Correlation between Humeral Head of Biceps Brachii Muscle and Variation of its Motor Innervation: A Descriptive Study

Dr. Amar Jayanthi. A[*], Dr. Sajna MV[**], Dr. Arunkumar K G [***]

[*] Additional professor of Anatomy, Government medical college, Thrissur, kerala state, India.
[**] Assistant professor of Community medicine, Government medical college, Thrissur, kerala state, India.
[***] Junior Resident in Anatomy, Government Medical College, Thrissur, Kerala, India.

***Abstract*- Background and Aim**: Variations in the morphology of biceps brachii muscle and its motor nerve , the musculocutaneous nerve have been studied extensively. The infero medial type of accessory third head of biceps and anastomoses between musculocutaneous and median nerve are the most common and frequent of all the reported variations. Studies describing existence of the said anomalies are few in literature. The aim of this study is to analyse the correlation between the most common reported anomaly of biceps and its motor nerve. **Materials and Methods**: The study was performed in 384 arms in the department of anatomy, Thrissur Government Medical College, Kerala. **Results**: Out of the 14 limbs with three heads of biceps intercommunication between the two nerves was observed in 14.3% arms. There is no statistically significant difference between the proportions of nerve connection among arms with normal and anomalous biceps muscle. Knowledge of the existence of accessory muscles and their innervating nerve anomalies are useful in determining the pathophysiology and treatment for compression neuropathies.

***Index Terms*-** humeral head of biceps, musculocutaneous-median nerve communication, accessory head of biceps, absence of musculocutaneous nerve.

I. INTRODUCTION

Medical progress needs a more accurate knowledge of the variations of the human morphology to improve diagnosis and therapeutic performance[1]. Traditionally biceps is described as a two headed muscle that originates by a long head and short head from the scapula. Variations in the morphology of biceps brachii muscle have been studied extensively. 8 to 12 % of arms show biceps muscle variation with gender difference more in males. Presence of multiple heads ranging from three to seven with origins from the coracoid process, from the articular capsule of the glenohumeral joint and tuberosities of the humerus have been reported[2]. Among the humeral origin of third head of biceps brachii, the infero-medial type, as classified by Rodriguez et al[3] forms the most common variation. A descriptive study on the variations of biceps brachii muscle conducted by the author found 10.8% prevalence of three heads of biceps muscle in a population of central Kerala[4].

Anatomic studies on variations in the course and branching pattern of musculocutaneous nerve supplying biceps are available in literature. The most frequent musculocutaneous nerve anomaly is its communication with median nerve [5]. The authors observed that, in the same population, the musculocutaneous nerve showed a variation of 24.2 % [6]. To the best of our knowledge, except for case reports, only few studies describing co-existence of biceps brachii muscle variation and musculocutaneous nerve anomalies and their prevalence are available in literature. The aim of this study wasto analyse the correlation between the most common anomaly of biceps brachii with the most common variation of musculocutaneous nerve. Knowledge of the existence of accessory muscles and their innervating nerve anomalies are useful in determining the pathophysiology and treatment for compression neuropathies. In this article we present the prevalence and importance of humeral head of biceps brachii and musculocutaneous – median nerve intercommunication.

II. MATERIALS AND METHODS

The study was performed in 384 limbs of 192 bodies between 2006 and 2013, in the department of anatomy, Thrissur Government Medical College, Kerala, India. Of the 192 bodies 124 were of males and 68 belonged to females. The study included 92 adult human cadavers and 100 human fetuses of both sexes, from spontaneous abortions and stillbirths aged 28 weeks to full term obtained from department of Obstetrics and Gynaecology of the same institution. Fetuses were collected after prior approval from institutional ethical committee. Dissection of axilla and front of arm were carried out from the infra clavicular part to the level of elbow. The muscles supplied by musculocutaneous nerve were studied for anomalies in the origin, termination and innervation. The median and musculocutaneous nerves were dissected out from their origin to exit from the arm at elbow with particular emphasis to communication between them. Deviation from the normal pattern were studied in detail, sketched and photographed. Data collected were entered in Microsoft excel and analysed quantitatively and qualitatively using epi info soft ware. Data was analysed using proportions and 95% Confidence interval. The relationship between the muscle anomaly and its nerve anomaly was tested using Chi square test. The significance level was kept at 5% level.

III. RESULTS

In our study, out of 192 bodies, humeral head of origin of biceps brachii was found in 7.3% of arms (95% CI = 4.76 – 9.83). Out of this 4.1 % had anomaly on the left arm and 3.1% on the right arm. Bilateral three heads were found in one case 0.5%. Humeral head was more in males 8.87% than in females 1.4%. Prevalence of the anomalies observed in this study is shown in table 1.

Musculocutaneous nerve was absent in 2.3% of arm. In this study musculocutaneous – median nerve intercommunication was observed in 9.9 % of arms (n=49). Bilateral anomaly was observed in 3.1%. Of the 192 bodies there was no difference in the prevalence of intercommunication between the sides, 13% and 12.5%.

Photograph showing humeral head of biceps brachii and musculocutaneous median nerve intercommunication on the right arm of a male cadaver was shown in Fig.1. Out of the 14 limbs with three heads of biceps, intercommunication between the two nerves was observed in 14.3% (n=2) limbs. This is similar to the proportion observed in musculocutaneous – median nerve connection of 12.6% of biceps brachii with two heads in this study. Relation of three heads of biceps brachii and musculocutaneous- median nerve intercommunication shown in table 2. There is no statistically significant difference between the proportions of nerve connection among limbs with normal and anomalous biceps brachii muscle.

IV. DISCUSSION

Developmental anomalies of biceps brachii and its innervation are a common finding during routine dissection. Detection of association between biceps anomaly and musculocutaneous nerve variation is of great significance in the management of peripheral nerve disorders. The present study documents the prevalence of tricipital head of biceps to be 7.3%. Accessory fascicles of biceps brachii muscle arising from the shaft of humerus is described as the humeral head of biceps. Literature reports that the incidence of third head is rare in Indian population. Several authors suggested a racial variation for the occurance of humeral head. It is found to be 2% in Indians according to Vollala[7], 5% in South Indians as reported by Lokanadham[8], 3.7% in Srilankans as per Ilayperuma[9] and 7.5% - 18.3% according to Vinnakota[10]. Rodriguez found three heads of biceps in 7.7% of arms and classified humeral heads into three types based on their location[3].

Many authors reported connections between the musculocutaneous and median nerve and the prevalence ranging from 5% to 63.5%[11]. Bhattarai and Poudel[12] revealed the prevalence of musculocutaneous median nerve communication to be 6.25% of arms with no statistically significant difference by gender and side. Kosugi et al[13] reported that the presence of a supernumerary head effected the course and branching of the musculocutaneous nerve. In their study, a communicating branch arising from the median nerve was found in 16% of the cases with a supernumerary head of biceps brachii muscle. Previous study by the authors observed 15.1% of musculocutaneous median nerve intercommunication in Kerala population[6]. The present study revealed that 14.3 % of biceps with three heads showed nerve intercommunication. The results indicates that no relationship exists between accessory head of biceps and musculocutaneous – median nerve communication.

Kayode et al[14] observed accessory heads of biceps from humerus with intercommunication between musculocutaneous and median nerve in I out of 48 upper limbs. Four headed biceps brachii muscle with variation in the course of musculocutaneous nerve was observed in left arm of a male cadaver as reported by Anjali[15]. Abu-Hijleh [16] observed in a cadaver, an anteromedial type of three-headed biceps brachii muscle associated with duplicated musculocutaneous nerve, where coracobrachialis and biceps were supplied by the proximal musculocutaneous nerve and distal musculocutaneous nerve arose from the median nerve in the lower arm and supplied the supernumerary head and brachialis and then continued as the lateral cutaneous nerve of forearm.

Co-existence of infero-medial humeral head of biceps brachii with absent musculocutaneous nerve and muscle innervation by lateral root of median nerve was observed on the right arm of a male cadaver by Renata et al[17]. Similar case of accessory head supplied by median nerve in the absence of musculocutaneous was observed by Arora and Dhingra[18].

Clinically supernumerary heads with their motor nerves intercommunicating with other nerves are important in post traumatic evaluation of arm. Vinnakota states that the accessory head may not give extra strength or cause an unusual displacement of fracture fragments of humerus; but might cause compression of the median nerve when it pass between fibres of accessory head. They may cause compression of neurovascular structures because of their close relation to the brachial artery and median nerve[10]. Awareness of different patterns of variations are essential for the differential diagnosis and treatment of neurovascular compression syndromes. According to Stefano et al anatomical variations of musculocutaneous nerve cause difficulties to reanimate the biceps muscle by neurotization of the motor branches of the musculocutaneous nerve in C5–7 avulsion-related brachial plexus injuries[19].

During biceps muscle flap transfer, accessory heads may cause difficulty in muscle lifting . Ramon Gheno observed an accessory head of biceps brachii near bicipital groove on routine MRI evaluation of shoulder, suggests that the accessory muscle can easily be misinterpreted as partial longitudinal tearing of long head of biceps tendon[20].

During surgeries for recurrent dislocation of shoulder musculocutaneous nerve is at risk[21]. Iatrogenic injuries to musculocutaneous nerve can occur from retractors placed under coracoid process during coracoid process grafting and in shoulder surgery[22]. Damage to the nerve is indicated by a reduction in the power of flexion of the elbow and of supination of the forearm. Presence of accessory head co existing with median nerve intercommunication may confuse a surgeon and lead to diagnostic errors.

It is presumed that development of a third head of biceps may influence the course or branching pattern of musculocutaneous nerve[23]. Limb muscles develop from dorsolateral mesenchyme of somite that migrate into the developing limb bud. The spinal nerves follow the growth cones, regulated by cues produced by the muscle[24]. Variation of muscle patterns may be a result of molecular changes occurring in

myogenic precursor cells. Presence of supernumerary heads of biceps brachii especially the infero-medial type, may be due to the musculocutaneous nerve that pierces biceps and cause a longitudinal splitting of myotubules which are later covered by connective tissue[25]. Lokanatham suggested that presence of humeral head was due to the musculocutaneous nerve piercing the brachialis muscle and producing a supernumerary separate head[8].

The variation in the directional growth of nerve fibers can be explained by the theory of neurotropism or chemotropism hypothesis of Ramon and Cajal[26]. Axonal growth cones act as sensors to concentration gradients of molecules in the environment and grow up the gradient towards the target[27].

V. Conclusion

A thorough knowledge of the possible anatomical variations of biceps brachii muscle and its innervating musculocutaneous nerve are essential to the medical fraternity because of the increasing frequency of shoulder and axillary surgeries.

References

[1] Sanudo J R, Vazquez R and Puerta J. Meaning and clinical interest of the anatomical variations in the 21st century. Eur J Anat. 2003; 7 (1): 1-3.

[2] Akhilandeswari B. Supernumerary head of biceps brachii. International Journal of Anatomical variations 2010; 3: 214-215.

[3] Rodriguez – Niedenfuhr N, Vazque T, Choi D et al. Supernumerary humeral heads of biceps brachii revisited. Clinical Anatomy. 2003; 16 (3): 197-203.

[4] Amar Jayanthi A, M A Elezy. Study of variations in the origin of biceps brachii muscle in Kerala. International Journal of Scientific and Research Publications. Aug 2012; Vol 2(8): 1-4.

[5] Chauhan R and Roy T S. Communication between the median and musculocutaneous nerve –a case report. J Anat Soc. India. 2002; 51 (1): 72 – 75.

[6] Amar Jayanthi and Arunkumar K G. Variations in the course and branching pattern of musculocutaneous nerve. National Journal of clinical anatomy. 2013; vol 2 (4): 195 – 199.

[7] Vollala V R, Nagabhooshana S, Bhat S M et al. Multiple accessory structures in the upper limb of a single cadaver - case report. Singapore Med J. 2008; 49 (9): e256.

[8]

[9] Lokanadham S and subhadra Devi V. Unusual presentation of supernumerary head of biceps brachii muscle in south Indian population. World Journal of Medical sciences. 2011. 6(3;115-120.)

[10] Ilayperuma I, Nanayakkara G & Palahepitiya N. Incidence of humeral head of biceps brachii muscle - Anatomical insight. Int J Morphol 2011; 29(1):221-225.

[11]

[12] Vinnakota S, Battom N. Bilateral three headed biceps brachii - a case report. People's Journal of Scientific Research 2011; July vol 4(2: 53-54.)

[13] Feray Güleç, Uyaro, Gülgün Kayal et al. Anastomotic branch from Median nerve to Musculocutaneous nerve- a case report;anatomy, 2008; 2 : 63-66.

[14] Bhattarai C, Poudel PP. unusual variation in musculocutaneous nerves. Kathmandu University Medical Journal.2009; vol 7, No.4, Issue 28: 408 – 410.

[15] Kosugi K, Shibata S and Yamashita H. Supernumerary head of biceps brachii and branching pattern of the musculocutaneous nerve in Japanese. Surg Radiol Anat. 1992; 14; 175 – 85.

[16] Kayode A Oluyemi, Olamide A. Adesanya, C L Saalu et al. Communication between Median and Musculocutaneous Nerve and Accessory head of biceps brachii muscle : a case report. The Internet Journal of Surgery . 2007; vol 12: 1.

[17] Anjali A, Harjeet K, Daisy S et al. Four- headed biceps brachii muscle with variant course of musculocutaneous nerve: anatomical and clinical insight. International Journal of Anatomical variations 2009; 2: 127 – 128.

[18] Abu- Hijleh, M F. Three headed biceps brachii muscle associated with duplicated musculocutaneous nerve. Clin Anat. 2005; 18 (5) : 376 – 9.

[19] Renata Pacholczak, Wiesiawa Klimek – Piotrowska et al. Absence of the musculocutaneous nerve associated with a supernumerary head of biceps brachii: a case report. Surg Radiol Anat. Jan 2011.

[20] L Arora and R Dhingra. Absence of musculocutaneous nerve and accessory head of biceps brachii: a case report. Indian Journal of Plastic Surgery. July-Dec 2005; vol 38 (2) : 144 – 46.

[21] Stefano F, Debora Garozza and Paolo Buffatti. Reinnervation of the biceps in C5-7 brachial plexus avulsion injuries, results after distal bypass surgery. Neurosurgery focus. 2004;16 (5).

[22] Ramon Gheno, Cristiane S, Zoner Florian M et al. Accessory head of biceps brachii muscle: Anatomy, Histology and MRI in cadavers. AJR 2010; 194: w80-w83.

[23] Rolfe B, George B, John D et al. Iatrogenic injuries of peripheral nerves. The journal of bone and joint surgery. 1991; 73-B: 280-2.

[24] Shweta J P, Rashvaita K P, Chintan B et al. Variation of musculocutaneous nerve in arm with additional muscular slip in forearm. International journal of anatomy and physiology . March 2013; vol 2 (3): pp 020-022.

[25] Hitendra k, S Das and G Rath. An anatomical insight into the third head of biceps brachii muscle-clinical study. Bratisl Lek Listy. 2008; 109 (2): 76 – 78.

[26] A k Dutta. Essentials of human embryology. 2010. 6th Edn. Current books international. P286.

[27] Moore and Persuad T V N, The Muscular System. The Developing Human Clinically Oriented Embryology. 2009; 8th edn: p358 -62.

[28] Susan Standring. Development of nervous system. Gray's Anatomy. 39th Edition. Elsevier Ltd. 1999; 249-250.

[29] Jamuna M. Two cord stage in the infraclavicular part of the brachial plexus. International Journal Of Anatomical Variations, 2010; 3: 128-129.

Authors

First Author – Dr. AMAR JAYANTHI.A, Date of birth : 19.05.1960. Qualification: MBBS 1987, MS 1997, University of Kerala. Senior Residency in Obstetrics and Gynaecology 1989, Foundation course in Palliative Medicine 2006. Extra curricular activity: Served the community through National Service Scheme as student volunteer, under Kerala University from 1976 to 1985 and as Programme officer of National Service Scheme under Calicut university from 1999 to 2002. Awards: Best paper award for embryology in 58th National Conference of Anatomical Society of India in 2011. Life member of Anatomical Society of India, Society of Clinical Anatomists and Indian Medical Association.Trust member of charitable society "SOLACE". Publications :Four.Two international and two National Journals, Presented papers and chaired sessions in national conferences. e-mail ID jayanthiamar@yahoo.co.in, mobile no. 9447698881

Second Author – Dr. SAJNA MV. MBBS MD DNB., Date of birth: 04.04.1980, Qualification: MBBS 2002, MD 2010, - Calicut University, DNB 2011 Experience: Worked as Assistant surgeon in Kerala Health services. Award: First Dr C R Soman Memorial award for best PG thesis in all kerala in 2010. Life member of Indian Public Health Association of India. Presented papers in National Conferences. Chaired session in Student National conference. Participated in various nationwide surveys. E-mail I D mvsajna@yahoo.com

Third Author – Dr. ARUNKUMAR K G. MBBS, Date of birth : 24.08.1971. Qualification: MBBS, 1996, University of Kerala.

Member of Anatomical Society of Indiaand Society of Clinical Anatomists. Presented scientific papers in national conferences.
e-mail ID drkg_arunkumar@yahoo.com.

Table.1 showing prevalence of biceps brachii muscle and musculocutaneous nerve anomalies.

Sl. No.	Prevalence of anomaly (N = 384)	No.	%	95% C I
1	3heads of biceps	14	3.64	1.81 - 5.46
2	Absent MCN	9	2.3	0.83 - 3.76
3	MCN – MN intercommunication	49	9.9	6.98 – 12.81

N= total number of limbs studied. CI – confidence interval. MCN – Musculocutaneous nerve. MN – Median nerve.

Table. 2 showing relationship of biceps brachii with three heads of origin and intercommunication between musculocutaneous and median nerve.

Biceps	MCN – MN connection			Chi Square = 0.04 p = 0.82 (NS)
	Present	Absent	Total	
3 heads	2 (14.3%)	12 (35.7%)	14	
2 heads	47 (12.6%)	323 (87.36%)	370	

MCN – Musculocutaneous nerve. MN – Median nerve. NS – Not significant.

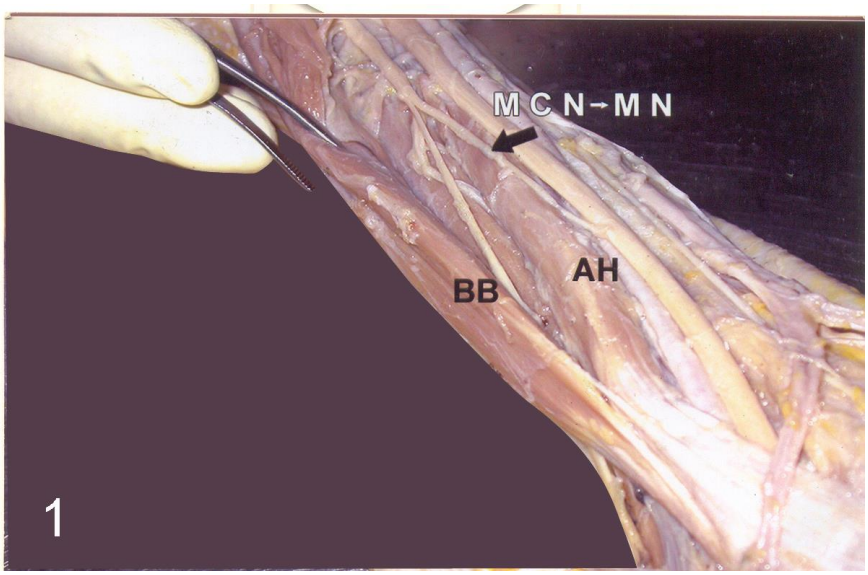

Fig.1 Photograph of front of arm showing humeral head of biceps brachii muscle with connection between musculocutaneous and median nerve. Biceps brachii reflected laterally to expose the communicating segment and accessory head. BB = Biceps brachii muscle, AH = the third head arising from the front of arm medial to brachialis muscle and joining with the main biceps muscle. MCN= Musculocutaneous nerve, MN = Median nerve. MCN-MN= intercommunication between musculocutaneous and median nerve.