

Case Report of the Bilateral Absence of the Musculocutaneous Nerve Combined with the Unilateral Brachioradial Artery

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Abstract : During the routine gross anatomical dissection, bilateral absence of the musculocutaneous nerve and unilateral brachioradial artery were found in a 76-year-old Korean male cadaver. At the apex of the axilla, the lateral cord of the brachial plexus united into the median nerve without branching off the musculocutaneous nerve. The flexor arm musculatures, normally innervated by the musculocutaneous nerve, were innervated by two separate branches from the median nerve. The distal one continued as the lateral antebrachial cutaneous nerve. In addition, the radial artery of the left arm was originated from the middle one-third of the brachial artery. At bifurcation, it lay deep to the median nerve and crossed it medially. However, at the elbow, it crossed again the median nerve anterolaterally. Just above the cubital fossa, it anastomosed with the brachial artery. The arterial distribution of the right arm was normal. The separate reports which described the absence of the musculocutaneous nerve or brachioradial artery have been reported. However, this combined variation has not been documented until now.

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Introduction

The musculocutaneous nerve, one of the terminal branches of the lateral cord of the brachial plexus, is formed by the ventral primary divisions of the C5 to C7 spinal nerves. It normally pierces the coracobrachialis muscle and continues deep between the brachialis and biceps brachii muscles, to innervate all these three muscles. Right above the elbow, it penetrates the brach-

ial fascia lateral to the biceps tendon and continues through the forearm as the lateral antebrachial cutaneous nerve (Woodburne and Brukel 1988).

The brachial artery, a continuation of the axillary artery, begins from the lower border of the teres major muscle. At its origin, it lies medial to the humerus and then in front of it before crossing the epicondyles at the elbow. In its course within the arm, the artery gives off the deep brachial artery, the nutrient artery, the superior and inferior ulnar collateral arteries, and many unnamed arteries. It ends by dividing into radial and ulnar arteries at the lower part of the cubital fossa (Woodburne and Brukel 1988).

A number of variations regarding the origin and

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courses of the musculocutaneous nerve and brachial artery have been reported and classified (Rodriguez-Niedenfuhr et al. 2001, Bergman et al. 2004). The clinical importance of the precise knowledge of these variants has also been emphasized by many other authors (Pabst and Lippert 1968, Alnot 1988, Gacek 1990, Harry et al. 1997, Bianchi 2001, Patnaik et al. 2002, Morris et al. 2005, Fregnani et al. 2008). Here, we report a case of bilateral absence of the musculocutaneous nerve associated with unilateral variation of the brachial artery (brachioradial artery). The median nerve takes over the innervations of the flexor musculatures of the arm.

Materials and Methods

This study has been done in the Department of Anatomy and Neurosciences, School of Medicine at Eulji University in Republic of Korea. During the educational dissection course in the second semester of 2008, we observed unusual features of the neurovascular distribution in the upper extremities of a 76-year-old Korean male cadaver who had died from pneumonia and donated himself to our Department for educational and research purposes. The abdominal and thoracic organs did not show any anomalies and variations. To preserve the origins, its distributions of the brachial plexus, and the brachial artery, a careful dissection of the axilla and the proximal regions of the arm was undertaken. To ensure a clear field for visualization of the brachial region, both clavicles were removed and the pectoralis major and minor muscles were cut from their origin and reflected. All veins of the upper extremities were identified and cleared carefully.

The findings were photographed using a Samsung digital camera (VLUU NV10; Samsung Inc., Seoul, Korea), and schematic diagrams were illustrated using Adobe Photoshop (version 6.0; Adobe System Inc., San Jose, CA, U.S.A).

Results

1. Absence of the musculocutaneous nerve

In both arms, it was observed that the lateral cord of the brachial plexus gave off the lateral pectoral nerve and then, without giving off the musculocutaneous nerve, it merged into the median nerve as the lateral root of it. The median nerve was formed in front of the axillary artery by the union of the lateral and medial roots from each cord (Fig. 1). The flexor musculatures of the arm, the biceps brachii, brachialis and coracobrachialis muscles, were innervated by two branches which emerged from the brachial part of the median nerve. The proximal one arose from about 9 cm inferior to the point of the formation of the median nerve, at the level of the bifurcation of the long head and short head of the biceps brachii muscle. It ran laterally to the depth of the biceps brachii muscle and innervated it with the coracobrachialis muscle (arrowheads in Fig. 1). The distal one also emerged from the median nerve about 3 cm below the proximal branch and innervated the brachialis muscle (double arrowheads in Fig. 1). After giving rise to muscular branches to the brachialis muscles, the latter one took a downward and lateral path between the biceps brachii and brachialis muscles. Then it pierced the deep fascia lateral to the tendon of the Biceps brachii and continued as the lateral antebrachial cutaneous nerve. No other nerve variation was found in both upper extremities.

2. Brachioradial artery

On the left arm, the brachioradial artery was branched off medially from the middle one-third of the brachial artery, at the midpoint between the proximal and distal muscular branches of the median nerve described above (Asterisk in Fig. 1). Distal from its commencement, the brachioradial artery lay deep to the median nerve and

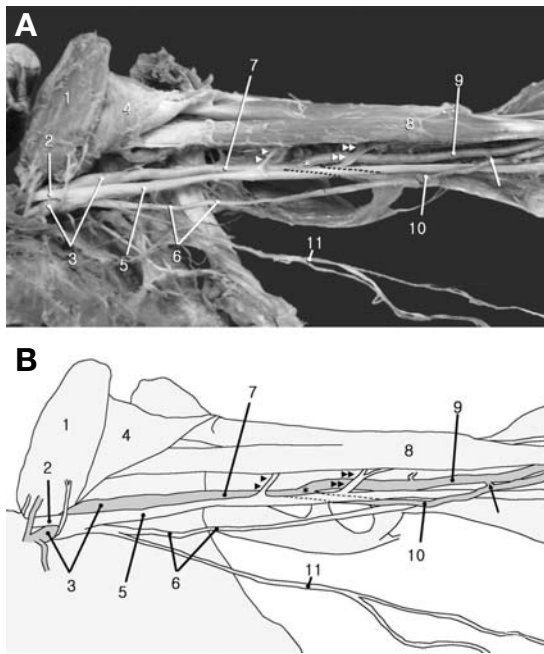


Fig. 1. Photograph of dissected left axilla and brachial region (A) and its schematic drawing (B). All veins in the regions are removed, and the pectoralis major and minor muscles are reflected from their origins. After giving off the lateral pectoral nerve, the short segment of the lateral cord of the brachial plexus merges into the median nerve as the lateral root of it, without giving off the musculocutaneous nerve. The arrowheads and double arrowheads indicate the proximal and distal muscular branches of the median nerve to innervate the arm flexor muscles. The arrow indicates the anastomosis between the brachial artery and the brachioradial artery. Note the bifurcation of the brachioradial artery from the middle one-third of the brachial artery (asterisk). (1) pectoralis minor muscle; (2) lateral cord of the brachial plexus; (3) axillary artery; (4) pectoralis major muscle; (5) median nerve; (6) ulnar nerve; (7) brachial artery; (8) biceps brachii muscle; (9) continuation of brachial artery; (10) brachioradial artery; (11) common branch of the medial brachial and antebrachial cutaneous nerve.

ran cross it medialward (dot line in Fig. 1). In the cubital fossa, it crossed the median nerve and brachial artery anterolaterally again and then gave off some muscular branches and radial recurrent artery (Fig. 2). Just above the cubital fossa, it anastomosed with the brachial artery

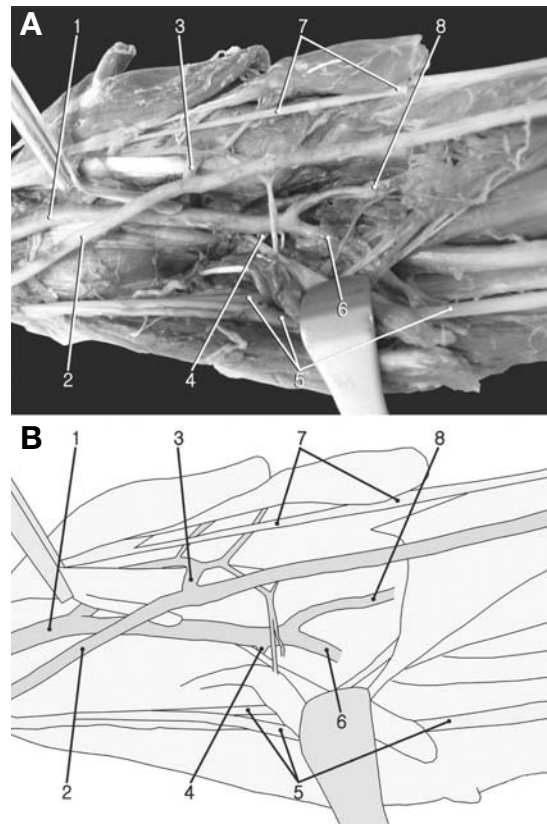


Fig. 2. Photograph of dissected left elbow region (A) and its schematic drawing (B). The median nerve reflected medially. (1) brachial artery; (2) brachioradial artery; (3) recurrent radial artery; (4) recurrent ulnar artery; (5) median nerve and its twigs; (6) ulnar artery; (7) radial nerve; (8) common interosseous artery.

(arrow in Fig. 1). Meanwhile, the brachial artery gave off some muscular branches in the arm and continued its course laterally to the median nerve. In the cubital fossa, it divided into two arteries: the common interosseous and ulnar artery. The ulnar recurrent artery originated from the brachial artery right before its bifurcation into two branches. The following course of each of the radial, ulnar, and common interosseous artery was within normal limit. The arterial distribution of the right arm did not show any peculiar variations.

Discussion

The precise knowledge of the variations in the peripheral nervous and arterial system is important to the surgeons and radiologists for their clinical diagnosis and surgical procedures as well as to the anatomists (Haeri and Wiley 1982, Watanabe et al. 1985, Harry et al. 1997, Jurjus et al. 1999, Pandey et al. 2004). This study observed the bilateral absence of the musculocutaneous nerve combined with the unilateral brachioradial artery in a 76-year-old male Korean cadaver.

Bergman et al. (2004) classified the variations of the musculocutaneous nerve according to its origins, courses, and distributions. Normally, it arose from the lateral cord (90.5%), from the lateral and posterior cords (4%), from the median nerve (2%), as two separate bundles from the medial and lateral cords (1.4%) or from the posterior cord (1.4%). They also mentioned the duplication or the absence of the musculocutaneous nerve without statistical presentation. A few cases on the prevalence of complete absence of the musculocutaneous nerve or brachioradial artery variation have been reported respectively (Lang and Spinner 1970, Ihunwo et al. 1997, Gumusburun and Adiguzel 2000, Song et al. 2003, Beheiry 2004, Aydin et al. 2006, Fregnani et al. 2008), but the bilateral absence of musculocutaneous nerve combined with unilateral brachioradial artery has not reported yet. In these cases, it is considered natural that the median nerve innervates the flexor musculatures of the elbow and the skin of the lateral surface of the forearm, because the lateral cord of the brachial plexus completely united to the median nerve. The branching pattern of the median nerve for arm region innervations is various. Our case is very similar to that of the Gumusburun and Adiguzel (2000): on the way of its passage, two branches are given off from the median nerve and innervate all flexor musculatures of the arm and its terminal portion becomes to form the lateral cutaneous

nerve of the forearm. Three or four branches might be given off from the median nerve (Aydin et al. 2006, Fregnani et al. 2008). It also has been reported that the coracobrachialis muscle was innervated by the lateral cord and the biceps brachii and brachialis muscles were innervated from the median nerve (Lang and Spinner 1970, Song et al. 2003).

These variations of peripheral nerves in the brachium can be explained by the failure of differentiation of the brachial plexus (Shinohara et al. 1990). During the early stage of limb development, the brachial plexus appeared as a single radicular cone in the upper limb. After dividing into ventral and dorsal segments, the ventral segment of the brachial plexus gives off the median and the ulnar nerves. After that, the musculocutaneous nerve arises from the median nerve (Iwata 1960). Therefore the failure of the separation of the musculocutaneous nerve from the median nerve may be able to explain the absence of the musculocutaneous nerve.

Compared with the nervous variation, the variations of the main arteries of the upper limb are more common events. McCormack et al. (1953) reported that the percentage of the variation of the major arterial pattern of the upper limb was 18.53%, based on the observation of 750 dissected upper extremities. In order to simplify previous classifications, and to unify the terminology and morphological descriptions, Rodriguez-Niedenfuhr and his colleagues (2001) reviewed the literatures on arterial variations in the upper limb. They also examined their own 192 cadavers and presented statistically reliable data on the arterial variations of the upper limb (Rodriguez-Niedenfuhr et al. 2001). On their criteria, our case could be classified as brachioradial artery, which can be defined as a radial artery with a high origin. This brachioradial artery has been described as the most frequently observed variation of the upper limb (Grüber 1867, Keen 1961, Rodriguez-Baeza et al. 1995). The brachioradial artery could be originated from the axillary artery (23%), the upper one-third of the brachial

artery (65%), the middle one-third of the brachial artery (7%), and the lower one-third of the brachial artery (3%). At the elbow, the brachioradial artery could pass either anterior to the bicipital aponeurosis (36%) or posterior to it (65%) (Rodriguez-Niedenfuhr et al. 2001). In our case, the brachioradial artery was originated from the middle one-third of the brachial artery and passed the bicipital aponeurosis posteriorly.

The superficial position (the anterior pass) of the brachioradial artery to the bicipital aponeurosis at the cubital fossa is clinically significant. It is not only vulnerable to trauma injury but also can be mistaken for a superficial vein for venepuncture, with the risk of potential intra-arterial injection (Pabst and Lippert 1968, Nakatani et al. 1998, Yazar et al. 1999, Jacquemin et al. 2001). However, if it can be notified before any surgical procedures, it also could be used for an easy and fast route to arterial catheterization (Nakatani et al. 1998, McWilliams and Sodha 2000, Jacquemin et al. 2001).

It is not easy to elucidate the link between the nerve variation and arterial abnormally, because they develop relatively independent manner. There have been no literatures to demonstrate the relationship between them so far. If we could investigate a vast number of cadavers, we could have opportunity to find some cues to reveal the relationship between nerve and arterial variation, and that work will give us valuable knowledge about human development. Further investigations are needed.

This study reported the rare case of upper limb variation: the bilateral absence of the musculocutaneous nerve in combination with the unilateral brachioradial artery. To our knowledge, this combined arterial and neural variation is reported here for the first time. Although this variation of the upper limb may not have affected the function of the arm, the awareness of such variation will be helpful not only to anatomical education but also on surgical or diagnostic procedures.

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근육피부신경의 양측성 부재와 일측성 위팔노동맥 증례 보고

송대용, 오경민, 이지혜, 우란숙, 유하늘, 백태경
울지대학교 의과대학 해부학 및 신경과학교실 · 의과학연구소

간추림 : 해부학실습 과정 중, 76세 한국인 남성 시신에서 양쪽 팔 모두에서 근육피부신경이 없고, 한쪽 팔에서 위팔노동맥이 형성된 사실을 발견하였다. 겨드랑쪽대기에서 팔신경얼기의 가쪽신경다발이 근육피부신경을 내지 않고 모두 정중신경으로 합쳐졌다. 정상적인 경우 근육피부신경에 의해 지배받는 위팔의 굽힘근들이 정중신경에서 기원한 두 가닥의 신경가지에 의해 지배받았다. 이 중 먼쪽 신경가지는 계속되어 가쪽아래팔피부신경이 되었다. 또한 왼쪽 팔의 노동맥이 위팔동맥의 중간 삼분의 일 지점에서 기원하였다. 위팔동맥으로부터 분지되는 지점에서 노동맥은 정중신경의 깊은 곳을 안쪽으로 가로질렀다. 그러나, 팔꿈치 부위에서 노동맥은 다시 정중신경을 앞가쪽으로 가로질러 주행하였다. 팔오금 바로 위에서 노동맥은 위팔동맥과 연결되는 작은 문합가지를 내었다. 오른팔의 동맥분포는 정상이었다. 근육피부신경의 부재와 위팔노동맥의 변이는 그동안 독립적으로 보고된 바 있다. 그러나 이번 연구에서와 같이 두 변이가 한 시신에서 동시에 발견된 보고는 일찍이 없었다.

찾아보기 낱말 : 근육피부신경, 위팔노동맥, 해부학적 변이