Some variations of the brachial plexus in man

Mustafa SARSILMAZ[1], Erdoğan ŞENDEMİR[2], H.Hamdi ÇELİK[3], Yakup GÜMÜŞALAN[1], Cevat ŞİMŞEK[1]

[1] Department of Anatomy, Gülhane Military Medical Academy, Aankara, TURKEY
department of Anatomy, Uludağ University Faculty of Medicine, Bursa, TURKEY
[3]Department of Anatomy, Hacettepe University Faculty of Medicine, Ankara, TURKEY

Four unusual unilateral distributions of the brachial plexus, observed on 71 cadavers in the last four years, are reported. In the first case median nerve contributes to musculocutaneus nerve in two points. The second case is identical to the first one. In the third case lateral root of median nerve (radix lateralis nervi mediani) separates from the lateral cord (fasciculus lateralis) as two branches and these branches join to the median nerve 1.6 cm apart from each other. Fourth case-includes three varieties of formation and distribution in itself.
Apart from the suggestions that anomalies are mostly combined as vascular and nervous variations which indicate embryologie influences, our cases do not show any vascular malformations. Although the anatomical variants of the brachial plexus are rare, one must always be alert in surgical interventions. [TurkJ Med Res 1993; 11(4): 161-165]

Key Words: Brachial plexus, Variation, Human.

The brachial plexus is formed by the union of ventral rami of the lower four cervical spinal nerves and the major part of the first thoracic ventral ramus; the fourth cervical ramus usually gives a branch to the fifth and the first thoracic ramus frequently receives one from the second (1).

However, variations in the constitution and distribution of the brachial plexus have been well described by many authors. Such variations may have clinical importance and could occassionally be noticed or they are usually found postmortally either in autopsy or cadaver dissection. For example,blockade of the brachial plexus or its branches with local anesthesia depends upon the anatomical arrangement of the plexus. In order to perform an axillary block successfully, there is no need for separate injections into the compartments in which each of the nerves in the axillary sheath lie (2).

Anatomical variations of the brachial plexus may also render it vulnerable to injury during routine neck dissection (3).

Received: Jan. 22, 1993 Accepted: March 18,1993

Correspondence: Mustafa SARSILMAZ
Department of Anatomy, Gülhane
Military Medical Academy, Ankara, TURKEY

Anomalous course or unusual distribution of the nerves are more prone to accidental injury and should be considered in examination and reconstruction (4).

Such unusual variations were correlated by Miller (1939) with the type of branching of lhe axillary artery and he emphasized the morphogenetic influence of this vessel on the anatomy of the nervous plexus but mostly on combined vascular and nervous anomalies. There is a dysmorphogenetic influence of aberrant arterial patterns on the early organization of the brachial plexus (5). Wachtler suggests an embryological explanation to such variations in his study, too (6).

Communications between the median and ulnar nerves in the hand and in the forearm provide for variations in the motor innervation of the intrinsic hand muscles, as proved by anatomical and nerve conduction studies. There has been a frequent anastomosis between the median and ulnar nerves in the upper part of the forearm (Martin-Gruber), a rare one between the same nerves in the distal forearm, and an anastomosis in the palm between the recurrent branch of the median nerve and the deep branch of the ulnar nerve (Riche-Cannieu). The knowledge of these anastomoses and the resulting anomalous innervation patterns is of major importance for the assessment of traumatic or entrapment lesions of the median and ulnar nerves. The incidence of Martin-Gruber anasto-

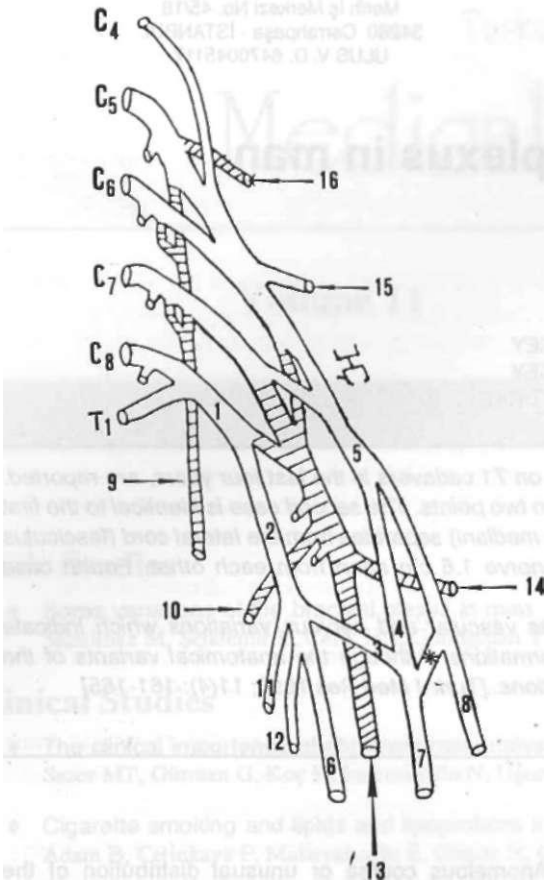


Figure 1. Schematic drawing of first case (*): An abnormal connecting branch between musculocutaneus and median nerves. 1. Truncus inferior, 2. Fasciculus medialis, 3. N. medianus, radix medialis, 4. N. medianus, radix lateralis, 5. Fasciculus lateralis,'6. N. ulnaris, 7. N. medianus, 8. N. musculocutaneus, 9. N. thoracicus longus, 10. N. thoracodorsalis, 11. N. cutaneus brachii medialis, 12. N. cutaneus antebrachii medialis, 13. N. radialis, 14. N. axillaris, 15. N. suprascapular^, 16. N. dorsalis scapulae.

mosis varies between 6% (novocaine nerve block) and 44% (anatomic dissection). The presence of a motor ulnar-to-median anastomosis has been established only in rare instances (7).

In this article our aim is to present four interesting cases of brachial plexus variations.

MATERIAL

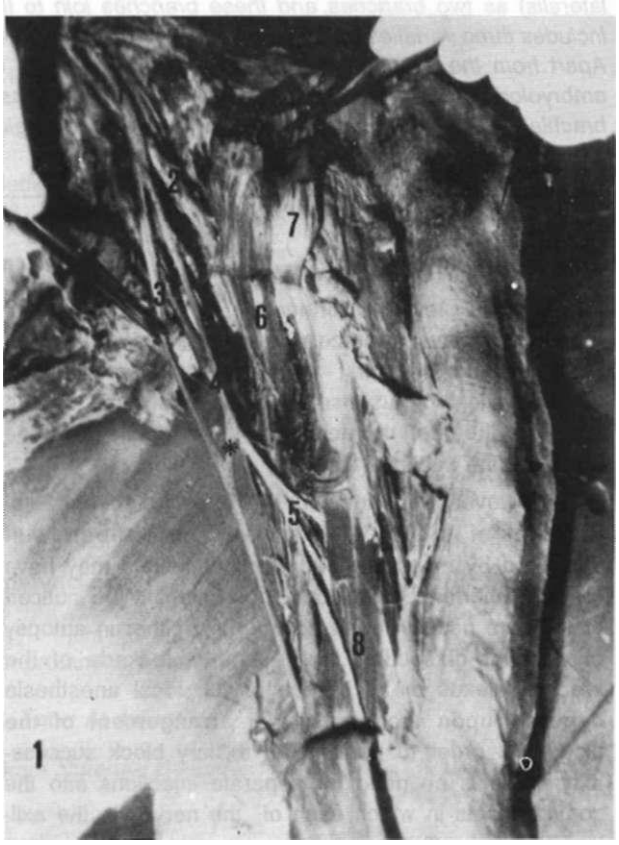
This paper contains the results of anatomical studies carried out in three different medical schools of the authors. 71 cadavers (C5 men, 6 women, aged between 12-64) were dissected and investigated for the formation of the brachial plexus, in the last four years.

OBSERVATIONS

Four of the cadavers dissected showed unusual unilateral distributions of the brachial plexus.

1st case: In this case there is a connection about one cm between the median and musculocutaneus nerves at the left arm. Both of the nerves formed normally, except this connection, which happened approximately at the middle of the left arm. Proximal part of the connecting branch begins from the musculocutaneus nerve, coursing obliquely between two nerves, clings to the median nerve distally (Figure 1, Picture 1).

2nd case: Resemling to the first case, the median nerve contributes to the musculocutaneus nerve in two points. It makes the first connection to the musculocutaneus nerve about 6 cm medial to the coracoid process, after forming anterior to the axillary artery, parallel to the coracobrachialis muscle. The



Picture 1. In the left arm region, the relationship between musculocutaneus and median nerves. Musculocutaneus nerve was liberated medially from coracobrachialis muscle for demonstration (*): An abnormal connecting branch between musculocutaneus and median nerves separating from musculocutaneus nerve and joining to median nerve,

1. Fasciculus lateralis, 2. A. axillaris, 3. N. medianus, 4. N. musculocutaneus, 5. Motor branches of musculocutaneus nerve, 6. M. coracobrachialis, 7. Caput breve musculi bicipitis brachii, 8. M. brachialis.

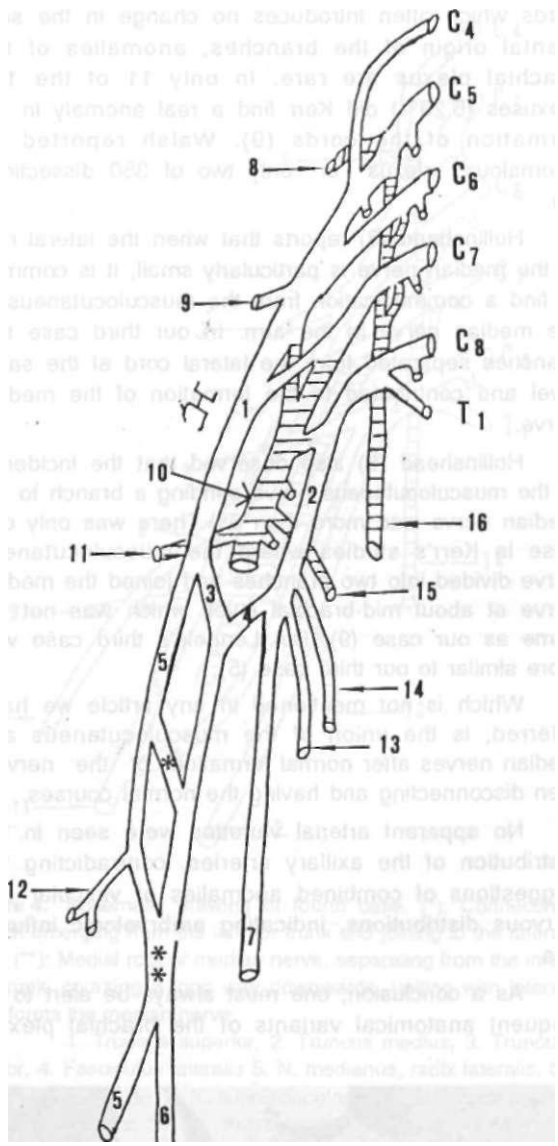


Figure 2. Schematic drawing of second case. Two different connections between musculocutaneus and median nerves are shown. (*); Proximal connecting branch separating from musculocotaneus nerve, coursing obliquely and connecting to median nerve. (**): Union and common course of musculocutaneus and median nerves as a unique trunk. 1. Fasciculus lateralis, 2. Fasciculus medialis, 3. N. medianus, radix lateralis, 4. N. medianus, radix medialis, 5. N. musculocutaneus, 6. N. medianus, 7. N. ulnaris, 8. N. dorsalis scapulae, 9. N. suprascapularis, 10. Fasciculus posterior, 11. N. axillaris, 12. N. musculocutaneus, rami musculares, 13. N. cutaneus antebrachii medialis, 14. N. cutaneus brachii medialis, 15. N. thoracodorsals, 16. N. thoracicus longus.

length of the common branch forming the first connection is about 2 cm. The part of this common branch beginning from musculocutaneus nerve is more proximal to its ending at median nerve and it courses obliquely from lateral (from musculocutaneus nerve) to medial (to median nerve). The second uniting point of the musculocutaneus and median nerves is more distal and thicker than the first one. At the same time it is like two separate parts forming a unique one. While there is a common branch in the first case, in this second case, instead of the common branch, musculocutaneus and median nerves unite and course about 1.6 cm together, then disconnect again. The point of connection is about the section of the middle 1/3 rd of coracobrachialis muscle with the distal 1/3 rd, of it. This variation is on the right arm, where the left brachial plexus seems normal (Figure 2, Picture 2).

3rd case: In the right axillary region lateral root of the median nerve separates from the lateral cord as two branches at the level of coracoid process. Although the departing points of the branches from the lateral cord are too close, they join to the median nerve distally about 1.6 cm apart from each other. The lengths of the branches from their beginning to uniting points are 2.7 cm for the first and 4.6 cm for the second branch. The first (proximal one) lateral root of median nerve unites with the medial root of median nerve (radix medialis nervi mediani) in front of the axillary artery, and then the second (distal one) lateral root of the median nerve joins them. The formation and course of the median nerve and other nerves are normal (Figure 3, Picture 3).

4th case: In this case, the inferior trunk, while coursing distally, gives off three branches at the origination level of the subscapular artery from the axillary artery. The most lateral branch courses first inferior then medial to the axillary artery. After crossing

Picture 2. In the right arm region, double connection between musculocutaneus and median nerves. (*): Proximal connecting branch, (**): Uniting region of musculocutaneus and median nerves. 1. Processus coracoideus, 2. Caput breve musculi bicipitis brachii, 3. N. axillaris, 4. N. musculocutaneus, 5. A. axillaris, 6. Radix lateralis nervi mediani, 7. N. medianus, 8. N. ulnaris, 9. N.cutaneus antebrachii medialis, 10. V. axillaris, 11. Motor branches of musculocutaneus nerve.

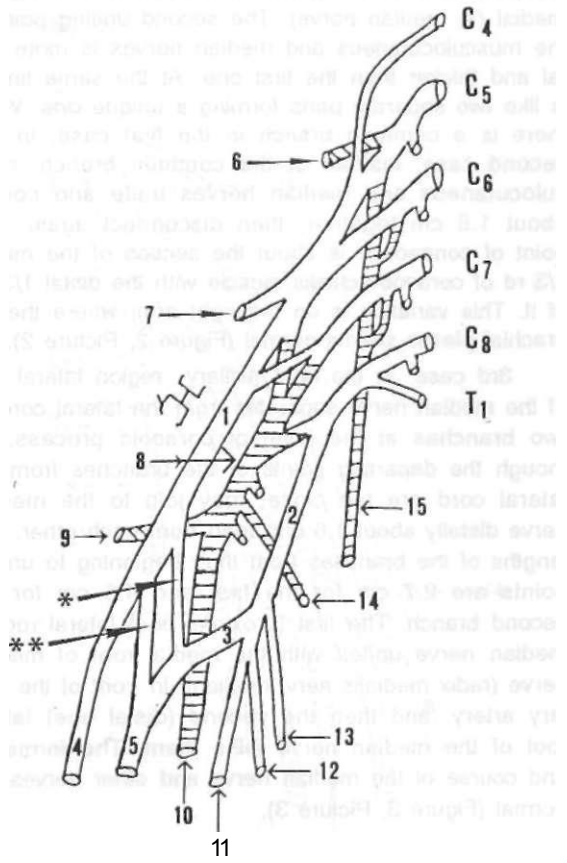


Figure 3: Schematic drawing of third case. Duplication of the lateral root of median nerve is shown. (*): Radix lateralis nervi mediani, proximal part, (**): Radix lateralis nervi mediani, distal part. 1. Fasciculus lateralis, 2. Fasciculus medialis, 3. N. medianus, radix medialis, 4. N. musculocutaneus, 5. N. medianus, 6. N. dorsalis scapulae, 7. N. suprascapular^, 8. Fasciculus posterior, 9. N. axillaris, 10. N. radialis, 11. N. ulnaris, 12.N. cutaneus antebrachii medialis, 13. N. cutaneus brachii medialis, 14. N. thoracodorsal^, 15. N. thoracicus longus.

the artery anteriorly, it unites with the lateral cord. This union resembles the formation of the median nerve by lateral and medial roots in front of the axillary artery. The second branch of the inferior trunk (radix medialis nervi mediani), after coursing distally medial to the axillary artery, forms the median nerve by uniting with the lateral root of the median nerve, distal to the lateral border of the latissimus dorsi tendon, anterior to the beginning of the brachial artery. The third (most medial) branch of the inferior trunk runs distally as ulnar nerve (Figure 4, Picture 4).

DISCUSSION

The common and more obvious variations in the brachial plexus are in its gross form (at the level of junction or separation of its components).

Aside from apparent improper distribution of cords which often introduces no change in the segmental origin of the branches, anomalies of the brachial plexus are rare. In only 11 of the 175 plexuses (6.28%) did Kerr find a real ancmaly in the formation of the cords (9). Walsh reported an anomalous plexus in only two of 350 dissections (8).

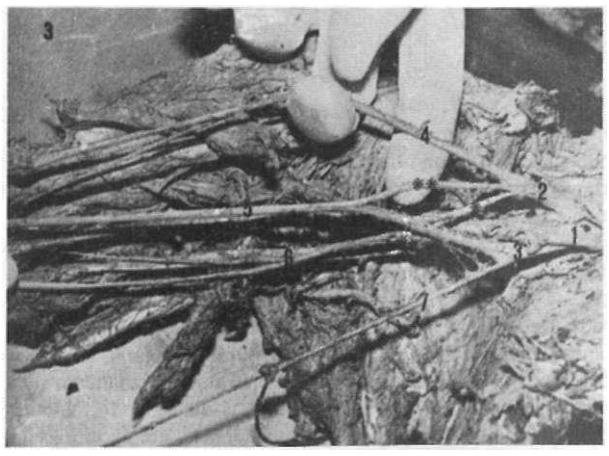
Hollinshead (8) reports that when the lateral root of the median nerve is particularly small, it is common to find a communication from the musculocutaneus to the median nerve in the arm. In our third case two branches separated from the lateral cord at the same level and contributed to the formation of the median nerve.

Hollinshead (8) also observed that the incidence of the musculocutaneus nerve sending a branch to the median nerve was more than 6%.There was only one case in Kerr's studies where the musculocutaneus nerve divided into two branches and joined the median nerve at about mid-brachial level, which was not the same as our case (9). But Lengele's third case was more similar to our third case (5).

Which is not mentioned in any article we have referred, is the union of the musculocutaneus and median nerves after normal formation of the nerves, then disconnecting and having the normal courses.

No apparent arterial varieties were seen in the distribution of the axillary arteries, contradicting the suggestions of combined anomalies of vascular and nervous distributions, indicating embryologie influences.

As a conclusion, one must always be alert to infrequent anatomical variants of the brachial plexus,



Picture 3. In the right axillary region, duplication of the lateral root of median nerve. (*): Proximal part, and (**): Distal part of radix lateralis nervi mediani.

1. A. axillaris, 2. Fasciculus lateralis, 3. Fasciculus medialis, 4. N. musculocutaneus, 5. N. medianus, 6. N. ulnaris, 7. N. cutaneus antebrachii medialis.

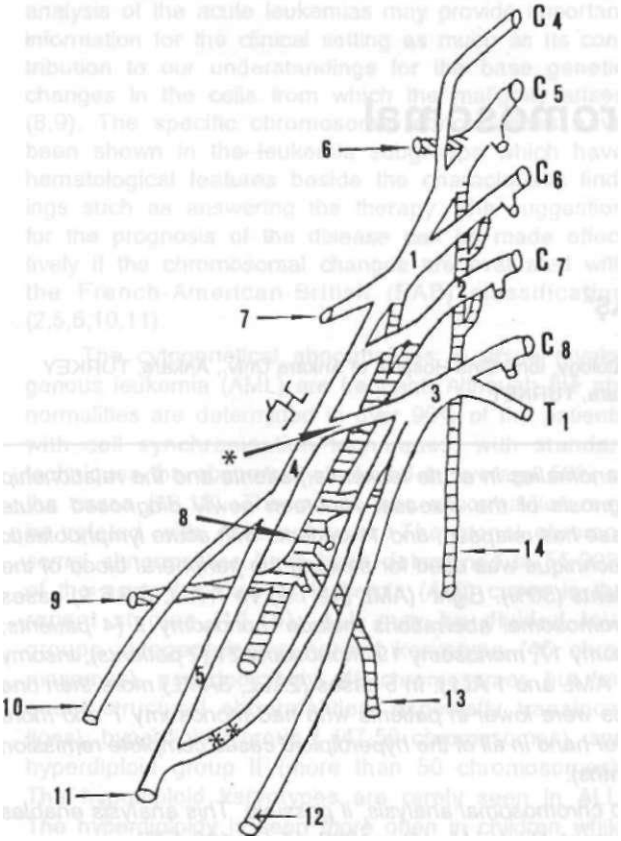


Figure 4. Schematic drawing of fourth case. (*): Connecting branch emerging from the inferior trunk and joining to the lateral cord, (**): Medial root of median nerve, separating from the inferior trunk, coursing a long way downwards, uniting with lateral root, forms the median nerve.

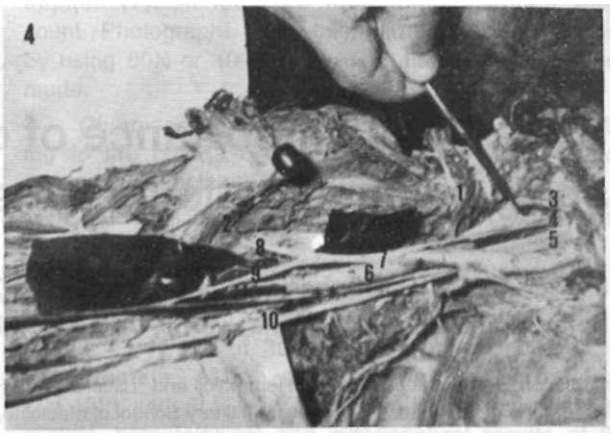
1. Truncus superior, 2. Truncus medius, 3. Truncus inferior, 4. Fasciculus lateralis 5. N. medianus, radix lateralis, 6. N. dorsalis scapulae, 7. N. suprascapular, 8. Fasciculus posterior, 9. N. axillaris, 10. N. musculocutaneus, 11. N. medianus, 12. N. ulnaris, 13. N. thoracodorsalis, 14. N. thoracicus longus.

which can lead to injury in radical neck dissections, in surgical interventions due to breast carcinomas, or to neural complications with anaesthetic injections.

insanlarda bazı brakial pleksus varyasyonları

Son dört yılda disseke edilen 71 kadavrada dört olağandışı tek taraflı brakial pleksus dağılımı gözlenmiştir.

İlk olguda n.medianus iki noktada n.musculocutaneus'a katılmaktaydı, ikinci olgu birinciyle tam uyumluydu. Üçüncü olguda radix lateralis nervi mediani fasciculus lateralis'den iki dal halinde ayrılmakta ve bu iki dal birbirinden 1.6 cm uzaklıkla n.medianus'a birleşmekteydi. Dördüncü olgu ise kendi oluşum ve dağılımında üç farklılık içeriyordu.



Picture 4: In the right axillary region, three different variations in the configuration of brachial plexus are seen. (*): Connecting branch emerging from the inferior trunk and joining to the lateral cord, (**): Media! root of median nerve, separating from the inferior trunk, coursing a long way downwards, uniting with lateral root, forms the median nerve, 1. Processus coracoideus, 2. M. coracobrahialis, 3. Truncus superior, 4. Truncus medius, 5. Truncus inferior, 6. A. axillaris, 7. Fasciculus lateralis, 8. N. musculocutaneus, 9. Radix lateralis nervi mediani,' 10. N. ulnaris, 11. A. brachialis.

Anomalilerin çoklukla embriyona! etkileri gösteren kombine vasküler ve sinirsel varyasyonlar şeklinde olduğu düşüncesine karşılık, belirlediğimiz olgularda vasküler malformasyonlar yoktu. Brakial pleksusun anatomik varyasyonları nadir olmakla birlikte, cerrahi girişimlerde daima dikkatli olunmalıdır. [TurkJMedRes 1993; 11(4): 161-165]

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