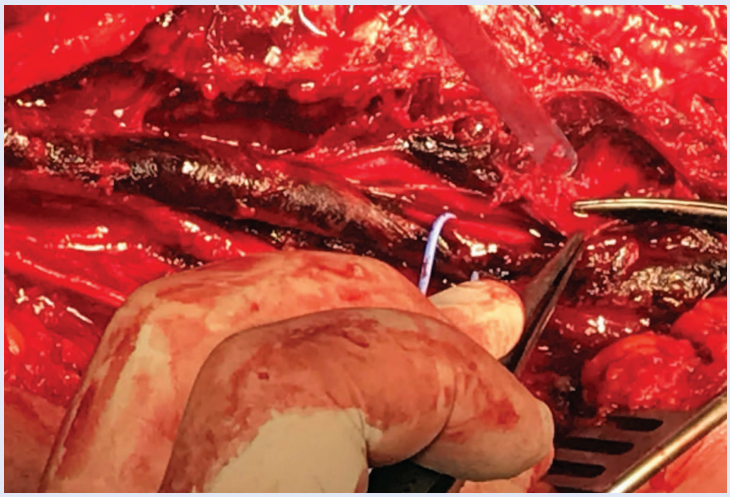

Figure 2. Punctiform lesion of the brachial artery with active extravasation, after evacuation of hematoma (above the scissors' tip). Median nerve with subparaneurial hemathoma (secured by a loop).

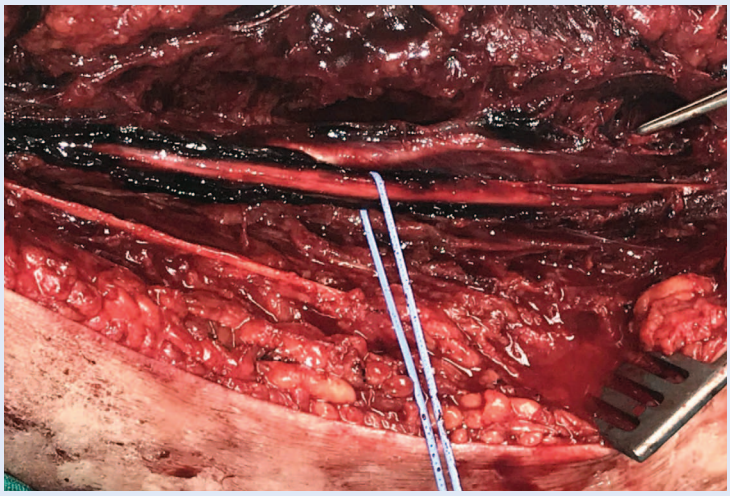

Figure 3. Median nerve after decompression by longitudinal paraneuriotomy (secured by a loop) and brachial artery (above), repaired by lateral sutures.

Postoperatively, a complete resolution of neurological deficit ensued, with swift regression of sensory loss and muscle weakness. A small patch of skin underwent necrosis, which was sequentially debrided, and the defect ultimately healed by secondary intention.

DISCUSSION

Intraneural hematomas of peripheral nerves can rarely be encountered after an endovascular intervention, vein puncture, or even electromioneurography[1, 9]. However, due to the increasingly frequent brachial access for endovascular procedures, the median nerve has become more frequently affected, usually by an inadvertent needle puncture, more so in anticoagulated patients. De Ruiter et al.[4] recommend surgical decompression of subparaneurial and subepineurial hematomas by paraneuriotomy or epineuriotomy. However, they advise against perineuriotomy of intrafascicular hematomas, due to their diffuse nature and the risk of further iatrogenic nerve injuries, recommending external decompression as a first option. For the same reasons, they also do not recommend ultrasound-guided percutaneous thin needle aspiration (FNA), although some authors report success using this technique[7]. In our patient however, intraneural hematoma of the median nerve was discovered intraoperatively, due to a false aneurysm of the brachial artery and a forearm and the upper arm compartment syndrome, which necessitated urgent surgical exploration, fasciotomy, and brachial artery repair, so the nerve lesion was addressed together with the other accompanying injuries.

The acute setting and a simultaneous vessel injury with compartment syndrome thus warranted immediate surgical exploration and facilitated discovery of the intraneural hematoma. However, if not coupled with additional injuries, epineural hematomas can initially have more subtle presentation, and may cause a progressive deterioration of the nerve function, requiring microsurgical neurolysis, nerve transfer or even transplantation, if neglected[10, 11]. Conversely, if an intraneural hematoma is associated with muscle

compartment syndrome, its clinical presentation can be masked by rapidly evolving signs and symptoms of muscle compartment syndrome. This fact and the rare occurrence of the condition were the reasons why the MDCTA evidence of longitudinal protrusion extending cranially from the site of extravasation and in parallel with the brachial artery did not raise the suspicion of intraneural hematoma by itself.

In doubtful cases, apart from tissue pressure measurements to exclude compartment syndrome, a high resolution ultrasound[7, 12, 13] or magnetic resonance imaging[14] can be used to confirm and classify peripheral nerve lesions.

To prevent disabling complications[10], the interventionist should therefore respect the anatomy, closely adhere to the instructions for usage, choose the most appropriate arterial access site and prefer the non-dominant arm[1, 15]. Due to intimate relationship of brachial artery with median nerve, and the propensity for higher incidence of complications using brachial approach in comparison to others, a radial approach should therefore be preferred instead. Whenever possible, anticoagulation therapy should be discontinued prior to the procedure.

The main reason for median nerve hemathoma, associated with brachial artery pseudoaneurysm and compartment syndrome in our patient, lies in the mobility of the brachial artery during puncture with an 18G angiographic puncture needle without ultrasound guidance.

We, therefore, emphasize that ultrasound guidance should be employed whenever possible, even in presence of readily palpable arterial pulsations, as it is known to reduce complications, which is also substantiated by recent studies[16]. Judicious usage of vascular closure and compression devices should also be considered[1, 17]. The patient should be closely monitored on the ward after endovascular interventions and medical personnel should be trained with low threshold for recognizing these complications, to prevent irreparable neurologic deficit.

CONCLUSIONS

In patients with acute fascial compartment syndrome after endovascular interventions, a special emphasis should be put on recognizing direct nerve injury, as it can be neglected on fasciotomy, due to the dominance of signs and symptoms caused by increase in compartmental pressure. We therefore suggest to always explore the compartmental nerves after fasciotomy which was warranted due to compartment syndrome after arterial punctures and catheterizations, to prevent neglecting intraneural hematomas.

Emphasis should be on prevention end early recognition and treatment of neurologic complications after endovascular interventions. Compartmental nerves should always be explored after fasciotomy which was warranted due to compartment syndrome after arterial punctures and catheterizations, to prevent neglecting intraneural hematomas.

To reduce the rate of neurologic and other complications after endovascular interventions, a meticulous interventional technique should be used, accompanied by ultrasound guidance whenever possible, as it reduces the number of inadvertent punctions and lesions of surrounding structures. An appropriate usage of vascular compression and closure devices is also recommended.

Although novel therapeutic options, including stem cell and growth factor therapies, as well as pharmacological agents have been steadily improving, a promising improvement of the nerve function in patients with developed traumatic neuropathy[18-20], the golden rule “better safe than sorry” still applies, giving emphasis to prevention of complications, as well as early nerve decompression when indicated, as it prevents further damage after nerve injuries and yields better results.

Conflicts of Interest: Authors declare no conflicts of interest.

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