Rare multiple variations in brachial plexus and related structures in the left upper limb of a Dravidian male cadaver

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Abstract: Anatomical variations of the nerves, muscles, and vessels in the upper limb have been described in many anatomical studies; however, the occurrence of 6 variations in an ipsilateral limb is very rare. These variations occur in the following structures: the pectoralis minimus muscle, the communication between the external jugular vein and cephalic vein, axillary arch, the Struthers ligament, the medial, lateral, and posterior cords of the brachial plexus, and the common arterial trunk from the third part of the axillary artery. The relationship of these variations to each other and their probable clinical presentation is discussed.

Key words: Pectoralis minimus, Axillary arch, Struthers ligament, Bifurcated posterior cord, Median nerve

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Introduction

Variations in the formation and branching pattern of the brachial plexus are common and are clinically important in diagnosis and treatment. However, the concurrent presence of variant muscles and vessels in intimate relationship with such variations of the brachial plexus can further complicate the clinical picture. In the present report, we present one such case with 2 findings that have not been reported in the literature, thus far: a bifurcated posterior cord with an axillary arch and a common arterial trunk from the axillary artery located between them, and Struthers ligament giving rise to muscle fibers blending with the bicipital aponeurosis.

Case Report

During routine dissection by undergraduate medical students, rare multiple variations were detected in the left upper limb of a male, middle-aged Dravidian (South Indian) cadaver in the Department of Anatomy, Chennai Medical College Hospital and Research Centre, Trichy, Tamil Nadu, India.

An unusually large cephalic vein was found to separate the fibers of the pectoralis minor from the pectoralis minimus in close proximity to its termination into the left subclavian vein (Fig. 1). Fibers of the pectoralis minimus muscle arose from the medial end of the first rib lateral to the origin of the subclavius muscle and inserted into the coracoid process. Moreover, the pectoralis minimus was not present on the right side.

The cephalic vein received a communicating branch from the external jugular vein before piercing the clavipectoral fascia, which was found superficial to the clavicle at its junction between the medial two-thirds and lateral one-third (Fig. 2).

The posterior cord of the brachial plexus was found to be

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Fig. 1. Left pectoral region showing the cephalic vein separating the pectoralis minimus from the pectoralis minor muscle.

Fig. 2. Left pectoral region showing the communication of the cephalic vein with the external jugular vein, which was located superficial to the clavicle.

bifurcated into upper and lower divisions on the left side by an axillary arch and a common arterial trunk from the third part of the axillary artery (Fig. 3). The upper division of the posterior cord gave rise to the axillary nerve and the radial nerve. The lower division of the posterior cord gave rise to the upper and lower subscapular nerves and thoracodorsal nerve. A muscular band called the axillary arch, 7.3 cm in length and 1.5 cm in breadth, arose from the coracoid process; the fibers ran deep to the axillary vessels and nerves and inserted into the latissimus dorsi muscle and were supplied by a twig from the lower division of the posterior cord. The common arterial trunk gave rise to the subscapular artery and the anterior and posterior circumflex humeral arteries. The posterior cord appeared normal on the right side.

Fig. 3. Left axilla showing the axillary arch and common arterial trunk (CAT) from the axillary artery, which bifurcated the posterior cord. LDPC, lower division of the posterior cord; UDPC, upper division of the posterior cord.

Fig. 4. Anterior view of the left upper arm showing variations in the medial and lateral cords. AA, axillary artery; BA, brachial artery; BV, basilic vein; LC, lateral cord; LD, lateral division of the lateral cord; LRM, lateral root of the median nerve; MC, medial cord; MCN, musculocutaneous nerve; MD, medial division of the lateral cord; MN, median nerve; MRM, medial root of the median nerve; NCB, nerve to the coracobrachialis; UN, ulnar nerve.

The lateral cord gave a direct branch to the coracobrachialis muscle (Fig. 4) and then divided into medial and lateral divisions; the lateral division passed down lateral to the third part of the axillary artery and divided at the level of the lower border of the teres major into the musculocutaneous nerve and the lateral root of the median nerve. The medial division (probably containing C7 fibers) crossed the third part of the axillary artery anteriorly, from the lateral to medial side, and joined the medial cord to form a common trunk,

Fig. 5. Anterior view of the left arm, showing the median nerve (MN) and the brachial artery (BA) running deep to the Struthers ligament, with muscle fibers arising from it. MCN, musculocutaneous nerve.

which descended medial to the axillary artery and divided at the level of the upper border of the teres major into the medial root of the median nerve and the ulnar nerve. The median nerve was formed, at the level of insertion of the coracobrachialis muscle, by the union of the lateral root and the medial root of the median nerve. The lateral and medial cords appeared normal on the right side.

A tendinous band called the Struthers ligament extended from the shaft of the humerus at the point of insertion of the coracobrachialis to the medial epicondyle of the humerus. Muscle fibers arose from this tendinous band and blended with the bicipital aponeurosis. The median nerve along with brachial artery passed deep to the Struthers ligament and emerged at the cubital fossa (Fig. 5). The Struthers ligament with muscle fibers was present bilaterally.

The rest of the course of the radial, musculocutaneous, ulnar, and median nerves in the forearm and hand was found to be normal on both sides.

Discussion

A variant muscle arising from the first rib and inserting into the coracoid process is called the pectoralis minimus [1]. The presence of the cephalic vein between the pectoralis minor and the pectoralis minimus may cause compression of the cephalic vein during hyperabduction of the arm, and may lead to venous stasis and lymphedema.

It is important to be aware of the communication between the cephalic vein and the external jugular veins across

the clavicle. During cannulation, the catheter can easily pass into this communicating vein, and thus, miss its intended direction. In case of fracture of the clavicle, the communicating vein running superficial to the clavicle may bleed profusely [2].

An axillary arch is considered to be a variant muscle or tendinous slip that arises from the lower border of the latissimus dorsi to join the tendon of the pectoralis major, coracobrachialis, or fascia over the biceps [1]. Axillary arches can be classified clinically as superficial or deep. Superficial arches cross anterior to the axillary vessels and nerves, and the veins could be primarily affected by this variation, which may play a role in intermittent obstruction of the axillary vein. Deep arches are so named because they occur deeply on the posterior or lateral walls of the axilla. These arches usually cross only parts of the neurovascular bundle, and axillary or radial nerves could possibly be affected [3]. The incidence of axillary arch has been reported by Pai et al. [4] to be 1.47% among the Dravidian population. Our case had a deep axillary arch. Contraction of the deep axillary arch in association with arm movements can cause radial nerve traction [5], and pulsations of the common arterial trunk from the axillary artery between the upper and lower divisions of the posterior cord can cause complex neurovascular symptoms such as unexplained neuralgia and vascular insufficiency. The axillary arch can limit shoulder elevation and cause hyperabduction syndrome due to restriction by the axillary muscular slip [6]. During mammography interpretations, it should be considered that the radiographic signs of a muscular slip related to the latissimus dorsi muscle may be observed in this area. Magnetic resonance imaging is also helpful for a definitive evaluation. The axillary arch is usually asymptomatic, and it importantly causes confusion during routine axillary surgery [7]; in such cases, the surgeon must assume its possible presence and exercise caution during dissection. Guy et al. [8] found that 92% of arches had medial lymph nodes that may have been important to determine prior to sentinel node biopsy. The axillary arch is also associated with various surgical and medical problems because it is likely to present as an axillary mass, which can be confused with axillary lymph nodes.

The knowledge of the variations of the peripheral nervous system is useful in clinical as well as surgical practice because they may cause nerve palsy syndromes and ischemia resulting from the variable relationship of nerves with the surrounding muscles and the vessels. The presence of anatomical variations

in the peripheral nerves is used to explain certain unexpected signs and symptoms noted in medical practice. Variations of the brachial plexus are vulnerable to injury during surgical procedures of the axilla and upper arm, such as nerve block, axillary artery perfusion, fixation of humeral fracture, surgical resection of axillary tumors, repair of shoulder dislocation, vessel and nerve repair after trauma, radical mastectomy, lymph node biopsy, and lymphadenectomy of the axilla [9]. The familiarity of radiologists with the arch facilitates its recognition so that they can communicate appropriate clinical correlations to referring physicians.

The Struthers ligament is a tendinous band, positioned in the anterior compartment of the arm and extending from an anomalous spur, the supracondylar process, which is located 3 to 5 cm above the medial epicondyle to the junction of the medial epicondylar ridge with the medial epicondyle [10]. Our case is unique in that muscle fibers were present at this location. No bony spur was palpable. The Struthers ligament can cause entrapment of the median nerve. The presence of brachial plexus variations accompanied by vascular variations and accessory muscles in the axilla and arm may confuse surgeons during procedures, cause compression of neurovascular structures, or lead to variation of normal mechanical actions. These variations noted in the present study have clinical and surgical importance in posttraumatic evaluations and exploratory interventions of the arm for peripheral nerve repair and flap dissections. Therefore, precise knowledge of variations may prove valuable in traumatology

of the arm, as well as in plastic and reconstructive repair.

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