

A High Bifurcation of the Dorsal Branch with Dominant Superficial Palmar Branch of the Radial Artery: A Case Report of an Aberrant Radial Artery with Traumatic Aneurysm

Christian Weinand · Cameron Akbari · Sean O'Donnell

Received: 29 November 2010 / Accepted: 11 February 2011 / Published online: 17 June 2011
© Society of the Hand & Microsurgeons of India 2011

Abstract Anatomical abnormalities such as unusual bifurcations or aberrant arteries of the radial artery are extremely rare and due to malformation or disruption of the vascular net. We present a case of a 64 year old woman with a high bifurcated dorsal branch of the left radial artery, consulting us for a pulsatile mass in the anatomical snuffbox after a fall. The mass measured 3–4 mm in diameter and was located on the dorsal aspect of the wrist over the anatomical snuffbox. Primary imaging studies using Duplex Ultrasound suggested an aneurysm of the radial artery, further imaging with arteriogram revealed a high bifurcation of the dorsal branch of the radial artery, presenting with an aneurysm. The deep palmar branch of the ulnar artery was the dominating vessel, allowing ligation and excision of the aneurysm. Histological evaluation revealed intimal wall hyperplasia within the aneurysm, suggesting an injury as initiating factor. A review of the literature showed that this abnormality of high bifurcation of the dorsal palmar branch of the radial artery has not been previously reported. Management of aneurysms at the wrist is discussed.

Keywords Anatomical variance · Vascular malformation · Aneurysmal wall hypertrophy · Aneurysm · Case report · Literature review

Introduction

The blood supply of the hand and the lower forearm is derived from the brachial artery which splits into the

ulnar and radial arteries within the antecubital fossa. Although the radial arterial system is fairly constant in its structure, rare anomalies have been described. McCormack et al. described in a study of 750 cadaver extremities anatomical variations of the radial artery in 4.3% of the sample [1]. In a review of 100 upper extremity arteriograms Uglietta and Kadir found an overall incidence of radial artery anomalies in 9% of the cases [2]. Other vascular anomalies of the forearm previously described include an aberrant dorsal course of the radial artery, that passed around Lister's tubercle of the radius [3], a radial artery that passed deep to the pronator teres [4], the antebrachial superficial dorsal artery [5], and a high origin of the radial artery from the brachial artery, this being the most frequently encountered anomaly in 7% of individuals [2, 6]. It is hypothesized that malformation or disruption of the vascular net of the arm results in anomalies of the adult vasculature and may lead to musculoskeletal deformities [7]. Very few aberrant radial arteries have been encountered at the level of the wrist [2, 6].

True aneurysms of the radial artery are rare. Most reported cases are post-traumatic pseudoaneurysms of the radial artery, especially after placement of radial arterial lines for blood pressure monitoring; aneurysms of the ulnar artery, the hypothenar hammer syndrome, a more common described aneurysm [8–11]. There are few reports of aberrant radial arteries aneurysms in the literature [2]. Excision of the aneurysm with or without reconstruction is the most common treatment [9–11, 13, 14, 18]. No report has been done so far on an aneurysm of a radial artery malformation.

We report the case of a high bifurcation of a dominant superficial branch with aberrant radial artery with an aneurysm.

C. Weinand (✉) · C. Akbari · S. O'Donnell
The Washington Hospital Center, Center for Vascular Care,
110 Irving Street NW,
Washington, DC 20010, USA
e-mail: Christian.weinand@medstar.net

Case Report

A 64 year old woman complained about a new tender persistent swelling in her left wrist for 1 week. 2 days previously she had sustained a fall. Her medical history was remarkable for thyroid disease and a melanoma of the left lower extremity. Physical examination showed a 3–4 mm pulsatile mass on the dorsal aspect of her wrist in the anatomical “snuffbox”. Radial artery and ulnar artery pulses were both palpable, Allen’s test confirmed good perfusion of the palmar arch by the ulnar artery. Sensory and motor function of the left hand were normal. Duplex ultrasound revealed a 4.7 mm fusiform aneurysm of the radial artery with the suggestion of an intraluminal thrombus. Arteriography revealed a high bifurcation of the superficial palmar branch of the radial artery, branching off in the mid forearm and forming the superficial palmar arch. This branch was larger than the main radial artery. The radial artery formed the deep palmar arch along with the ulnar artery. The remainder of the forearm and hand arteriogram was normal (Fig. 1). The patient opted for elective surgery with ligation of the radial artery and resection of the aneurysm.

An arteriogram was performed in the operating room just prior to the surgical exploration. Serial arteriography was performed from the upper arm to the hand. The above findings were noted to include a high bifurcation of the superficial palmar branch of the left radial artery with an aneurysm of the radial artery approximately 4 – 5 mm at the

level of the wrist. The main radial artery formed the deep palmar arch along with the ulnar artery. The digital arteries appeared to be normal. After the arteriography of the left hand was performed and the aneurysm identified to be in the radial artery, the decision was made to proceed with ligation and excision of the aneurysm. The area overlying the aneurysm was infiltrated with local anesthesia and the aneurysm repaired by ligation and excision.

Pathological examination of the specimen revealed a $0.9 \times 0.5 \times 0.2$ cm portion of tan-pink to tan-white soft tissue. The portion of the arterial wall showed myointimal hyperplasia (Fig. 2) (Figs. 3 and 4).

Discussion

Drizenko et al. proposed that variations of the radial artery suggest hemodynamic insufficiency of the axial vascular network, allowing persistence of certain portions of the superficial system of the upper limb [10]. The most frequently encountered distal anatomic variation of the radial artery is a sizable palmar branch – but more slender than the radial artery itself – located in a more superficial plane than the tendon of the flexor carpi radialis muscle and situated on its radial side before turning to the dorsum of the hand at the distal extremity of the radius [11]. Unusual findings suggested by pulse or Doppler vascular signals being in wrong place indicate a developmental variation of



Fig. 1 High bifurcation of the dorsal branch with dominant superficial palmar branch of the radial artery (arrow), forming the superficial palmar arch and with a smaller radial artery, continuing to form the deep palmar arch

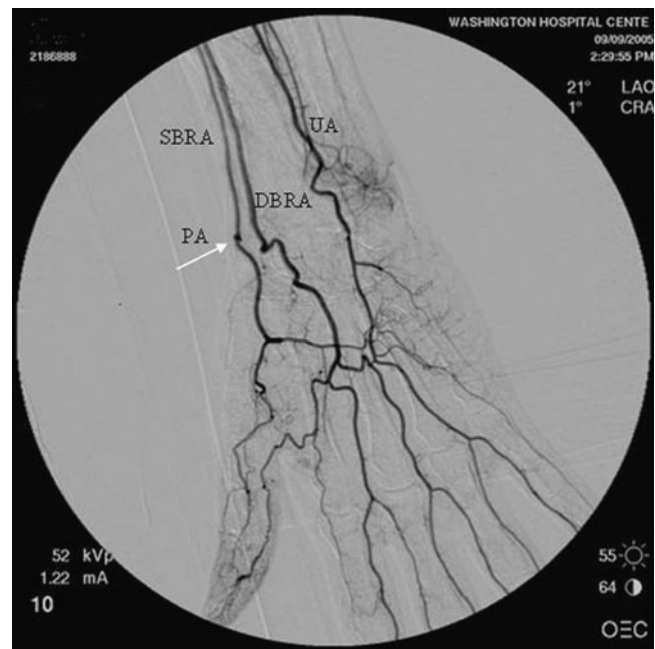


Fig. 2 Angiogram of the hand, showing the dominant superficial palmar branch of the radial artery (SBRA) to the superficial palmar and the radial artery branch, forming now the deep palmar arch. The pseudoaneurysm (PA, arrow) is in the anatomical “snuffbox”

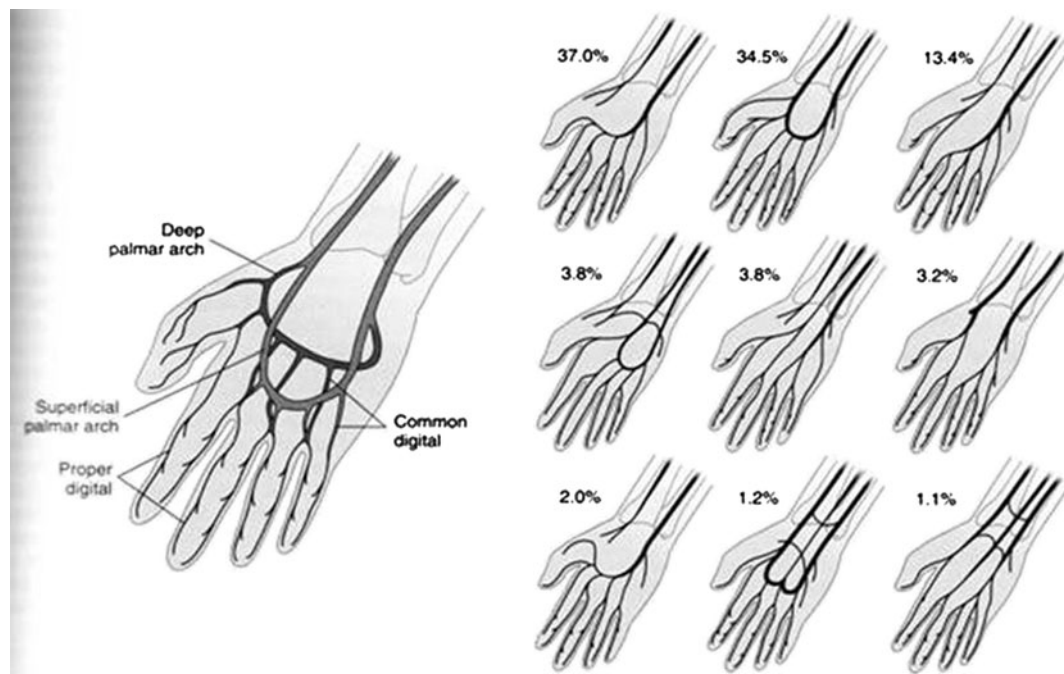


Fig. 3 Anatomical variations of the superficial and deep palmar arches (Used with permission from Elsevier, [19])

the forearm arterial anatomy. In our case Doppler ultrasound detected a fusiform aneurysm of the superficial branch of the radial artery. In an extensive series of dissected specimens of 750 upper extremities, McCormack et al. reported an incidence of 6 radial artery duplications [1]. These brachial and antebrachial arterial variations are probably caused by an abnormal embryologic development of the vascular plexus of the limb buds [12]. Their incidence has been reported at between 1% - 15%, depending on their location in the upper or lower forearm respectively.

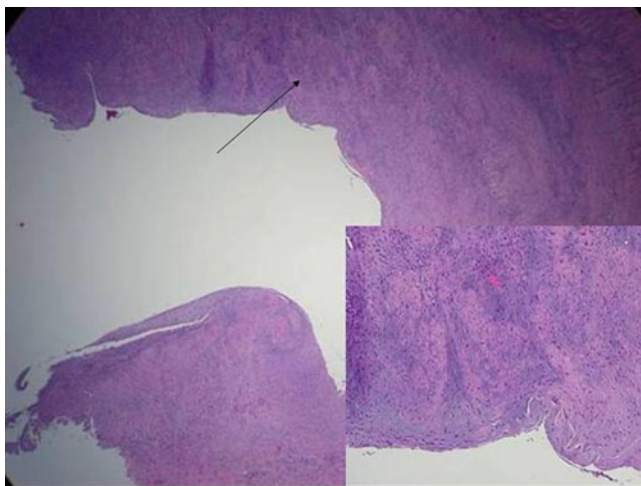


Fig. 4 Histologic evaluation of the resected aneurysm, showing intimal hyperplasia (arrow). Staining H&E, magnification 100 and 400×

Most aneurysms in the forearm are found in the distal ulnar artery, called ulnar hammer syndrome [8]. The incidence of radial artery aneurysms is rare and often combined with traumatic events, especially after access of the radial artery in anesthesia for blood pressure monitoring [9]. There is paucity in the literature for true aneurysm case reports [13]. Traumatic pseudoaneurysms are histologically described as hyperplasia of the intima due to transection of the entire vascular wall. In our case, the aneurysm was found to be a pseudoaneurysm of the accessory radial artery with intimal wall hyperplasia.

Walton and Choudhary described a similar case of an idiopathic radial artery aneurysm in the anatomical “snuff-box”, draining into the second digital artery [14]. It was also described as a pulsatile mass, confirmed to be an aneurysm by MRI of 1.5 cm diameter. In contrary to our case this aneurysm originated from the radial artery itself and was a shortcut to the second digital artery. This aneurysm was not resected, so no histological comparison can be made. Our patient turned out to have a pseudoaneurysm of an accessory radial artery. We performed Doppler Ultrasound examination of the extremity and serial arteriograms preoperatively, instead of MRI investigation.

Current standard in diagnosis is arteriography, which may help to evaluate for other aneurysm and whether a reconstruction will need to be done. In addition high resolution sonography and MRI are described for diagnostic imaging studies [15, 16]. However MRI imaging is costly and sonography can only be used as diagnostic imaging study, whereas an arteriogram offers evaluation

and treatment in one step. In our case we chose an arteriogram to evaluate the lesion, which is in concordance with the current imaging standard.

The current standard of care of a radial artery aneurysm is ligation of the radial artery proximal to the aneurysm, provided that the Allen's test showed perfusion of the deep palmar arch via the ulnar artery. In our case, the patient presented with an aneurysm of a high bifurcation of the palmar branch of the radial artery, where the aneurysm occurred after a fall. The superficial and deep arches were formed regularly by the radial and ulnar artery respectively. Both arches were complete and dominance of the deep palmar branch allowed complete resection without reconstruction. Only few cases are described where embolization or even an angioplasty was performed in radial artery aneurysms [17, 18].

Imaging studies to evaluate the lesion comprise of angiography, sonography or event MRI. The treatment most commonly performed is ligation of the artery, with or without vascular reconstruction. The exact criteria for reconstruction are not defined and good clinical assessment is necessary in the immediate post ligation time [9, 13, 18].

Radial accessory arteries and radial artery aneurysms are rare. Accessory radial arteries and varying bifurcations are due to abnormal embryologic development of the vascular pattern of the forearm [19]. Pseudoaneurysms are most due to traumatic events. The clinician has to keep a high suspicion to look for further existing illnesses. The location of the accessory radial artery in the anatomical snuffbox may have been prone to trauma and the formation of a pseudoaneurysm.

References

- McCormack LJ, Cauldwell EW, Anson BJ (1953) Brachial and antebrachial arterial patterns. *Surg Gynecol Obstet* 96:43–54
- Uglietta JP, Kadir S (1989) Arteriographic study of variant arterial anatomy of the upper extremities. *Cardiovasc Inter Radiol* 12:145–148
- Otsuka T, Terauchi M (1991) An anomaly of the radial artery. Relevance for the forearm flap. *Br J Plast Surg* 44:390–391
- Small JO, Miller R (1988) The radial artery forearm flap: an anomaly of the radial artery. *Br J Plast Surg* 38:501–503
- Brown MJ, Edstrom LE, Zienowicz RJ (1999) A symptomatic radial artery anomaly and its surgical treatment. *J Hand Surg* 24:178–181
- Icten N, Sullu Y, Tuncer I (1996) Variant high-origin radial artery: a bilateral case. *Surg Radiol Anat* 18:63–66
- Van Allen MI, Hoyne HE, Jones KL (1982) Vascular pathogenesis of limb defects. I. Radial artery anatomy in radial aplasia. *J Pediatr* 101:832–838
- Smith HE, Dirks M, Patterson RB (2004) Hypothenar hammer syndrome: distal ulnar artery reconstruction with autologous inferior epigastric artery. *J Vasc Surg* 40:1238–1242
- Narsete EM (1964) Traumatic aneurysm of the radial artery – a report of three cases. *Am J Surg* 108:424–427
- Drizenko A, Maynou C, Mestdagh H, Mauroy B, Bailleul JP (2000) Variations of the radial artery in man. *Surg Radiol Anat* 22:299–303
- Alameddine AK, Alimov VK, Engelman RM, Rousou JA, Flack JE, Deaton DW, Engelman DT (2004) Anatomic variations of the radial artery: significance when harvesting for coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 127:1825–1827
- Singer E (1933) Embryological pattern persisting in the arteries of the arm. *Anat Rec* 55:403–409
- Barmwell-Smith R (1897) A case of spontaneous aneurysm of the radial artery in the tabatière: treatment by excision of the sac. *Lancet* 150:1044
- Walton NP, Choudhary F (2002) Idiopathic radial artery aneurysm in the anatomical snuffbox. *Acta Orthop Belg* 68:292–294
- Magarelli N, Ambrosini R, Carriero A (1997) Imaging with magnetic resonance in a case of post-traumatic aneurysm of the radial artery. *Radiol Med (Torino)* 93:214–217
- Gooding GA (1988) Sonography of the radial artery at the wrist. *AJR Am J Roentgenol* 150:629–631
- Komorowska-Timek E, Teruya TH, Abou-Zamzam AM Jr, Papa D, Ballard JL (2004). Treatment of radial and ulnar artery pseudoaneurysms using percutaneous thrombin injection. *J Hand Surg [Am]*. 29: 936 – 942. PMID: 15465248
- Cozzi DA, Zani A, Pacilli M, Morini F (2004) Uncomplicated iatrogenic pseudoaneurysm of the superficial palmar arch treated by excision and vascular reconstruction. *Am J Crit Care* 13:315–319
- Longo GM, Pearce WH, Sumner DS (2005) Evaluation of upper extremity ischemia. In: Rutherford RB (ed) *Vascular Surgery*, 6th edn. Elsevier Saunders, Philadelphia, pp 1274–1293