VIA MEDICA

ORIGINAL ARTICLE

Vol. 65, No. 4, pp. 400–405

ISSN 0015–5659
www.fm.viamedica.pl

High origin of a superficial ulnar artery arising from the axillary artery: anatomy, embryology, clinical significance and a review of the literature

K. Natsis, A.L. Papadopoulou, G. Paraskevas, T. Totlis, P. Tsikaras

Department of Anatomy, Medical School, Aristotle University of Thessaloniki, Greece

[Received 31 March 2006; Revised 7 July 2006; Accepted 28 July 2006]

The superficial ulnar artery (SUA) is an ulnar artery of high origin that lies superficially in the forearm. Its reported frequency ranges from 0.17% to 2%. During anatomical dissection in our department we observed a unilateral case of SUA in a 75-year-old white male human cadaver. It originated from the right axillary artery at the level of the junction of the two median nerve roots and followed a looping course, crossing over the lateral root of the median nerve and running lateral to it in the upper and middle thirds of the arm, whereas in the inferior third of the arm the SUA crossed over the median nerve and ran medially to it. In the cubital fossa, it passed superficially over the medial side of the ulnar aponeurosis and coursed subcutaneously in the ulnar side of the forearm superficially to the forearm flexor muscles. In the hand the SUA anastomosed with the superficial palmar branch of the radial artery, creating the superficial palmar arch. Additionally, it participated in the development of the deep palmar arch. The axillary artery, after the origin of the SUA, continued as the brachial artery and divided into the radial and common interosseous arteries in the cubital fossa. The normal ulnar artery was absent. No muscular or other arterial variations were observed in this cadaver. The embryological interpretation of this variation is difficult and it may arise as a result of modifications to the normal pattern of capillary vessel maintenance and regression. The existence of a SUA is undoubtedly of interest to the clinician as well as to the anatomist. This report presents a case of unilateral SUA along with a review of the literature, embryological explanation and analysis of its clinical significance.

Key words: artery, anatomical variation, upper limb, forearm flap

INTRODUCTION

The superficial ulnar artery (SUA) is defined as an ulnar artery which branches from the axillary, brachial or superficial brachial arteries, courses over the forearm flexor muscles and coexists with a brachial or superficial brachial artery that branches into either the radial and common interosseous arteries or, less frequently, into the radial and ulnar arteries [19, 31, 32].

According to the typical arterial pattern, the subclavian artery becomes the axillary artery as it crosses the first rib. At the inferior border of the teres major muscle the latter continues as the brachial artery, which in the cubital fossa ends up dividing into the radial and the ulnar arteries [12]. The arterial pattern of the upper limb extremity may vary at different levels from the axillary artery, proximal to the origin of the median nerve, as far as the level of the palmar arches [2].

Although, variations of the upper limb arterial pattern are fairly common, the presence of a SUA of

Address for correspondence: K. Natsis, MD, PhD, Ass. Prof., Medical School, Aristotle University of Thessaloniki, P.O. Box: 300 Postal Code: 541 24, Thessaloniki, Greece, tel./fax: 0030 2310999681, e-mail: natsis@med.auth.gr

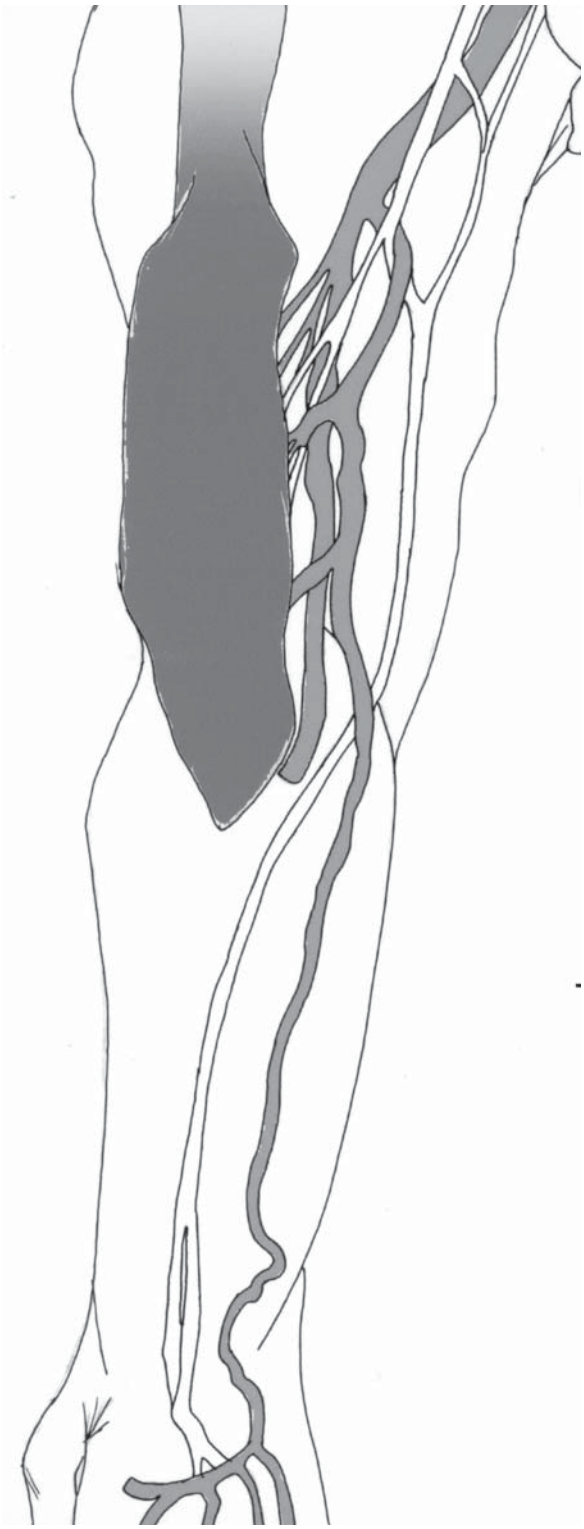

Figure 1. Schematisation of our case.

high origin, such as one from the axillary artery, is considered a rare anatomical variation with clinical significance [2, 7, 12, 16, 21, 24, 31, 34, 36]. This report presents a case of unilateral SUA along with a review of the literature, embryological explanation and analysis of its clinical significance.

CASE REPORT

During anatomical dissection in our department we observed a unilateral case of SUA in a 75-year-old white male human cadaver (Fig. 1). The SUA originated from the right axillary artery after the origin of the subscapular artery and the anterior and posterior humeral circumflex arteries at the level of the junction of the two median nerve roots, 7 mm proximally to the teres major muscle inferior border. The SUA followed a looping course, crossing over the lateral root of the median nerve in the upper and middle thirds of the arm close to the biceps brachii muscle, giving rise to arterial branches for this muscle (Fig. 2). In the inferior third of the arm the SUA crossed over the median nerve and running lateral to it and ran medially to it. In the cubital fossa the SUA passed superficially over the medial side of the ulnar aponeurosis and coursed subcutaneously over the antebrachial fascia in the ulnar site of the forearm superficially to the forearm flexor muscles (Fig. 3). In the hand the SUA layed subcutaneously and anastomosed

Figure 2. The superficial ulnar artery's origin between the median nerve roots.

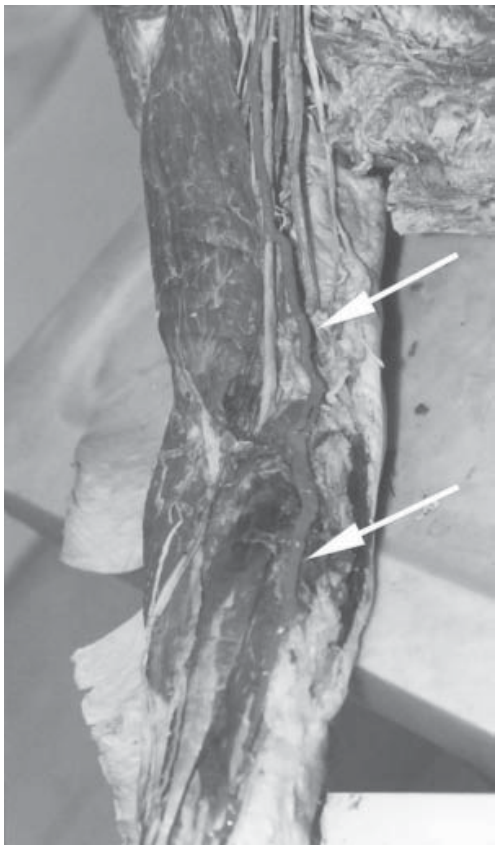

Figure 3. The superficial ulnar artery in the arm and forearm.

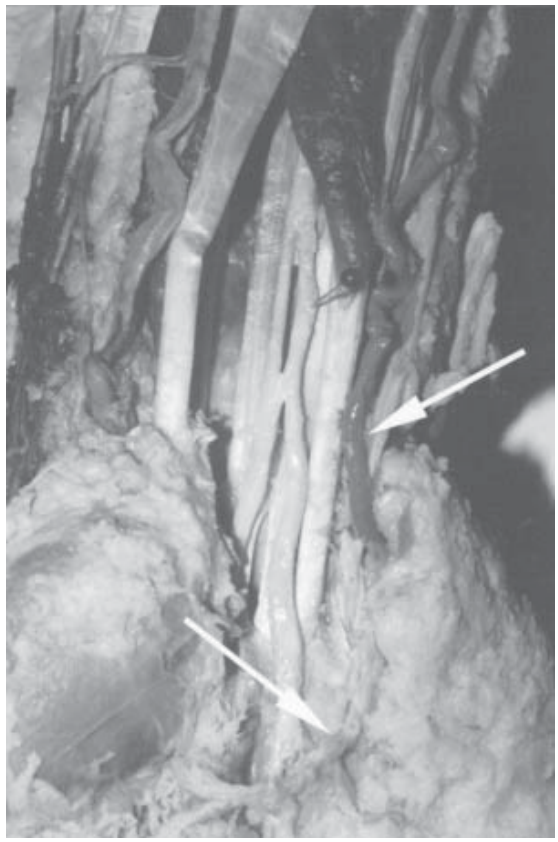

Figure 4. The superficial ulnar artery in the hand.

with the superficial palmar branch of the radial artery, creating the superficial palmar arch. Additionally, the SUA participated in the development of the deep palmar arch (Fig. 4). After the origin of the SUA the axillary artery continued as the brachial artery, which was 12 mm thick and divided into radial and common interosseous arteries in the cubital fossa. The normal ulnar artery was absent. In this cadaver there were no muscular or other arterial variations.

DISCUSSION

Diversions from the typical anatomical arterial pattern of the upper limb are well documented and considered quite common, as they have an incidence of up to 20% in human adult limbs [3, 4, 6, 7, 12, 15, 16, 21, 24, 26, 29, 30, 36]. Various authors have reported a total incidence of 0–9.38% for the SUA (Table 1) [1, 5, 7, 8, 11, 13, 14, 16, 18, 20, 22, 23, 25, 27–31, 33–35]. However, the frequency of a SUA originating from the axillary artery is reported in the literature as ranging from 0.17% to 2% (Table 2) [1, 5, 11, 13, 14, 16, 20, 23, 28–31, 33].

Moreover, on the basis of the classification of the arteries according to their position in relation to the median nerve carried out by Lippert & Pabst (1985), a looping form of a SUA, in which the artery crosses over the lateral root of the median nerve and passes to the lateral side of the arm supplying the biceps brachii muscle, is a rare anatomical variation. The high origin of the SUA in combination with the above-mentioned looping course makes this anatomical variant even rarer [2, 19].

The course of a SUA over the forearm flexor muscles has been described in two different ways: it either runs over the antebrachial fascia in a subcutaneous position, as observed in our case, which is also the most frequent course, or more rarely it runs under the antebrachial fascia. Our case did not present any other arterial anomalies or muscular variations, although some authors have associated the SUA with additional anatomical variations in the upper limb, such as a persistent median artery [32].

The embryological interpretation of the development of a SUA is difficult, since neither anatomists nor embryologists have yet reached a unanimous conclusion [2, 16, 29]. In humans three developmental theories have so far been proposed. The first suggested that the formation of the final and definite

Table 1. Overall Incidence of SUA

Author (year)	Sample	Incidence	%	Specimen	Method
Quain (1844) [27]	422	29	6.87%	Cadavers	Dissection
Gruber (1867) [13]	700	20	2.86%	Cadavers	Dissection
Breme (1899) [5]	388	7	1.8%	Cadavers	Dissection
Muller (1903) [23]	100	2	2%	Cadavers	Dissection
Adachi (1928) [1]	1198	8	0.67%	Cadavers	Dissection
Miller (1939) [22]	480	0	0%	Cadavers	Dissection
Hazlett (1949) [14]	188	6	3.19%	Cadavers	Dissection
Hazlett (1949) [14]	542	15	2.77%	Living subjects (medical & dental students)	Inspection & palpation
McCormack et al. (1953) [20]	750	17	2.27%	Cadavers	Dissection
Weatherby (1956) [35]	451	3	0.67%	Still-born infants	Dissection
Weatherby (1956) [35]	408	10	2.45%	Cadavers	Dissection
Fuss et al. (1985) [11]	200	3	1.5%	Cadavers	Dissection
Unglietta and Kadir (1989) [33]	100	1	1%	Patients	Angiographies
Rodriguez-Baeza et al. (1995) [31]	160	8	5%	Cadavers (150 adults & 10 full term infants)	Dissection
Devash (1996) [7]	32	3	9.38%	Cadavers	Dissection
Devash (1996) [7]	76	7	9.21%	Patients	Forearm flaps
Fadel and Amonoo-Kuofi (1996) [8]	144	2	1.39%	Cadavers	Dissection
Nakatani et al. (1998) [25]	150	1	0.67%	Cadavers	Dissection
Rodriguez-Niedenfuhr et al. (2000) [30]	158	8	5.06%	Cadavers	Dissection
Rodriguez-Niedenfuhr et al. (2001) [29]	150	7	4.67%	Embryos	3-D reconstrustion
Rodriguez-Niedenfuhr et al. (2001) [31]	384	16	4.17%	Cadavers	Dissection
Latha et al. (2002) [18]	100	1	1%	Cadavers	Dissection

Table 2. Incidence of a SUA originating from the axillary artery

Author (year)	Sample	Incidence	%	Specimen	Method
Gruber (1867) [13]	700	4	0.57%	Cadavers	Dissection
Breme (1899) [5]	388	1	0.26%	Cadavers	Dissection
Muller (1903) [23]	100	1	1%	Cadavers	Dissection
Adachi (1928) [1]	1198	2	0.17%	Cadavers	Dissection
Hazlett (1949) [14]	188	3	1.6%	Cadavers	Dissection
McCormack et al. (1953) [20]	750	7	0.93%	Cadavers	Dissection
Fuss et al. (1985) [11]	200	1	0.5%	Cadavers	Dissection
Unglietta and Kadir (1989) [33]	100	1	1%	Patients	Angiographies
Rodriguez-Baeza et al. (1995) [30]	160	2	1.25%	Cadavers (150 adults & 10 full term infants)	Dissection
Rodriguez-Niedenfuhr et al. (2001) [29]	150	3	2%	Embryos	3-D reconstrustion
Rodriguez-Niedenfuhr et al. (2001) [31]	384	4	1.04%	Cadavers	Dissection

arterial pattern was the result of a remodelling of the complex primitive networks. According to the second, on the other hand, the sprouting theory, the arteries of the upper limb sprout from the axial artery. Another group [29], using three-dimensional reconstruction, studied the most representative stages in human embryos and proposed a third developmental theory. According to this, the arterial pattern of the upper extremity develops from an initial capillary plexus by a proximal-to-distal differentiation in the forearm with a posterior-anterior polarity, as a result of the maintenance, enlargement and differentiation of certain capillary vessels and the regression of others. Although the reasons for a modified arterial development have not yet been clarified, the presence of a SUA may be due to haemodynamic forces, chemical factors, foetal position in the uterus, first limb movements, developmental arrest in the early stages and genetic predisposition [2, 16, 26, 29].

Apart from the anatomical rarity of a SUA branching from the axillary artery, the persistence of such a vessel, which usually runs along and crosses over subcutaneous veins, is clinically important [7, 12, 16, 24, 31, 36]. A SUA may complicate intravenous drug administration with disastrous results, venopuncture in general [12, 16, 18, 21, 24, 31, 32, 36] and percutaneous brachial catheterisation [12, 16]. Owing to its course, it is more prone to injury, resulting in bleeding [12, 16, 19]. Additionally, the artery may be mistaken for a vein [12, 16, 19] and then for phlebitis [21], or near the distal end of the forearm it might be mistaken for a persistent median artery [34]. Its superficial course makes it more accessible to cannulation [12, 16]. Furthermore, the presence of a SUA complicates surgical procedures, such as the preparation of a free forearm flap with neurosensory potential [7, 10, 16, 19, 21, 24, 31, 32, 36] and radial artery grafting for coronary bypass [31]. In cases where the SUA replaces the ulnar artery, such as that reported by us, its accidental injury during surgical procedures can result in serious ischaemia of the forearm [7, 16, 21, 24, 36]. In plastic surgery, however, if this anatomical variant is diagnosed preoperatively, a reliable flap will be designed over the SUA and it will be quick and easy to raise [7, 16]. Moreover, the SUA can cause misinterpretation of incomplete angiographic images [12, 16, 32, 36] and is clinically significant in arterial anastomosis performed for haemodialysis [9, 17].

Since a SUA may lead to many surgical and diagnostic problems, it is important to set the diagnosis before any surgical procedure. The SUA may be diagnosed during routine and careful palpation of the antecubital fossa and forearm in clinical examination. Additionally, Doppler ultrasound provides a confident diagnosis of this anatomical variation [21].

In view of this, knowledge of this variation is very important, not only to anatomists, but also to radiologists, angiologists and orthopaedic, plastic surgeons during their routine clinical practice [2, 12, 19].

REFERENCES

1. Adachi B (1928) Das Arterien System der Japaner. Kyoto, Maruzen, 1: 285–356.
2. Aharinejad S, Nourani F, Hollensteiner H (1997) Rare case of high origin of the ulnar artery from the brachial artery. Clin Anat, 10: 253–258.
3. Anson JB, Maddock WG (1958) Callander's surgical anatomy, 4th ed. W.B. Saunders Company, Philadelphia, London, pp. 823–824.
4. Arey LB (1965) Developmental anatomy. A text book and laboratory manual of embryology, 7th ed. W.B Saunders Company, Philadelphia, London, pp. 350–360.
5. Breme G (1899) Casuistischer Beitrag zur Kenntnis der Anomalien der Armarterien. Z Morphol Anthropol, 1: 483–494.
6. Collins P (1995) Embryology and development. In: Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MW (ed.). Gray's anatomy. The anatomical basis of medicine and surgery. 38th ed. Churchill Livingstone, UK, pp. 318–320.
7. Devansh MS (1996) Superficial ulnar artery flap. Plast Reconstr Surg, 97: 420–426.
8. Fadel RA, Amonoo-Kuofi HS (1996) The superficial ulnar artery: development and surgical significance. Clin Anat, 9: 128–132.
9. Fonseka WR, Rajamantri SD, Sheriffdeen AH (2002) Ulnar basilic arteriovenous fistula: an alternative. Transplant Proc, 34: 2412.
10. Funk GF, Valentino J, McCulloch TM, Graham SM, Hoffman HT (1995) Anomalies of forearm vascular anatomy encountered during elevation of the radial forearm flap. Head Neck, 17: 284–292.
11. Fuss FK, Matula CW, Tschabitscher M (1985) Die Arteria brachialis superficialis. Anat Anz, 160: 285–294.
12. Gormus G, Ozcelik M, Hamdi Celik H, Cekirge S (1998) Variant origin of the ulnar artery. Clin Anat, 11: 62–64.
13. Gruber W (1867) Archiv fur Anatomie. Physiologie und Wissenschaftliche Medizin, pp. 668–687.
14. Hazlett JW (1949) The superficial ulnar artery with reference to accidental intra-arterial injection. Can Med Assoc J, 61: 289–293.
15. Huelke DF (1959) Variations in the origin of the branches of the axillary artery. Anat Rec, 135: 33–41.
16. Jacquemin G, Lemaire V, Medot M, Fissete J (2001) Bilateral case of superficial ulnar artery originating from axillary artery. Surg Radiol Anat, 23: 139–143.
17. Kinnaert P (1995) Relevance of the ulnaris fistula as a dialysis shunt. Nephrol Dial Transplant, 10: 2379.
18. Latha VP, Anuradha L, Narayana K (2002) A case of superficial ulnar artery associated with retrobrachial median nerve. Folia Anat, 30: 49–51.

19. Mannan A, Saricioglu L, Ghani S, Hunter A (2005) Superficial ulnar artery terminating in a normal ulnar artery. Clin Anat, 18: 602–605.
20. McCormack LJ, Cauldwell EW, Anson BJ (1953) Brachial and antebrachial arterial patterns. A study of 750 extremities. Surg Gynecol Obst, 96: 43–54.
21. McWilliams RG, Sodha I (2000) Doppler ultrasound diagnosis of a superficial ulnar artery. Eur J Ultrasound, 12: 155–157.
22. Miller RA (1939) Observations upon the arrangement of the axillary artery and the brachial plexus. Am J Anat, 64: 143–163.
23. Muller E (1903) Beitrage zur Morphologie des Gefassystems. I. Die Armarterien des Menschen. Anatomische Hefte, 22: 377–575.
24. Nakatani T, Tanaka S, Mizukami S, Shiraishi Y, Nakamura T (1996) The superficial ulnar artery originating from the axillary artery. Ann Anat, 178: 277–279.
25. Nakatani T, Tanaka S, Mizukami S (1998) Superficial ulnar artery originating from the brachial artery and its clinical importance. Surg Radio Anat, 20: 383–385.
26. Poteat WL (1986) Report of a rare human variation: absence of the radial artery. Anat Rec, 214: 89–95.
27. Quain R (1844) The anatomy of the arteries of the human body. Taylor and Walton, London.
28. Rodriguez-Baeza A, Nebot J, Ferreira B, Reina F, Perez J, Sanudo JR, Roig M (1995) An anatomical study and ontogenic explanation of 23 cases with variations in the main pattern of the human brachio-antebrachial arteries. J Anat, 187: 473–479.
29. Rodriguez-Niedenfuhr M, Burton GJ, Deu J, Sanudo JR (2001) Development of the arterial pattern in the upper limb of staged human embryos: normal development and anatomic variations. J Anat, 199: 407–417.
30. Rodriguez-Niedenfuhr M, Sanudo JR, Vazquez T, Nearn L, Logan B, Parkin I (2000) Anastomosis at the level of the elbow joint connecting the deep, or normal, brachial artery with major arterial variations of the upper limb. J Anat, 196: 115–119.
31. Rodriguez-Niedenfuhr M, Vazquez T, Nearn L, Ferreira B, Parkin I, Sanudo JR (2001) Variations of the arterial pattern in the upper limb revisited: a morphological and statistical study, with a review of the literature. J Anat, 199: 547–566.
32. Sanudo JR, Mirapeix RM, Garcia R, Rodriguez--Nidenfunr M (1998) A superficial ulnar artery anastomosing with a larger anterior interosseous artery to supply the wrist and hand. J Anat, 192: 439–441.
33. Uglietta JB, Kadir S (1989) Arteriographic study of variant arterial anatomy of variant arterial anatomy of the upper extremities. Cardiovasc Intervent Radiol, 12: 145–148.
34. Weathersby HT (1956) Unusual variation of the ulnar artery. Anat Rec, 124: 245–248.
35. Weathersby HT (1956) Anomalies of brachial and antebrachial arteries of surgical significance. South Med J, 49: 46–49.
36. Yazar F, Kirici Y, Ozan H, Aldur MM (1999) An unusual variation of the superficial ulnar artery. Surg Radiol Anat, 21: 155–157.