DOI 10.4149/BLL_2024_64

Bratisl Med J 2024; 125 (7):
419–422

CLINICAL STUDY

Compression syndrome of distal peripheral aneurysms of the upper limb

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ABSTRACT
True aneurysm of the radial artery is very rare. Aneurysmal expansion of arteries due to degenerative changes, possibly infections, primarily affects the abdominal and thoracic aorta, intra and extracranial sections of cerebral arteries, popliteal artery, and visceral arteries. Published literature does not address the aneurysm on the distal sections of the arteries of upper or lower limb. Unlike the classic symptoms of aneurysmally altered arteries such as rupture, thrombosis and embolization, we encounter more often vascular compression syndrome in distal peripheral aneurysms. We demonstrate the case management of a patient with over 20 years increasing wrist resistance. A fusiform aneurysm of the distal section of the radial artery was identified by sonography. Under general anesthesia, we performed aneurysm resection and artery reconstruction using an interpositum from the ipsilateral cephalic vein. The histological examination of the resected tissue confirmed the presence of all three layers of the vascular wall, confirming the true aneurysm of the radial artery. No complications developed in the patient in the postoperative period and all problems related to the aneurysm subsided *(Fig. 4, Ref. 23)*. Text in PDF www.elis.sk
KEY WORDS: aneurysm, arteria radialis, surgical reconstruction.

Introduction

Expansion of the radial artery (hereafter *a. radialis*) aneurysm occurs in two forms: as a pseudoaneurysm (PSA) and as a true aneurysm. The formation of PSA is related to iatrogenic or traumatic damage to the artery and is more common than a true aneurysm (1, 2). The clinical picture is dominated by the presence of palpable hyperpulsation in the wrist area, mainly due to the superficial location of the artery, a feeling of numbness and tingling, and limitation of wrist mobility (2). Compression of surrounding structures, especially nerve structures, occurs here more often than in other locations. Possible complications are a peripheral embolization with signs of digital ischemia and a rupture that does not lead to a hemorrhagic shock. The diagnostic method of choice is a sonographic examination of the *a. radialis*, as well as *a. ulnaris,* in all circumstances (3). The treatment method of choice is a surgical intervention, for which there is no 'cut-off' parameter of vessel diameter. It is recommended to perform an intervention for each newly identified radial artery aneurysm. The available surgical treatments are the following: a simple ligature, with necessarily verified preserved patency of the *a. ulnaris*, exclusion and direct end-to-end anastomosis or resection with complex reconstruction (4, 5, 6).

This case report demonstrates the surgical *a. radialis* aneurysm resection and artery reconstruction.

Case report

A female patient was sent to our outpatient clinic by a surgeon for numbness in her left upper limb and increasing resistance on the palmar side of her left wrist, which, according to her, limits the wrist movement. In addition, the patient complains of swelling of the hand, especially in the evening. Otherwise, the limb was without sensory or motor deficit. The patient, born in 1953, has no other associated diseases, does not take any medications, has no personal history of injury or endovascular intervention. We performed a sonographic examination that confirmed the finding of an aneurysm of *a. radialis* with the size of 16x11x15 mm (Fig. 1). Spectral recording on *a. radialis* at the point of expansion showed a turbulent flow, the finding on *a. ulnaris* was physiological. The family and personal anamnesis did not confirm the presence of a systemic disease, either inflammatory or of connective tissue. The patient had no confirmed risk factors of a high cardiovascular risk. As part of the sonographic examination, we also performed screening of the abdominal aorta and popliteal arteries with adequate, physiological findings.

Considering the given situation, we decided for a surgical intervention. In a sonographic examination we confirmed the suitability of the cephalic vein graft –diameter 4 mm in the distal section, no

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Fig. 1. Sonographic finding of radial artery aneurysm.

thickening of the vessel wall, with spontaneous, phasic flow, without signs of obstruction – in case the end-to-end anastomosis will not be possible. The great saphenous vein was also examined. Under general anesthesia, we dissected the radial artery above and below the expansion. The artery was in close contact with the surrounding structures, both vascular and nervous. We administered 4,000 units of heparin. After clamping we resected the aneurysm and sent the tissue for histological examination. The aneurysmal sac was empty, with no evidence of thrombotic material. Vascular wall was intact. Due to the impossibility to perform the end-to-end anastomosis, we decided to suture the interpositum using the cephalic vein. The surgery was performed without any complications. We detected patency of the graft with adequate spectral recording on the post-operative sonographic examination. The patient was discharged on the third postoperative day and continued anticoagulant therapy for 14 days. Half a year after surgery was the patient with palpable pulsations on the *a. radialis*, without signs of early thrombosis or PSA formation. The difficulties that the patient described before the operation subsided after the surgery (Fig. 2–4).

Discussion

The radial artery is one of the terminal arteries of the upper limb. It lies on the forearm between *m. brachioradialis* and *m. flexor carpi radialis*. In the dorsal part of the hand, in the space between the heads of *m. interosseus dorsalis primus* it enters the *Guiot's space* and forms *arcus palmaris profundus.* Further it issues the branch *r. palmaris superficialis*, which participates in creating the superficial palmar arch. Another terminal branch (the ulnar artery) forms the basis of the superficial arch (7, 8). Although the ulnar artery is the dominant artery for supplying the hand, it is generally accepted that the ligature of one or the other artery, with simultaneous patency of the other, does not lead to ischemic manifestations in the limb. However, it is necessary to perform the Allen test and spectral sonographic recording before such intervention (9). The term aneurysm comes from the Greek word *aneurusma*, which means expansion. We define it as permanent and irreversible dilation of sections of any artery or vein (10). From a historical point of view, the first case of *a. radialis* aneurysm was described in Great Britain in 1914, while a case series of patients with this disease was presented only in 1958 (eight cases from 1943 to 1957, treated at Mayo Clinic, USA) (3). Similar to other locations, even at the level of the terminal arteries of the upper limb, aneurysms are divided into true and

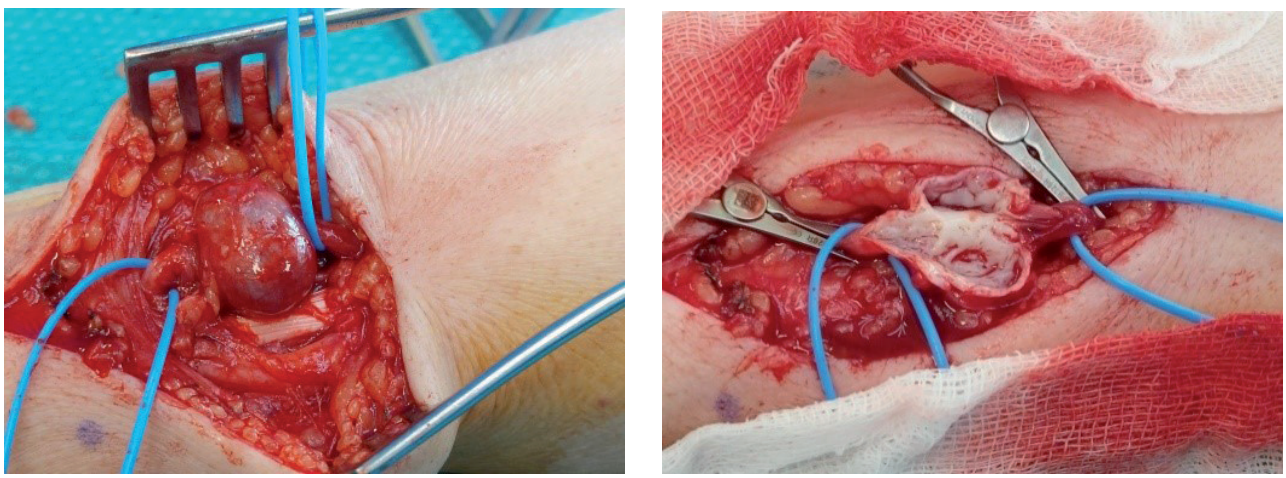

Fig. 2. Perioperative finding of a. radialis aneurysm (left), opening of the aneurysm sac (right).

false – called pseudoaneurysms (PSA). In the case of *a. radialis*, pseudoaneurysms appear more often than true aneurysms and are the result of traumatic or iatrogenic damage to the artery wall. A case of secondary PSA of *a. radialis* infection is also described (11). This occurs most frequently after invasive blood pressure monitoring and after endovascular interventions. PSA formation after catheterization is the most common in the femoral artery (1-3% of interventions), it is rare in the radial artery (0.009% of interventions) (12, 9). The occurrence of a true aneurysm is even less frequent. Only 25 separate cases have been published worldwide (1,13). In general, the formation of a true aneurysm is attributed to degenerative changes. Male, sex, age, hypertension, chronic obstructive pulmonary disease, hyperlipidemia and family history are considered risk factors (14, 13, 15). Pathophysiologic etiology is the disintegration of connective structures, namely elastin and collagen. Elastin is mainly contained in the *tunica media* of the vascular wall, collagen (type I and III) in the *tunica media* and in large quantities in the *tunica adventitia*. Both components can be degraded by specific proteases (15). While the fragmentation of elastic fibers and the decrease of elastin contribute to the early stages of the formation of the expansion, collagen (as the dominant component responsible for the strength of the artery) is, in its deficiency, a key factor in the eventual rupture (16, 4). Elastic and collagen fibers are degraded by proteolytic enzymes, especially matrix metalloproteinases (MMP). The production of proteolytic enzymes is mostly controlled by smooth muscle cells of the media, adventitia fibroblasts and lymphomonocytic infiltrates (17). An equally important role is played by the presence of the thrombus itself. On one hand, it can reduce the wall stress, but, on the other, an increase in its thickness leads to the simultaneous hypoxia of intimal layer and subsequent neovascularization, which promotes inflammatory changes in the vessel wall and creates a vicious circle (18). This general process of aneurysmal formation can also be assumed in true aneurysms of the radial artery. In addition, there are other, specific causes of aneurysm formation, such as connective tissue diseases (Marffan synrome, Ehlers-Danloss syndrome type IV), aneurysms associated with systemic inflammatory disease, or infectious aneurysms (23). The clinical picture of a radial artery aneurysm can vary, from asymptomatic, expressed palpable hyperpulsations and limited wrist mobility to compressive syndrome, mainly from the compression of the median nerve (1, 2). Acute complications include distal embolization and eventual aneurysm rupture. The course of the rupture is only assumed, it is not possible to generalize it due to a very limited number of publications (10). However, hemodynamically, a condition similar to pseudoaneurysm rupture of *a. femoralis* is not expected (10). The basic diagnostic tool is the physical examination, as well as the Allen test (2). The imaging method of choice is the sonographic examination in its entire range (B-mode, color flow doppler, pulsed wave doppler), while again the examination of the ulnar artery is also necessary. Angiographic examination is not essential. Treatment management remains controversial. Most authors recommend surgical intervention when any such aneurysm is found. Among the surgical techniques, simple ligature of the artery in the case of adequate sonographic findings on the ulnar artery, exclusion and simple anastomosis or resection with subsequent reconstruction are considered (6). Endovascular techniques include stent implantation or embolization (6). Scientifics studies describing these endovascular techniques on true aneurysm of *a. radialis* have not been published yet and there is only a minimum of studies on the endovascular solution of PSA available (19). In the case of PSA of *a. radialis*, articles were published on the implementation of the procedure used in PSA of *a. femoralis*. Compression with a sonographic probe for 20 minutes in three patients was unsuccessful. Injection of thrombin under sonographic control was also carried out, and despite a relatively high success rate (86%), the risk of serious complications was also confirmed, especially the thrombosis of the *a. brachialis*, which required urgent surgical intervention (20, 21, 22). Therefore, these methods cannot be used as the first line of PSA of *a. radialis* therapy in the future.

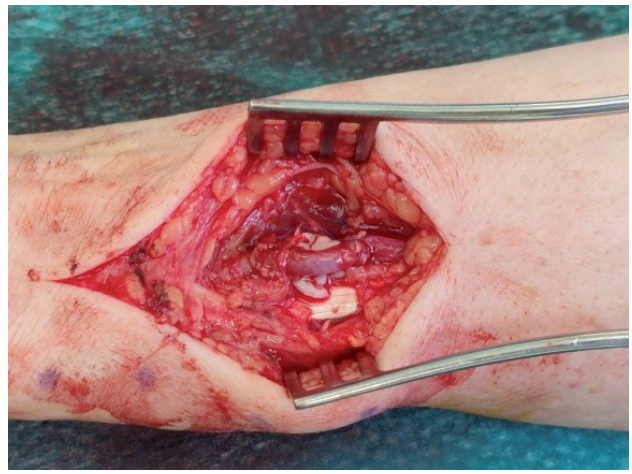

Fig. 3. Perioperative finding, venous interpositum suture.

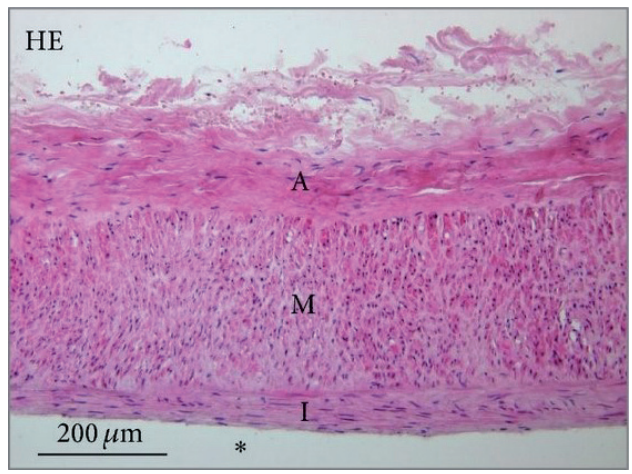

Fig. 4. Histological finding: parts of the vessel wall with all anatomical layers: intima (I), smooth muscle (M) and adventitia (A). Small calcifications are caught in the wall. No sign of inflammation or thrombosis.

Conclusion

Aneurysm of *a. radialis* is a rare disease. Encountering a pseudoaneurysm in clinical practice is more frequent than a true aneurysm, the occurrence of which is documented only in dozens of cases worldwide (6). A pseudoaneurysm develops based on a disintegration of the vessel wall during trauma, but more often in connection with interventions that use the *a. radialis* as an access artery. Although the occurrence of such a complication is unlikely, an increasing incidence can be expected in the future, especially due to the increasing volume of cardiologic interventions (2). Within the aneurysm diagnostics, it is necessary to verify the flow of not only the *a. radialis* but also the *a. ulnaris* and not to rely on the dominance of the *a. ulnaris* in supplying the palmar arch (5). One of the dominant manifestations of the disease is vascular compression syndrome, which reduces the quality of life of patients. Although there are no general recommendations for the treatment of this condition, we propose the method of choice should be surgical intervention, ideally the reconstruction that is preferred to a simple ligature of the artery.. At the same time, most of these surgeries can take place in an elective mode. In the case of finding the true aneurysm, as with other aneurysms, we recommend screening the abdominal aorta and popliteal artery, to check for aneurysms in the family history and to exclude the connective tissue or systemic inflammatory diseases.

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Received December 17, 2023.
Accepted February 12, 2024.