Introduction

Human brachialis muscle has a long-running controversy regarding its gross morphological characteristics and manner of innervation. Most anatomical textbooks (Gray's anatomy 40th ed. and Last's anatomy 7th edition) have described origin of brachialis muscle from the lower half of the front of the humerus, starting on either side of the insertion of deltoid, and extending distally to within 2.5 cm. of the cubital articular surface. It also arises from the intermuscular septa, more from the medial than the lateral. Its fibers converge to a thick, broad tendon which is attached to the ulnar tuberosity and on the anterior aspect of the coronoid process. Regarding the nerve supply to brachialis, many previous authors have vaguely alluded to a dual innervation to this muscle, whereas some have either considered the musculocutaneous nerve as the sole supply or thought the radial nerve contribution entirely sensory.

Materials and methods

Twenty embalmed cadavers (40 upper limbs) including 11 males and 9 females were dissected on both right and left side. The brachialis muscle was completely visualized during dissection, and its length was visually divided into three equal segments to allow comparison with previous studies (Mahakkanukrauah and Somsarp, 2002). The segment into which branches from radial and musculocutaneous nerve entered was recorded. We also noted the course of the branches after they arose from the main trunk.

For each arm, a tape measure was used to measure the distance from the tip of the acromion process to the proximal part of the tip of the lateral epicondylar of the humerus. Measurements of the total length of the brachialis muscle and length of its extramuscular tendinous part were expressed as a percentage of the distance between the lateral epicondylar and acromion. Histological sections were made of 5 branches of the radial nerve to brachialis to confirm the presence of nerve tissue.

RESULTS AND OBSERVATION:

Brachialis muscle was seen uniformly to be consisting of 2 heads, superficial and deep. The superficial head forming the main bulk of the muscle originated from the anteromedial and anterolateral surface of the middle third of the humerus, embracing the deltoid insertion. In addition fibers ran vertically and terminated in a thick tendon to be inserted onto the ulnar tuberosity. Fibers of the deep head could be seen arising from the anteromedial and anterolateral surface of the distal third of the humerus. In addition fibers were seen to be attached to the medial and lateral intermuscular septum. Fibers of the deep head coming from anterolateral surface ran obliquely across the elbow joint crossing from lateral to medial side. Some of these fibers invaginated the tendon of the superficial head and rest converged to form a thickened aponeurosis with the vertically running fibers of the deep head (coming from anterior-medial surface) to be inserted onto the medial side of the coronoid process. The mean of the total length of the superficial head of the muscle as a percentage of the distance between lateral epicondyle and acromion process was 67.13% (range 60-72%) and for deep head was 28% (range 22-34%).

The mean length of the extramuscular tendon as a percentage of distance between lateral epicondyle to acromion process for superficial head was 54.9% (range 50-56.7%) and for deep head was 22.75% (range 18-28%).
All specimens of superficial head and 27.5% (11/40) specimens of deep head were supplied by branches from musculocutaneous only.

70% (28/40) specimens of brachialis were innervated by a branch from the radial nerve. Regarding all the parameters, there were no statistically significant differences between male and female cadavers or between the right and left side.

**DISCUSSION**

Our findings suggest that brachialis muscle uniformly consists of 2 heads, superficial and deep. Which differs from many of the anatomical textbooks describing 2 heads as a variation and not a regular feature. Whereas it goes in favour of 2 previous studies (Leonello et al., 2007 and Hatice Tuba Sanel, 2007). The differing morphology of these 2 heads indicates that they may have different developmental origins, nerve supply and function. Embryological basis for double innervations of the brachialis muscle by branches from musculocutaneous nerve and radial nerve in 70% (28/40) specimens can be explained by union of hypomere (flexor) and epimere (extensor) muscle masses derived from two different embryonic musculomemorial (Mahakkanukrauh, Somsarp). In the remaining muscles (30%) specimens, the brachialis must have been contributed to, solely by the ventral muscle mass which is innervated by the musculocutaneous nerve only. Our findings of 70% dual innervation in 40 limbs in Indians differs from the 100% incidence of 16 limbs reported by Ip and Chang in Chinese population (1968), 81.6% cases of 152 limbs by Mahakkanukrauh (2002) in Thai cadavers and 67% cases of 42 limbs by Blackburn et al. (2007) in Caucasians. It may reflect a difference in the sample size or ethnic differences.

Exhaustive study of literature did not yield any functional aspect of 2 heads of brachialis muscle even though Leonello et al. claims that the deep head is more important for the initiation of flexion from full extension and the superficial I head provides greater power once the elbow is flexed. Before planning humeral surgery, the variations regarding prevalence of brachialis innervations by radial nerve in different racial population should be considered so that injury may be avoided with an awareness of the potential presence of such a radial contribution & by carefully searching for and protecting the branch when operating in the plane between brachialis and brachioradialis.

A detailed and clear understanding of the true internervous plane could be used to improve the current anterior and anterolateral surgical approaches to the humerus so that the brachialis muscle can be split without either portion being significantly denervated.

**FIG 1**: Dissected specimen of arm showing superficial and deep head of human brachialis muscle.

**REFERENCE**