Case Report
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Unusual Axillary Artery Branching Pattern Associated with Multiple Neural Variations

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Abstract

Objective. This report presents a unilateral branching pattern of the axillary artery (AA) represented by an unusual common trunk division, vessel multiplications and concomitant neural variations. **Case Report.** In a Greek male cadaver, the right AA branched into a subscapular trunk and two accessory lateral thoracic arteries of variable origin and course. Concomitantly, a high-level interconnection between the musculocutaneous and median nerves was identified, as an accessory lateral root of the median nerve. More interestingly, a rare innervation of the upper part of the latissimus dorsi muscle by a lower subscapular nerve was also revealed. **Conclusion.** In-depth knowledge of the typical and variant AA branching patterns and coexisting neural variations is of paramount importance for surgeons and interventional physicians, for a safer diagnosis and for performing uneventful procedures in that area.

Key Words: Variation ▪ Subscapular Artery ▪ Thoracodorsal Artery ▪ Angular Branch ▪ Trunk.

Introduction

The axillary artery (AA) branching pattern presents with wide variability, particularly between the genders and different ethnic groups (1). Many of its branches may arise through common trunks (2), and others are multiplied. Clumping of the branches and common origin variants have been identified, with a higher incidence in Africans (3) and females (4). Neural and vascular aberrancies are usually paired. The current cadaveric report highlights an unusual subscapular trunk (SST) division into multiple branches, in combination with a rare variant innervation of the latissimus dorsi muscle (LDM) by the lower subscapular nerve. In addition, two accessory lateral thoracic arteries (LTAs) and a high-level interconnection between the musculocutaneous and median nerves (MCN-MN) were identified, forming an additional lateral root of the MN.

This paper presents a rare case with important surgical and clinical variations of the AA, the MN and LDM innervation.

Case Report

During the right axilla dissection of a 70-year-old formalin-fixed Greek cadaver, in the Department of Anatomy and Surgical Anatomy of the Medical School of the Aristotle University of Thessaloniki, an unusual SST, along with three LTAs were found. Moreover an atypical LDM innervation and a high-level interconnection of the MCN with

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the MN were revealed. At the AA 3rd part, the anterior circumflex humeral artery (ACHA) and an unusual SST were recorded (Figure 1A, 2A). A circumflex accessory LTA supplied the upper part of the subscapularis muscle (SSM). The SST initially trifurcated into the posterior circumflex humeral artery (PCHA), the subscapular artery (SSA) and the second accessory LTA. The second trifurcation constituted from the SSA division into the thoracodorsal artery (TDA) and the circumflex scapular artery (CSA) in common origin with the lower subscapular artery (LSSA) (Figure 1B, 2B). At the upper humeral part, a (MCN-MN) interconnection was noticed. This thick interconnection is equivalent to an additional lateral root (2nd) of the MN, according to Buch-Hansen's (5) description. The brachial plexus posterior cord, typically, gave off the upper subscapular, the thoracodorsal and the lower subscapular nerves. The lower subscapular nerve innervated the SSM and, very interestingly, the LDM upper part (Figure 1C, 2C).

Discussion

The typical AA pattern occurs in only 27% of cases (6), as 23 variant patterns have been described as having a female predilection (4, 6). The most common variations involve the origin of the AA branches via common trunks (2).

No complete embryological theory explains the development of the AA network and its further variability. Rodríguez-Niedenführ et al. (7) supported the notion that upper limb arteries develop by selective enlargement or regression of a capillary micro-network plexus, in a proximal to distal fashion, following the development of muscular and osseous elements. Hypothetically, this could explain the discrepancy between the AA's wide variability in the origin of its branching pattern on the one hand, and the stability in the course of its branches and distribution on the other (laterality). Constancy in axillary muscular and vascular termination exists, while the vessels' origin is sub-

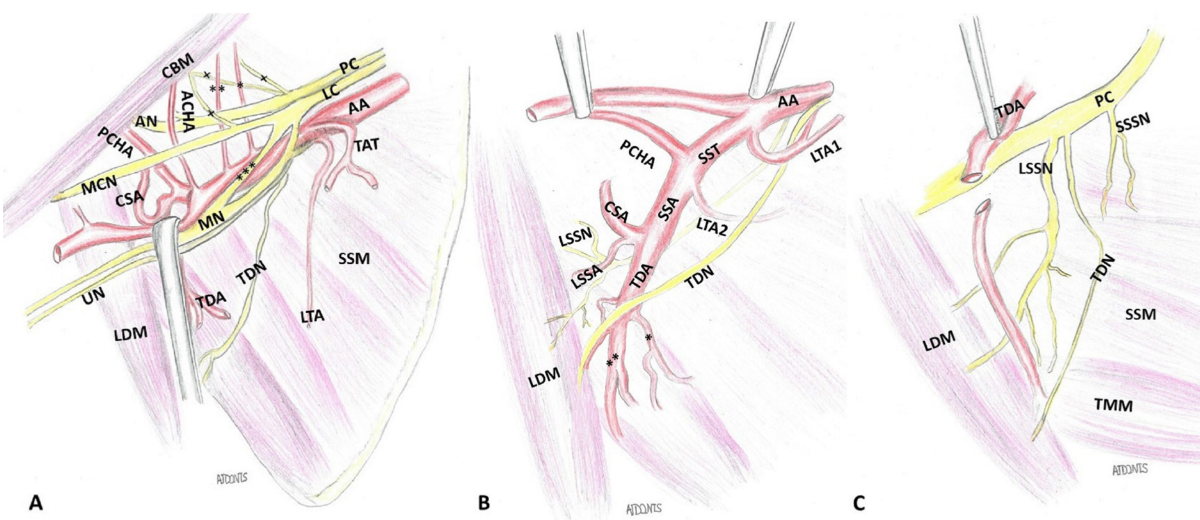

Figure 1. **A.** The axillary artery (AA) division into a thoracoacromial trunk (TAT) and a lateral thoracic artery (LTA). Two small-caliber (* and **) branches to the coracobrachialis muscle (CBM) and the shoulder joint capsule. CBM innervation by the musculocutaneous nerve (MCN) and by three additional thin neural branches (+) (two of them originate from the brachial plexus-BP posterior cord-PC), and the third from the MCN after its typical formation from the BP lateral cord-LC), MCN-MN interconnection (***, the additional MN lateral root), UN-ulnar nerve, LDM-latissimus dorsi muscle, SSM-subscapular muscle. **B.** AA 3rd part: circumflex accessory (LTA_1) loop anterior to thoracodorsal nerve (TDN). Subscapular trunk (SST) trifurcation into the posterior circumflex humeral artery (PCHA), subscapular artery (SSA) and LTA_2. SSA trifurcation into the thoracodorsal artery (TDA), the circumflex scapular artery (CSA) with common origin with the lower subscapular artery (LSSA). TDA division into a common trunk (*of descending course) which bifurcates into a branch for the serratus anterior muscle (SAM) and another for the SSM. A 2nd common trunk (**) along the lateral scapular margin until its lateral inferior angle (TDA angular branch). **C**. BP PC typical division into the superior subscapular, the thoracodorsal and the lower subscapular nerves (SSSN, TDN AND LSSN). Next to the TDN origin, the LSSN, typically innervates SSM and the upper part of the latissimus dorsi muscle (LDM), TMM-teres major muscle.

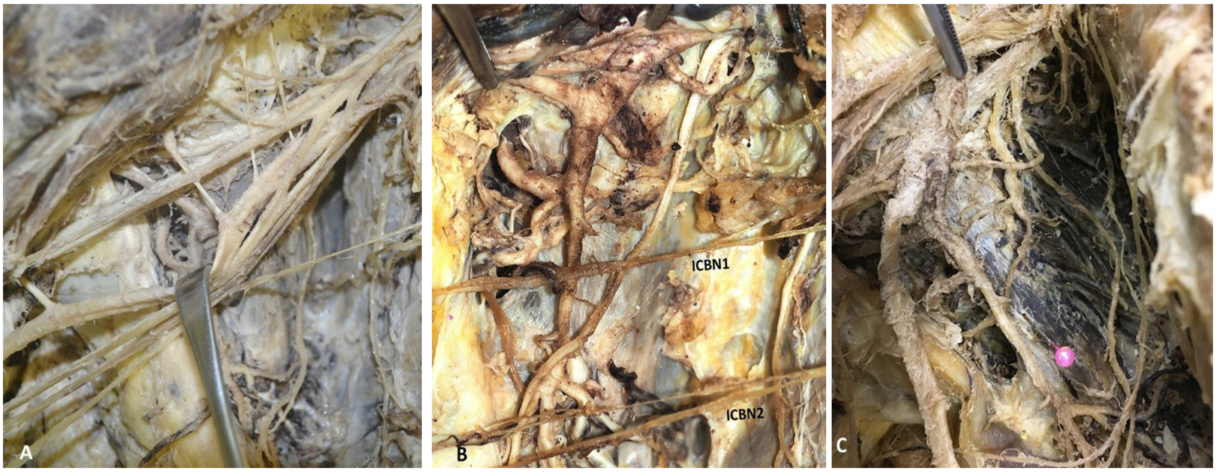

Figure 2. **A.** Right axilla dissection, **B.** ICBN-intercostobrachial nerve, **C.** Dissected area.

ject to environmental or genetic changes, or is directly affected by the brachial plexus development (7). Among the AA branches, the LTA, the SSA and the PCHA have the most variable origin and branching patterns (6). In the present case, two accessory LTAs were identified, thus three LTAs in total supply the lateral thoracic wall. LTA may variably originate from the thoracoacromial trunk (67.2%), less frequently from the AA, SSA and TDA (6), and more rarely from the SSA-PCHA common trunk (8). A high LTA origin (28.9%) (2), subscapular (4.2%) (6) and a low, from the deep brachial artery, origin, have also been described (9). Surgeons should be aware of the LTA variants, since the artery must remain intact during axilla reconstruction.The SSA may originate from the 3rd part (47.2-94.1%), the 2nd part (1.66-52.8%) and the 1st part (0.6%) of the AA. It also may create a common trunk with the PCHA (3.8-20%), the LTA (10%), and the transverse cervical artery in 6% of cases (10). The PCHA may have a highly variable origin from the AA 3rd part (77.1%), from the SSA (12%), from the deep brachial artery (8.4%), and from the LTA (1.2%) (11).

In the current case, great emphasis should be placed on the LDM upper part variant innervation by the LSSN, identified in 2.8% of cases (12). The high-level MCN-MN interconnection is also of high importance. According to Venieratos and Anagnostopoulou (13), the current case is classified as Type I, since the communicating branch originates before the MCN pierces the CBM. It is not clear whether this branch is considered an (MCN-MN) interconnection or a second lateral root of the MN. According to Buch-Hansen, who compare the thickness of the communicating branch with that of the MN lateral root, the MN in our case presents a 2nd lateral root (5). Detailed knowledge of the AA variant branching pattern is of paramount importance, as the variants may pose diagnostic dilemmas during angiography, and intraoperative misinterpretations during lymph node dissections. Thus, preoperative regional blood supply mapping, identified by Doppler ultrasound imaging or angiography (14) is an essential tool for planning and protecting the flaps and for making dissection quicker and easier. The SSA branching pattern may serve as a donor graft for reconstruction of the lateral thoracic wall and oromandibular defects, as well as in mastectomy restoration (6). In-depth knowledge of MCN-MN interconnections is of great importance for the diagnosis and treatment of MN and MCN dysfunction, especially in posttraumatic surgical repair (15).

Conclusion

This case describes an unusual AA branching pattern with a SST formation associated with accessory LTAs. A high level MCN-MN interconnection, as an additional lateral root of the MN was also revealed. A rare innervation of the LDM upper part by the LSSN was also observed. Surgeons should bear such variants in mind when performing muscle flap transfers, thoracic wall reconstruction, and axillary oncology procedures.

What Is Already Known on This Topic:
The typical axillary artery (AA) pattern occurs in only 27% of cases. The lateral thoracic (LTA), the subscapular (SSA) and the posterior circumflex humeral (PCHA) arteries present the widest variability in their origin and branching patterns. High SSA origin was reported in 28.9% of cases, and low origin far more rarely. A common subscapular trunk may give rise to a thoracoacromial trunk, the LTA, the SSA and the PCHA.

What This Case Adds:
The right-sided axillary artery had an unusual branching into a subscapular trunk and two accessory lateral thoracic arteries of variable origin and course. Concomitantly, a high-level interconnection between the musculocutaneous and median nerves was identified (the so-called additional lateral root of the MN). A very rare innervation of the upper part of the right latissimus dorsi muscle by a lower subscapular nerve was also found. The above combination has never been reported before.

Authors' Contributions: Conception and design: NL and MP; Dissection and photographs: NL and KN; Acquisition, analysis, and data interpretation: NL, MP, GP; Schematic drawings: IA; Drafting the article: NL and MP; Revising it critically for important intellectual content: GP, GS and KN; Approved final version of the manuscript: NL, MP, IA, GP, GS and KN.

Conflict of Interest: The authors declare that they have no conflict of interest.

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