

Anomalous Branching Patterns of the Axillary Artery

Patrones de Ramificación Anómalos de la Arteria Axilar

Jong-Wan Kim^{*}; Hyo Seok Park^{*}; Jin Seo Park^{*} & Yong-Wook Jung^{*}

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SUMMARY: Arterial variations in the upper limbs can cause iatrogenic injury during invasive procedures. During educational dissection of countered uncommon branching patterns of the axillary artery which have not yet been reported yet, to our knowledge. First, the second part of the axillary artery was divided into three trunks. The lateral trunk ran downward as a superficial brachioradial artery. The medial trunk raised the lateral thoracic artery, and was divided into the subscapular artery and the posterior circumflex humeral artery. The intermediate trunk branched off the anterior circumflex humeral artery as expected for an axillary artery. Second, in the other cadaver, we found a common trunk containing the thoracoacromial artery and a bulk artery dividing into three branches, the subscapular, posterior circumflex humeral, and lateral thoracic arteries. Taken together, we discuss the clinical implications and possible developmental origins of variations in the axillary artery branching and course.

KEY WORDS: Arterial variations; Axillary artery; Upper limb; Branching patterns.

INTRODUCTION

Axillary artery, a direct continuation of the subclavian artery, begins at the outer border of the first rib and ends at the inferior border of the tendon of the teres major muscle. It is classically divided into three parts according to the pectoralis minor muscle and each part has its own branches. The axillary artery normally branches off the superior thoracic artery in the first part, the lateral thoracic and thoracoacromial arteries in the second part, and the subscapular, anterior circumflex humeral, and posterior circumflex humeral arteries in the third part (Drake *et al.*, 2015). The subscapular artery divides into the circumflex scapular and thoracodorsal arteries (George *et al.*, 2007). However, axillary artery branching patterns are extremely variable and mostly subscapular artery and posterior circumflex artery are involved in the variations (Hattori *et al.*, 2013). Although some crucial points remain confusing due to the use of different terminologies and classification criteria, knowledge about arterial variation is critical in the clinical or surgical field to reduce chances of arterial damage during surgery.

In the present report, we describe what we believe to be a previously unreported branching pattern of the second part of axillary artery and discuss the clinical implications and possible developmental origins of these anomalies.

CASES REPORT

Case 1. Arterial variations were observed in the right upper limb of a 50-year-old Korean male cadaver during educational dissection. Axillary artery usually raises the superior thoracic and thoracoacromial artery in the first and second parts, respectively. However, in this case, the second part of axillary artery, just below the pectoralis minor muscle, was divided into three trunks. According to their positions, the trunks were named the lateral trunk, intermediate trunk, and medial trunk (Fig. 1). The lateral trunk descended superficially in the arm, medial to the biceps brachii muscle, covered only by skin, subcutaneous tissue, and brachial fascia. It continued 1.5 cm at length and then branched off a pectoral branch for the pectoralis minor muscle. It then coiled once (Fig. 1) and descended superficially in the arm and forearm, passing deep to the flexor retinaculum. Its subsequent course was normal. Accordingly, the artery was defined as a superficial brachioradial artery (Konarik *et al.*, 2009). The medial trunk continued 2 cm more from the trifurcated site, and branched off the lateral thoracic artery, which followed the lower border of the pectoralis minor muscle. At this point, the medial trunk was divided into the posterior circumflex humeral artery and the subscapular artery. The latter continued 1 cm more at length to terminate at the division of the circumflex scapular artery and thoracodorsal artery. The intermediate trunk coursed as a

^{*} Department of Anatomy, Dongguk University School of Medicine, Gyeongju, Republic of Korea.
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typical axillary artery, and branched off the anterior circumflex humeral artery in its third part (Fig. 2a and 2b).

Case 2. During a routine educational dissection, a rare branching pattern of right axillary artery was found in a 74-year-old Korean female cadaver. The pectoralis minor muscle was found and three parts of the axillary artery

were carefully divided. The superior thoracic artery was found to arise normally from the first part of the axillary artery. However, in the second part of the axillary artery, a common trunk was found with several branches. The common trunk continued around 3 cm more at length from the axillary artery and gave off the pectoral branch as the thoracoacromial artery, and then, a bulk artery dividing

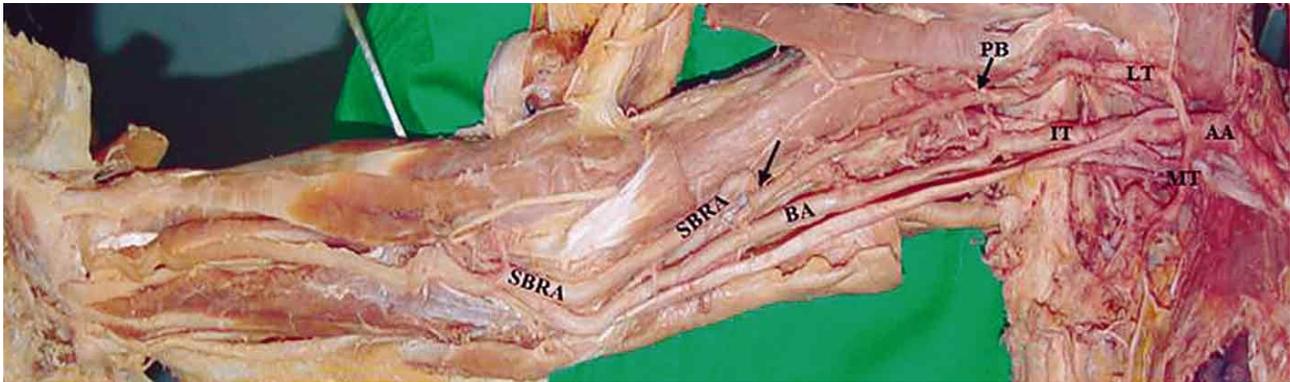


Fig. 1. The second part of the axillary artery was divided into lateral, intermediate, and medial trunk. The lateral trunk descended superficially in the arm, and then coursed as a superficial brachioradial radial artery. The arrow indicates coiling of this artery. The intermediate trunk descended normally, as the brachial artery. AA - axillary artery, BA - brachial artery, IT - intermediate trunk, LT - lateral trunk, MT - medial trunk, PB - pectoral branch, SBRA - superficial brachioradial artery.

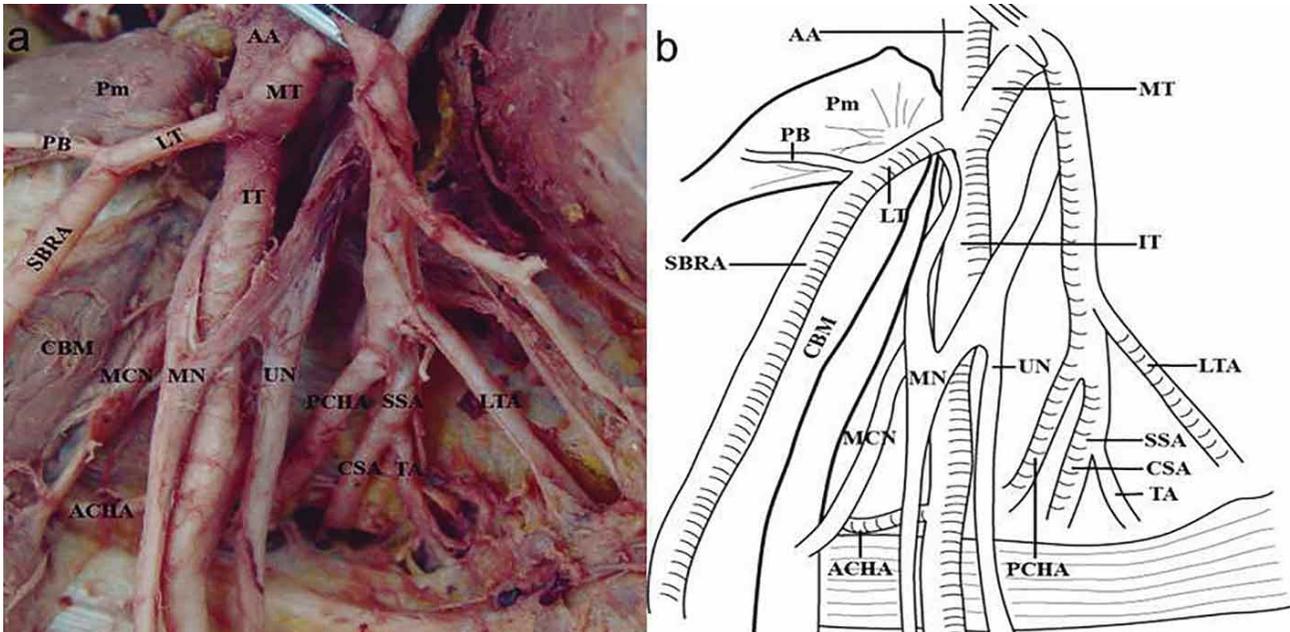


Fig. 2. Photograph (a) and schematic drawing (b) to show the trifurcated trunk of the second part of the axillary artery. The artery was trifurcated into three trunks, that is, the lateral, intermediate, and medial trunk. The lateral trunk divided into the superficial brachioradial artery and the pectoral branch. The intermediate trunk coursed as the typical axillary artery and gave off the anterior circumflex humeral artery. The medial trunk gave off the lateral thoracic artery and was divided into the subscapular artery and the posterior circumflex humeral artery. AA - axillary artery, ACHA - anterior circumflex humeral artery, BA - brachial artery, CBM - coracobrachialis muscle, CSA - circumflex scapular artery, IT - intermediate trunk, LT - lateral trunk, LTA - lateral thoracic artery, MCN - musculocutaneous nerve, MN - median nerve, MT - medial trunk, PB - pectoral branch, PCHA - posterior circumflex humeral artery, Pm - pectoralis minor muscle, SBRA - superficial brachioradial artery, SSA - subscapular artery, TA - thoracodorsal artery, UN - ulnar nerve.

into three branches, the subscapular, posterior circumflex humeral, and lateral thoracic artery (Fig. 3a and 3b). The subscapular artery continued 2 cm more from the thoracoacromial artery and then divided into the thoracodorsal and circumflex scapular artery. The posterior circumflex humeral artery was accompanied by the

axillary nerve and they entered the quadrangular space. The anterior circumflex humeral artery arose normally from the third part of the axillary artery. Below the lower margin of the teres major muscle, the axillary artery continued as the brachial artery. Its further course was normal.

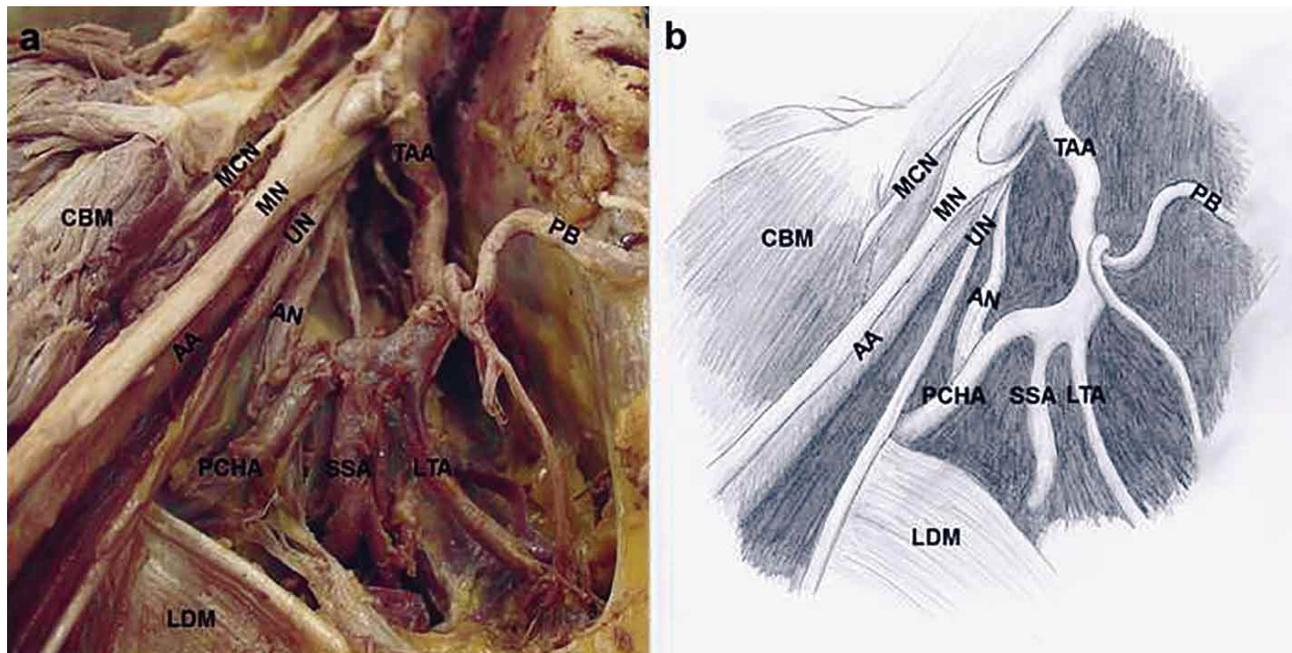


Fig. 3. Photograph (a) and schematic drawing (b) to show the common trunk of the second part of the axillary artery. AA, axillary artery; AN, axillary nerve; CBM, coracobraccio muscle; MCN, musculocutaneous nerve; MN, median nerve; LDM, latissimus dorsi muscle; LTA, lateral thoracic artery; PB, pectoral branch; PCHA, posterior circumflex humeral artery; SSA, subscapular artery; TAA, thoracoacromial artery; UN, ulnar nerve.

DISCUSSION

In the first case, the medial trunk was a common trunk for the lateral thoracic, subscapular, and posterior circumflex humeral arteries. The intermediate trunk gave off the anterior circumflex humeral artery. The lateral trunk extended the radial artery in the forearm as the superficial brachioradial artery. Because the radial artery is a useful route for coronary procedures, its variations are clinically important (Jelev & Surchev, 2008). We reviewed the literature on variations of the origin of the radial artery in order to understand these variations more. Recent report has described that high origin of the radial artery usually was represented as the brachioradial artery, or the superficial brachioradial artery (Loukas *et al.*, 2009). However, we could not find any literature to report the branching pattern and origin of superficial brachioradial artery observed in this case. In the second case, a common trunk from the second part of the axillary artery contained the thoracoacromial, lateral

thoracic, subscapular, and posterior circumflex humeral arteries. To the best of our knowledge, this is the first article to describe the trifurcated trunk or the common trunk for branches of the axillary artery.

These variations mentioned above could be explained by disturbed embryonic development of the vascular plexus of the upper limb bud. It has been established that the primitive blood vessels of limb buds are formed from developing dorsal aortic arches, which unite in the capillary plexus of arm buds (Testut & Latarjet, 1958). During development progresses, one connecting vessel remains and extends outward from the subclavian artery as a single axis that differentiates successively into the axillary, brachial, and interosseous arteries (Tuchmann-Duplessis *et al.*, 1972). However, a reduction in the available space required for normal embryonic development can occur because the axilla

contains many lymph nodes, adipocytes, and loose areolar tissues. In addition, extreme shoulder extension or flexion during uterine development may compress the axillary artery and surrounding nerves, and thus, the anatomical characteristics of the axilla can include unusual fusions and absorptions of the vascular plexus and result in the variations reported here.

In the present article, we described a unique branching pattern of the axillary artery. Driven by the increasing use of invasive procedures, accurate knowledge of arterial

variations of the upper extremity is of considerable importance for surgeries and interventional vascular procedures. Therefore, we believe that this case report will be helpful for clinicians and anatomists.

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RESUMEN: Las variaciones arteriales en los miembros superiores pueden causar lesiones iatrogénicas al realizarse procedimientos invasivos. Durante una disección de rutina de los patrones de ramificación de la arteria axilar, se encontró una disposición aún no informada. En primer lugar, la segunda porción de la arteria axilar se presentó dividida en tres troncos. El tronco lateral se desplazó hacia abajo como una arteria braquiorradial superficial (arteria radial originándose de la arteria axilar). El tronco medial dio origen a la arteria torácica lateral, y se dividió en arteria subescapular y arteria circunfleja humeral posterior. El tronco intermedio dio origen a la arteria circunfleja humeral anterior como se espera para una arteria axilar. En un segundo cadáver, encontramos un tronco común entre la arteria toracoacromial y una arteria de mayor tamaño que se dividió en tres arterias: subescapular, circunfleja humeral posterior y torácica lateral. Consideradas estas variaciones arteriales en conjunto, se discuten las implicaciones clínicas y posibles orígenes del desarrollo de las variaciones en la ramificación de la arteria axilar y su trayecto.

PALABRAS CLAVE: Variaciones arteriales; Arteria axilar; Miembro superior; Patrones de ramificación.

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Correspondence to:
Yong-Wook Jung
Department of Anatomy
Dongguk University School of Medicine
87 Dongdae-ro
Gyeongju, 780-350
REPUBLIC OF KOREA

Tel: +82-54-770-2404
Fax: +82-54-770-2402

Email: jungyw@dongguk.ac.kr

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