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Superficial brachioradial artery (radial artery originating from the axillary artery): a case report and embryological background

M. Konarik[1], J. Knize[1], V. Baca[1, 2], D. Kachlik[1, 2]

[1]*Department of Anatomy, Third Faculty of Medicine, Charles University in Prague, Ruská, Praha, Czech Republic*
[2]*Department of Medicine and Humanities, Faculty of Biomedical Engineering, Czech Technical University in Prague, Náměstí Sítná, Kladno, Czech Republic*

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*A case of anomalous terminal branching of the axillary artery, concerning the variant called superficial brachioradial artery (*arteria brachioradialis superficialis*) was described, with special regard to its embryological origin. The left upper limb of a male cadaver was dissected in successive steps from the axillary fossa distally to the palmar region. A variant artery, stemming from the end of the third segment of the axillary artery, followed a superficial course distally. It skipped the cubital fossa, ran on the lateral side of the forearm, crossed ventrally to the palm, and terminated in the deep palmar arch. This vessel is a case of so-called "brachioradial artery" (inexactly called a "radial artery with a high origin"). The origin of the brachioradial artery directly from the axillary artery belongs to the rare variants of the arterial pattern of the upper limb. Its incidence is approximately 3%. Moreover, this vascular variant was associated with another one concerning the brachial plexus. The medial cutaneous nerve of the forearm joined the median nerve in the middle third of the arm and ran further distally as a common trunk, as the normal median nerve does. Anatomical knowledge of the axillary region is crucial for radiodiagnostic and surgical procedures, especially in cases of trauma. The superficially located artery brings an elevated risk of bleeding complications in unexpected situations.* (Folia Morphol 2009; 68, 3: 174–178)

Key words: superficial brachioradial artery, arteria brachioradialis, axillary artery, radial artery, anatomy, variant, median nerve

INTRODUCTION

Variants of the main arteries of the upper arm (ulnar, brachial, and radial artery) are both quite frequent and rather distinct from each other [7, 8, 14, 18, 20]. The radial artery (RA), having a "high origin" over the intercondylar line, is called superficial brachioradial artery (SBrA, *arteria brachioradialis superficialis*). The SBrA stems from the axillary artery (AA) in the axillary fossa, runs superficially to the median nerve, crosses the cubital fossa, and in some cases anastomoses with the brachial artery (BA) in the arm.

According to the textbook pattern (Gray's anatomy [33]), AA is a continuation of the subclavian artery when it passes under the clavicle and then becomes the brachial artery at the surgical neck of the humerus [or better at the distal border of the pectoralis major (PM)]. Both points of the vessel name change are arbitrary ones.

Address for correspondence: D. Kachlik, Department of Anatomy, Third Faculty of Medicine, Charles University in Prague, Ruská 87, Praha 10, 100 00, Czech Republic, tel: +42 0267102508, fax: +42 0267102504, e-mail: david.kachlik@lf3.cuni.cz

The textbook pattern of AA branching is defined as a main trunk sending six separate side branches of large calibre and some smaller branches for nerves, lymph nodes, fat tissue, and subscapularis muscle [4]. The length of the AA can be divided into three segments:

— first (proximal) segment of AA, extending from the clavicle to the proximal border of the pectoralis minor (PMi), gives off the superior thoracic artery and thoracoacromial artery;
— second (middle) segment of AA, limited by the width of PMi and being situated dorsally behind the belly of PMi, sends off the lateral thoracic artery and subscapular artery, the latter immediately bifurcating into the circumflex scapular artery and thoracodorsal artery;
— distal (third) segment of AA, stretching from the distal border of the PMi to the distal border of the PM or to the surgical neck of the humerus, having two branches as well — anterior and posterior circumflex humeral arteries.

The BA is the main arterial trunk of the arm, starting at the distal border of the PM. It can be divided into three segments according to its distance from the artery arbitrary beginning. In the proximal third, it sends off the profunda brachii artery (deep artery of the arm; *arteria profunda brachii*), in the middle third, the superior ulnar collateral artery (middle collateral artery; *arteria collateralis ulnaris superior*), and in the distal third, the inferior ulnar collateral artery (inferior collateral artery; *arteria collateralis ulnaris inferior*), and finally bifurcates in the cubital fossa into the ulnar artery (UA) and RA. Throughout its course, it gives off other muscular branches, the largest separate one for the biceps brachii.

This article presents a case of a unilateral superficial brachioradial artery, and the description of this case is completed with an embryological background and thorough literature review.

MATERIAL AND METHODS

Eighty preparations of upper limbs of the cadaverous material (Czech population, Caucasian race), fixed with classical formaldehyde method, were dissected at the Department of Anatomy of the Third Faculty of Medicine at Charles University in Prague. This variant was found on the left upper limb of a 50-year-old male body. The anomalous course of the SBrA was followed from the axillary fossa as distal as the palmar region.

RESULTS

After dissecting the left axillary fossa, we noticed a different arrangement of the arteries in the distal part of the fossa. We observed a case of AA with an anomalous terminal branching. There was a normal textbook pattern branching arrangement in the first and second segments of AA. However, in the third segment of AA, approximately 75 mm distal to the artery arbitrary beginning, there was an anomalous branch stemming distally and running superficially to the median nerve. The calibre of the observed branch was 4 mm. The branch descended between the cutaneous nerve of the forearm and the median nerve to the medial side of the arm inside of the medial bicipital groove as far as the cubital fossa, where it crossed to the lateral side, deep to the superficial veins (cephalic, basilic, and median cubital veins) and superficially to muscles, nerves, and other arteries. The SBrA reached the palm and took part in the deep palmar arch. The proper BA followed its usual course deep to the median nerve in the medial intermuscular septum. On its way distally, the SBrA sent off a lot of muscular branches (supplying the biceps brachii in the arm and the pronator teres and the flexor carpi ulnaris muscle in the forearm) and some cutaneous branches. Its course was strictly superficial, and it did not pass under any muscle within the arm, the cubital fossa, or the forearm. There was no accompanying vein found here. The course in the forearm collided with the usual course of the RA on the lateral side, due to its position superficially to all the forearm flexor muscles, including the palmaris longus. Finally, the SBrA crossed the flexor retinaculum ventrally, entered the palmar region, passed as far as the proximal end of the first interosseous space, and pierced between the heads of the first interosseous dorsalis muscle to terminate in the deep palmar arch. The described vascular variant of AA was further associated with a variant of the brachial plexus. The median nerve and medial cutaneous nerve of the forearm (medial antebrachial cutaneous nerve; *nervus cutaneus antebrachii medialis*) merged in a common trunk in the upper third of the arm, at a distance of approximately 6cm distal to the inferior border of the pectoralis major muscle. The trunk descended to the cubital fossa as a regular median nerve does (Figs. 1–3).

DISCUSSION

The textbook pattern of the AA branching issued from the schema, as suggested by Adachi [1] and applied by Tiedemann [29], Trotter et al. [30], Charles et al. [3], Wankof [31], and Sahin and Seeling [25]. The reason for the existence of the vascular variants

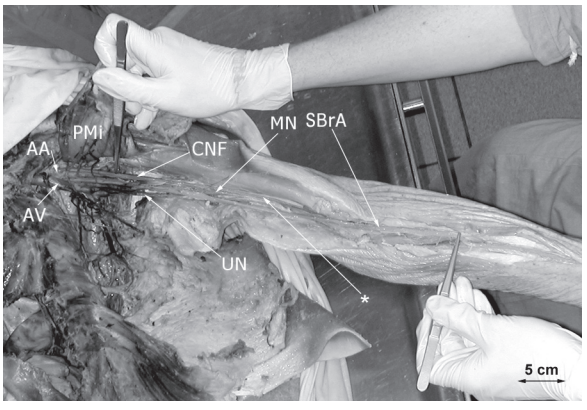

Figure 1. The superficial brachioradial artery (SBrA) as a whole; AA — axillary artery, AV — axillary vein, CNF — medial cutaneous nerve of the forearm, MN — median nerve, PMi — pectoralis minor muscle, UN — ulnar nerve, *common trunk for median nerve and medial cutaneous nerve of the forearm.

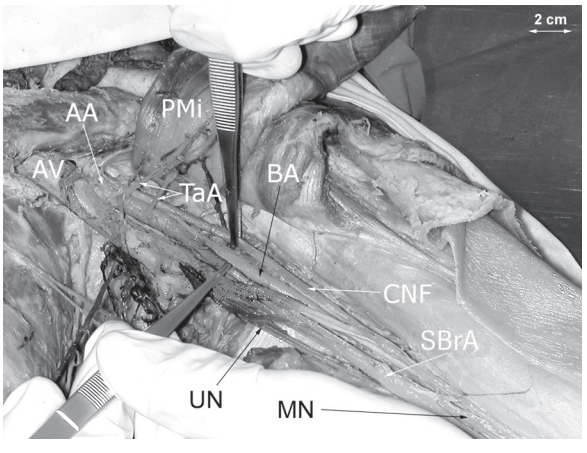

Figure 2. Detail of the superficial brachioradial artery (SBrA) in the axillary fossa; AA — axillary artery, AV — axillary vein, BA — brachial artery, CNF — cutaneous nerve of forearm, MN — median nerve, PMi — pectoralis minor muscle, UN — ulnar nerve, TaA — thoracoacromial artery.

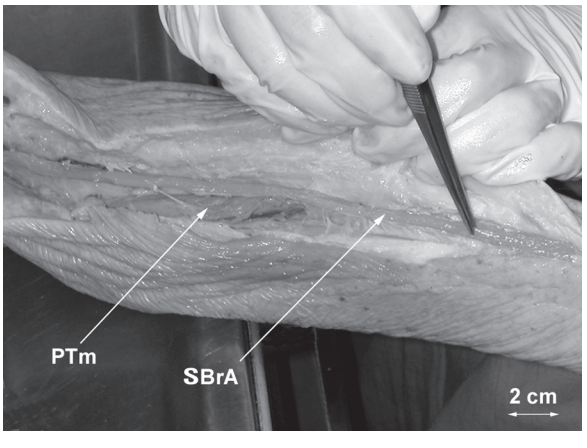

Figure 3. The course of the superficial brachioradial artery (SBrA) in the forearm; PTm — pronator teres muscle.

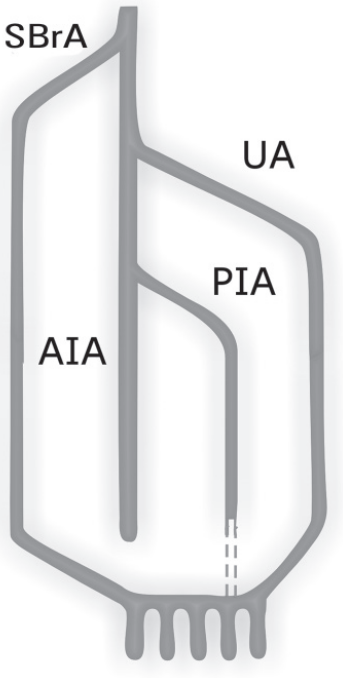

Figure 4. Developmental diagram of the superficial brachioradial artery (SBrA); AIA — anterior interosseous artery, PIA — posterior interosseous artery, UA — ulnar artery.

Table 1. Classification of superficial brachioradial artery according to its origin [24]

Group	Location	Frequency (%)
1	Distal segment of brachial artery	3.9
2	Middle segment of brachial artery	7.7
3	Proximal segment of brachial artery	65.4
4	Distal segment of axillary artery	23

can be traced back to the embryological period. Our findings depict a case of a vessel which should have been called the superficial brachioradial artery (*arteria brachioradialis superficialis*), if we follow the thorough and clear classification proposed by Rodríguez-Niedenführ et al. [24]. In our case, the existence of the SBrA is derived from a persisting part of the superficial brachial artery [13, 15] (Fig. 4).

We agree to the definition of SBrA: RA originating proximal to the intercondylar line from either the AA or the BA [6, 21]. The RA with a high origin is a frequently used synonym for this variant, but it is not very appropriate [2]. Due to the long distance between the axillary and cubital fossa, the exact location of the SBrA origin can be classified in four groups (Table 1).

Table 2. Origin site and percentage frequency of superficial brachioradial artery (SBrA)

Author	Number of cases	Total frequency (%)	Origin from AA
Quain (1844) [22]	429	30*	–
Müller (1903) [19]	300	25.8*	–
Adachi (1928) [1]	1198	31*	–
McCormack et al. (1953) [17]	750	15*	–
Wheatersby (1956) [32]	408	15.6	–
Rodríguez-Baezea et al. (1995) [23]	150	16.7*	–
Skopakoff (1959) [28]	610	19.7*	9%
Keen (1961) [12]	284	12.3*	5,9%
Rodriguez-Niedefüehr et al. (2001) [24]	384	13.8*	3.25%
Kachlik et al. [10]	80	#	1.25%

*most of the authors did not distinguish the origin site of SBrA; #the brachial artery was not part of the research, the data were beyond our study outlines, AA — axillary artery

The case of the SBrA described here ranks among the rarest variants, Group 4 (the RA stemming directly from the AA). In 2001 Rodríguez-Niedenführ et al. [24] performed an in-depth and thorough survey of the upper limb arterial variants and summarized the total amount of SBrA to be 13.8%. Nevertheless, the variant pattern, when the RA originated directly from the AA, was present only in 3.12% of cases. We performed another reference survey and we can state that this variant of SBrA pattern is present in 1.25% of cases [10].

The percentage frequency of SBrA and the origin site are summarized in Table 2. Many authors did not distinguish between the superficial brachial artery (which is the embryological precursor of SBrA) and SBrA itself. Then they mixed both variants into one group, as can be seen in Table 2.

The embryological background of this and similar variants can be explained as an abnormal deviation in the normal vascular pattern during embryological development [27].

The proximal part of the right subclavian artery arises from the fourth aortic arch, and the distal part is a persistent right seventh intersegmental artery, a direct branch from the dorsal aorta. The whole left subclavian artery comes from the left seventh intersegmental artery. The bud of the upper limb is supplied by branches of this vessel, forming the axial artery, which later gives rise to the AA, BA, etc.

The SBrA (the variant concerning the RA with high origin) is based on embryological abnormality, termed superficial brachial artery. The superficial brachial artery arises from the persistence of more than one cervical intersegmental artery which enlarges and does not perish [5, 9, 11, 16, 26].

CONCLUSIONS

Thorough anatomical knowledge of the upper limb is necessary for many medical fields, such as radiodiagnostics, traumatological surgery, oncological surgery, anaesthetic application, etc. The superficially located artery, the result of changed embryological conditions, elevates the risk of heavy bleeding in unexpected situations, not only in medical care but also during common personal daily activities.

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