

Superficial Brachial Artery: Its Embryological and Clinical Significance

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ABSTRACT

The principal arteries of the upper limb show a wide range of variations that are of considerable interest to orthopedic surgeons, plastic surgeons, radiologists and anatomists. We present here a case of bilateral superficial brachial artery found during the routine dissection of the upper limbs of a 50-year-old female cadaver. In both the limbs, the third part of the axillary artery divided into superficial brachial and deep brachial arteries; denominated according to their relation to the median nerve. The superficial brachial artery continued in the arm without giving any branches and ended in the cubital fossa dividing into radial and ulnar arteries. The deep brachial artery gave rise to anterior circumflex humeral, posterior circumflex humeral and profunda brachii arteries. Earlier superficial brachial artery has been reported with a prevalence rate varying from 0.2% to 25% but bilateral variation is extremely rare. The great variability of this arterial pattern may be attributed to the failure of regression of some paths of the embryonic arterial trunks. The embryological and clinical significance of this variant are also discussed in detail.

Keywords: Axillary artery, superficial brachial artery, deep brachial artery

Axillary artery (AA) is a continuation of the subclavian artery from the outer border of the first rib. It ends at the inferior border of the teres major and continues in the arm as brachial artery. According to textbooks, an AA penetrates the dorso-ventral divisions of the brachial plexus by passing between the lateral and medial roots of the median nerve. Rarely, an aberrant AA is unable to penetrate the brachial plexus. In this case, the AA is positioned superficial to the brachial plexus and then, this is known the superficial brachial artery (SBA).

The SBA has been reported by many authors because of its relatively high frequency in comparison with other vascular variations. It is necessary; however, to pay attention to the branches originating from the aberrant AAs, in addition to the various courses of the AA, in order to understand their morphogenesis.

CASE REPORT

During the routine undergraduate dissections on the upper limbs of a 50-year-old female cadaver, it was observed that on both the sides, the third part of the AA, after giving the subscapular artery, bifurcated into an SBA and a deep brachial artery. The SBA descended superficial to the lateral root of the median nerve, did not give any branch in the arm and continued as the brachial artery proper. Finally, on reaching the cubital fossa, it terminated by dividing into radial and ulnar arteries. The deep brachial artery passed deep to the medial root of the median nerve and gave anterior and posterior circumflex humeral branches of AA and profunda brachii branch of brachial artery. Then it terminated by giving twigs to the muscles of arm (Fig. 1).

DISCUSSION

Variations in the arterial pattern of the upper limb are common and have been reported by several investigators. The presence of an SBA and the usual pattern of its branching in the upper arm or forearm have also been reported.

The definition of the SBA was set for the first time by Adachi in 1928 and runs as follows: "The SBA is the one that runs superficial to the median nerve." It may replace the main trunk or may be accompanied by an

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Table 1. Incidence of the SBA in Various Studies

Name of Author	% of cases with SBA
Quain	0.2
Gruber	0.4
Muller	1
Adachi	3.1
Miller	3
McCormack et al	0.12
Skopakoff	19.7
Fuss et al	17
Rao and Chaudhary	4.2
Rodriguez-Niedenführ et al	4.9
Patnaik et al	6
Kachlik et al	5

equally important, less important or more important trunk running deep to median nerve. Table 1 shows the prevalence of SBA as observed by different authors from time-to-time.

ONTOGENY

The embryological background of these variations in the vasculature of the upper limb may be explained as abnormal deviations in the normal vascular patterns. Arey and Jurjus mentioned six explanations for the variations observed:

- The choice of unusual paths in the primitive vascular plexus
- The persistence of vessels which are normally obliterated
- The disappearance of vessels which are normally retained
- An incomplete development
- The fusion and absorption of parts which are normally distinct
- A combination of factors leading to an atypical pattern normally encountered.

Ontogenic basis of the present case can be easily made out if we look at Singer’s five stages of development of the brachial artery (Fig. 2):

- **Stage I:** Originally, the subclavian artery extends to the wrist, where it terminates by dividing into terminal branches for the fingers. The distal portion of the artery becomes the interosseous artery of the adult.

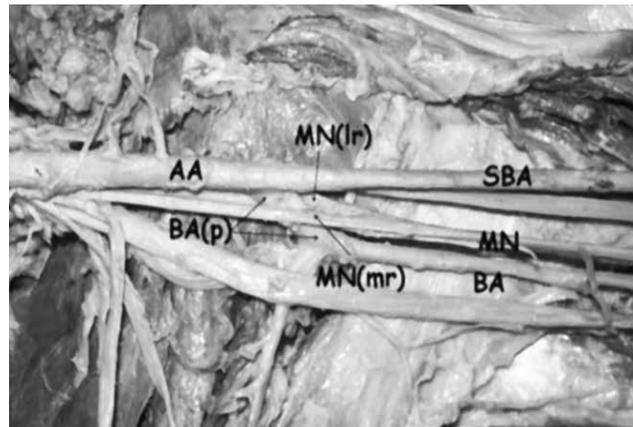


Figure 1. The third part of the axillary artery (AA) dividing into the superficial brachial artery (SBA) and the deep brachial artery [BA(p)]; MN(lr) - (lateral root of median nerve), MN(mr) - (medial root of the median nerve), MN (median nerve).

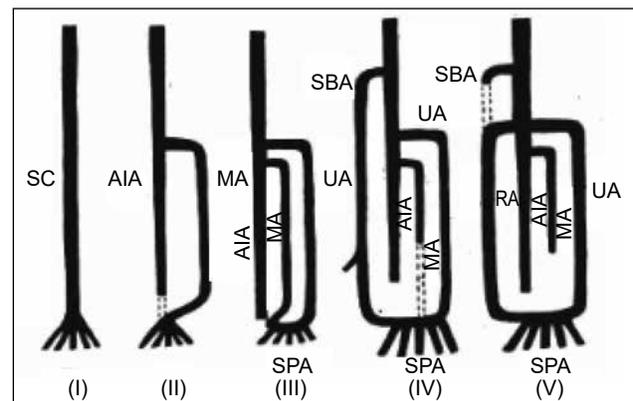


Figure 2. Stages of development of arteries of upper arm.

SC = Subclavian artery; MA = Median artery; AIA = Anterior interosseous artery; SBA = Superficial brachial artery; UA = Ulnar artery; SPA = Superficial palmar arch; RA = Radial artery.

- **Stage II:** The median artery arises from the interosseous artery and becomes larger while interosseous artery subsequently undergoes retrogression. During this process, the median artery fuses with the lower portion of interosseous artery and ultimately forms the main channel for the digital branches becoming the principle artery of the forearm.
- **Stage III:** In embryos of 18 mm, the ulnar artery arises from brachial artery and unites distally with the median artery to form superficial palmar arch. Digital branches arise from this arch.
- **Stage IV:** In embryo of 21 mm length, the SBA develops in the axillary region and traverses the medial surface of the arm and runs diagonally from the ulnar to the radial side of the forearm to the

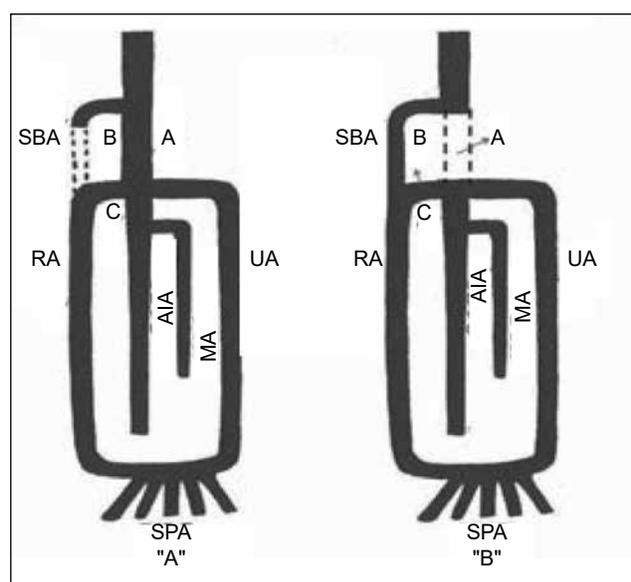


Figure 3. Normal development of the brachial artery ("A") and that in the present case ("B").

SBA = Superficial brachial artery; RA = Radial artery; UA = Ulnar artery; MA = Median artery; AIA = Anterior interosseous artery; SPA = Superficial palmar arch.

posterior surface of the wrist. There it divides over the carpus into branches for the dorsum of the thumb and index finger.

- **Stage V:** Finally three changes occur. When the embryo reaches the length of 23 mm the median artery undergoes retrogression becoming a small slender structure, now known as 'arteria nervi mediani'. The SBA gives off a distal branch, which anastomoses with the superficial palmar arch already present. At the elbow, an anastomotic branch between brachial artery and SBA becomes enlarged sufficiently to form with the distal portion of the latter, the radial artery, as a major artery of the forearm; the proximal portion of the SBA atrophies correspondingly.

In the present case, it seems that in Stage III of Singer, ulnar artery came from brachial artery as usual. SBA continued as radial artery and anastomosis between SBA and brachial artery developed normally (See Fig. 3). However, brachial artery between origin of SBA and ulnar artery ('A' in Fig. 3) retrogressed and lost its communication with common interosseous artery.

The SBA failed to retrogress and continued to supply radial artery. The anastomosis between SBA and brachial artery ('B' in Fig. 3), which usually forms proximal part of radial artery now formed proximal part of ulnar artery, thus giving appearance that ulnar artery and radial artery are terminal branches of SBA

and common interosseous artery ('C' in Fig. 3) came as a branch of ulnar artery.

CLINICAL SIGNIFICANCE

Gonzalez-Compta highlighted the diagnostic, interventional and surgical significance of such a vascular variation. Diagnostically, it may disturb the evaluation of angiographic images. Interventionally, accidental puncture of superficially placed arteries may occur while attempting venipuncture. Surgically, it is vulnerable in both orthopedic and plastic surgery operations. Hence, the anatomic knowledge of the vascular patterns of upper limb is of crucial importance not only for neurosurgeons, but for all those involved in radiodiagnostics, particularly in cases involving traumatic injuries, as improved knowledge would allow more accurate diagnostic interpretation and surgical treatment.

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Make sure

DURING MEDICAL PRACTICE

SITUATION: A 38-year-old woman with BP between 130-139 mmHg and 85-89 mmHg since 3 months came for follow-up.



LESSON: Treatment of prehypertension with candesartan is well-tolerated and reduced the risk of incident hypertension in the Trial of Preventing Hypertension (TROPHY). Over the 4 years of the study period, stage 1 hypertension developed in nearly two-thirds of patients with untreated prehypertension.

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