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Research Article

The study of brachial plexus anatomical variations in the Indore region variations in its formation, branching, and running

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Abstract:

Background: The brachial plexus, a sophisticated network of nerves, plays a pivotal role in clinical anatomy, surgery, and anesthesia, as it is responsible for the motor and sensory innervation of the upper limb. This neural network, which arises from the anterior rami of the C5 to T1 spinal nerves, navigates intricate anatomical regions prior to diverging to innervate the integumentary system and musculature. **Aim:** To determine the study of brachial plexus anatomical variations in the Indore region variations in its formation, branching, and running. **Materials & methods:** The study examined the anatomical variations of the brachial plexus in deceased humans, analyzing forty cadavers aged 50-85. It focused on development, branching, and trajectory, and documented variations such as root formation, cable configuration, and nerve trunks. The study also compared conventional descriptions to cadaveric findings. **Results:** The study found that the frequency of brachial plexus branching mutations was highest in a classic M pattern in 29 out of 80 samples. Other mutations included the common trunk of medial brachial cutaneous nerve, medial antebrachial cutaneous nerve, medial pectoral nerve, thoracodorsal nerve, ulnar nerve and brachial branches, musculocutaneous nerve, and posterior cord giving brachial branches to median nerve. **Conclusion:** The study of brachial plexus differences in cadaver samples emphasizes the importance of understanding nerve structure differences, which can improve surgical, anesthetic, and rehabilitative practices, aid in precise diagnoses, treatments, and patient care quality.

Key words: Medial brachial cutaneous nerve, medial antebrachial cutaneous nerve, medial pectoral nerve, thoracodorsal nerve, ulnar nerve, brachial branches.

Introduction:

A critical role in clinical anatomy, surgery, and anesthesia is played by the brachial plexus, a complex network of nerves that are responsible for the motor and sensory innervation of the upper limb [1]. This nerve network, which originates from the anterior rami of the C5 to T1 spinal nerves, traverses' complex anatomical regions before branching out to innervate the skin and musculature. The brachial plexus exhibits substantial anatomical variability, despite its well-known structure [2]. This variability can have critical implications for the diagnosis of neurological disorders, surgical interventions, and anesthetic blocks [3]. It is imperative for clinicians to comprehend these variations in order to reduce complications and optimize outcomes in procedures that involve the neck, shoulder, and upper extremities [4].

The cadaveric study of the anatomical variations of the brachial plexus provides a distinctive opportunity to investigate the variety of differences that exist within this nerve network. Cadaveric dissection continues to be one of the most dependable and informative methods for analyzing the complex anatomical details of the human body [5]. These studies offer valuable insights into the structural diversity that exists within populations through direct observation and meticulous anatomical mapping [6]. Despite the advancements in the visualization of nerves in living patients with imaging techniques such as MRI or ultrasound, cadaveric dissection enables a more precise comprehension of the physical characteristics and spatial relationships of nerves and their branches [7,8]. Hence the present study to determine the anatomical variations of brachial plexus in the Indore region variations in its formation, branching, and running

Materials & methods:

The anatomy department supplied all the cadavers utilized in the study, having obtained the necessary authorization for scientific research, and the study received approval from the institutional ethics committee. Methodology: The objective of this cadaveric investigation was to investigate the anatomical variations of the brachial plexus. We meticulously examined and analyzed forty cadavers (eighty-two sides) to document variations in the development, branching, and trajectory of the brachial plexus. The subsequent criteria were employed in this investigation to ascertain which cadavers would be utilized as samples: Deceased animals exhibiting no injuries to their spines and upper extremities. The second criterion for exclusion pertained to the presence of any abnormalities in the upper limb, neck, or shoulder regions, in addition to any history of surgical intervention or evident indications of trauma. Furthermore, we will exclude cadavers that exhibit advanced decomposition or have undergone substantial postmortem alterations, as these conditions would complicate dissection and potentially yield misleading results. The age, sex, and ethnicity of each cadaver were meticulously recorded. The ages of the 40 cadavers varied from 50 to 85 years, comprising 25 males and 15 females. We utilized an extensive compilation of cadaveric data to examine prospective anatomical variations among individuals of different ethnic backgrounds. Procedure for Conducting a Dissection: We employed traditional methodologies to perform the dissection, utilizing a surgical loupe for enhanced magnification. We positioned each corpse in a supine orientation, with the upper extremities abducted. We carefully excised the epidermis, superficial fascia, and deep fascia from the cervical and shoulder regions to reveal the brachial plexus. The dissection commenced at the spinal nerve origins, specifically from C5 to T1, and concluded with the axillary branches of the brachial plexus. We employed the axillary artery, clavicle, anterior and middle scalene muscles, along with other significant anatomical landmarks, to facilitate the dissection. We meticulously identified and delineated the brachial plexus bilaterally, comprising its roots, trunks, divisions, cords, and terminal branches. In certain instances, meticulous excision of muscle and soft tissue was necessary to enhance the visibility of the nerves. We diligently documented the anatomical variations, encompassing the patterns of formation and fusion of roots and trunks. 2. The configuration of the cables and the number of segments. 3. There exist supplementary nerve trunks or roots. We captured digital photographs at multiple phases of the dissection for subsequent analysis and documentation. The diameter of each nerve root and trunk was measured utilizing nerve calipers. Disparities Categorization: We will conduct a comparative analysis of the conventional descriptions of the brachial plexus as presented in anatomical textbooks against cadaveric findings in order to identify any discrepancies. We observed and categorized brachial plexus configurations that diverged from the standard based on their classification as pre-fixed or post-fixed, the presence or absence of additional nerve branches, and the occurrence of atypical fusions.

Results:

Table 1: Real frequency of brachial plexus branching mutations discovered in the current work

Variant	**Male**	**Female**	**Total**
Classic M pattern	14/50	14/30	29/80
Common trunk of medial brachial cutaneous nerve + medial antebrachial cutaneous nerve	2/50	4/30	6/80
Medial antebrachial cutaneous nerve from inferior trunk or ulnar nerve	2/44	0/27	2/71
Medial pectoral nerve from Medial cord + Lateral cord	5/25	3/21	8/46
Medial pectoral nerve from Lateral cord	2/25	6/22	8/47
Thoracodorsal nerve from axillary nerve	7/26	3/23	10/49
Ulnar nerve rec brachial branches from Lateral cord	6/41	3/29	9/70
Musculocutaneous nerve brachial branches to median nerve	0/40	2/30	2/70
Posterior cord gives brachial branches to median nerve	0/50	1/26	1/76

Table 1 shows the real frequency of brachial plexus branching mutations discovered in the current work. We observed a classic M pattern in 29 samples out of 80. Common trunk of medial brachial cutaneous nerve + medial antebrachial cutaneous nerve in 6 out of 80. Medial antebrachial cutaneous nerve from inferior trunk or ulnar nerve in 2 samples out of 71. Medial pectoral nerve from Medial cord + Lateral cord in 8 out of 46. Medial pectoral nerve from Lateral cord in 8 out of 47 samples. Thoracodorsal nerve from axillary nerve in 10 samples out of 49 samples. Ulnar nerve rec brachial branches from Lateral cord in 9 samples out of 70 samples. Musculocutaneous nerve brachial branches to median nerve in 2 samples out of 70 samples. Posterior cord gives brachial branches to median nerve in one sample out of 76 samples.

Discussion:

Martin-Gruber connections refer to the anastomoses of nerve fibers located in the forearm, specifically between the median nerve and the ulnar nerve [9]. These connections exhibit a significant prevalence in the forearm. Researchers have shown that these connections can cause confusion when evaluating nerve injuries, carpal tunnel syndrome, cubital tunnel syndrome, and leprosy neuropathy. However, the literature has not addressed the connections within the limb, specifically the Martin-Gruber anastomosis [9]. A research delineated the median-ulnar anastomoses in the forearm and demonstrated its presence in 15.2% of the limbs he dissected [10]. Research determined communications in the arm between the musculocutaneous and median nerves in 9 arms [11]. Another research identified 22 instances of communication between the musculocutaneous and median nerves in 16 out of a total of 79 cadaveric specimens [12]. They were presented bilaterally in six subjects. Of the 22 communications, nine were located in close proximity to the entry point of the musculocutaneous nerve into the coracobrachialis [13]. The associations identified in our analysis were unilateral and observed in five arms, representing 10.43%. Research indicates that a diminutive lateral root of the median nerve can lead to a connection between the musculocutaneous nerve and the median nerve [14]. However, in our investigation involving 48 cadaveric arms, we observed that the lateral root in one instance was not small. The connections were located near, but ahead of, the coracobrachialis muscle's origin. These interconnections among the nerves may offer additional motor and sensory innervation in the event of a deficit in them following a traumatic injury.

Research conducted a detailed examination of 54 cadaveric arms to elucidate the trajectory and anatomical relationships of the musculocutaneous nerve within the arm. 36% of the conducted dissections revealed interconnections between the musculocutaneous nerve and the median nerve [15]. The average length of these interconnections was 1.77 cm [16]. This represents a significantly greater percentage of interconnections compared to those identified in prior research as well as in our own study. The existing literature does not indicate any variations in the emergence of the radial nerve from the brachial plexus. It originates from the posterior ligaments of three of the trunks.

Conclusion:

Studying the differences in the brachial plexus in cadaver samples highlights the importance of knowing that nerve structure can differ from what is shown in textbooks. This type of information is highly beneficial for enhancing practices in surgical, anesthetic, and rehabilitative environments. Comprehending these distinctions can assist physicians in rendering more precise diagnoses and treatments, mitigating the risk of adverse effects, and enhancing the quality of patient care. Future research endeavors should investigate these disparities among various groups to attain a more profound comprehension of this essential neural network.

Conflict of interest:

There is no conflict of interest among the present study authors.

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