Anomalous patterns of formation and distribution of the brachial plexus in Nigerians and the implication for brachial plexus block

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ABSTRACT

Background: Structural variations in the patterns of formation and distribution of the brachial plexus have drawn attentions both in anatomy and anaesthesia.
Method: An observational study.
Results: The brachial plexus was carefully inspected in both the right and left arms in 90 Nigerian cadavers, comprising of 74 males and 16 females. Four anomalous patterns of formation and distribution of the plexus were observed in 65(72%) of the subjects. These include an additional 4th trunk formed by C5 in 20(22.2%) and the anticlockwise displacement of the cords with respect to the axillary artery in 12(13.3%) cases; such patterns had hitherto not been reported.
Conclusion: These findings have important clinical implications for brachial plexus block.

Key words: Brachial plexus, anomalous patterns, brachial plexus block

Introduction

Structural variations in the patterns of formation and distribution of the brachial plexus had drawn attentions both in anatomy [1, 2] and in anaesthesia.[3, 4] The brachial plexus originated from the fifth cervical to the first thoracic spinal nerves and supplies the whole of the upper extremity including the shoulder joint. [5] Regional anaesthesia such as the brachial plexus block is useful in cases where a general anaesthesia carries a risk out of proportion to regional surgery, [6] hence, observed cases of anomalies in the course of dissection of this region serve as useful aids and guides both in anatomy and anaesthesia in diagnosis, prognosis or therapy.

Materials and Methods

Structural patterns of the formation and distribution of the brachial plexus was studied in 90 Nigerian cadavers comprising 74 males and 16 females, dissected in the Department of Human Anatomy, Ahmadu Bello University, Zaria from 1991 to 2000. [7, 8] Both the right and left arms were studied in each cadaver and the unusual patterns recorded with a Nikkon 7245917 camera.

Results

Following thorough inspection, four anomalous patterns were observed: in the first pattern, 40 brachial plexuses were recorded in which in addition to the middle and lower trunks formed by C7 and C8, T1 respectively, two trunks were separately from each by C5 and C6, that is, TA, TB, (Figure 1). The trunk from C6 (TB) appears to be the normal upper trunk, this subsequently divided into anterior and posterior divisions; the latter joined the posterior cord while the former continued as the suprascapular nerve, hence, TA appears as an additional trunk. In the second pattern, there were 24 brachial plexuses with an anticlockwise displacement of the cords around the axillary artery (A), such that the posterior cord (P) laid medially, the medial cord (M) laterally, and the lateral cord (L) laying posterior to the axillary artery (Figure 2). In the third pattern, there were 30 brachial plexuses in which the median and musculocutaneous nerves arise by a common stem from the lateral cord, that is, the medial root of median nerve initially fused with the cord; about 5cm distal to this union, the lateral cord divided into the median and musculocutaneous nerves. In the fourth pattern, 36 brachial plexuses were recorded in which the median nerve arose by multiple roots from the lateral cord and with just a tiny contribution from the medial cord. A series of twigs from the musculocutaneous nerve also joined the median nerve outside the axilla.

Figure 1: An additional 4th trunk of the brachial plexus (TA). (Normal upper trunk TB, middle trunk TC, lower trunk T

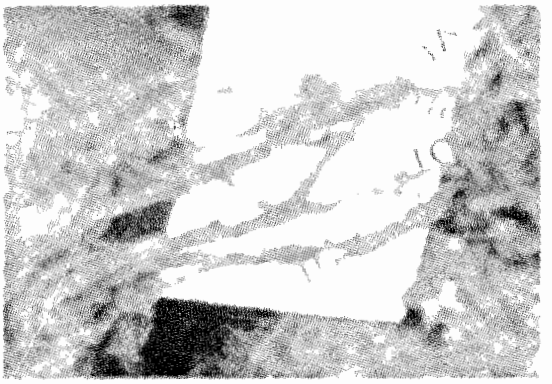

Fig. 2: Anti clockwise displacement of the brachial plexus cord (P = medially placed posterior cord; M = laterally placed medial cord; L = posteriorly placed lateral cord A = axillary artery)

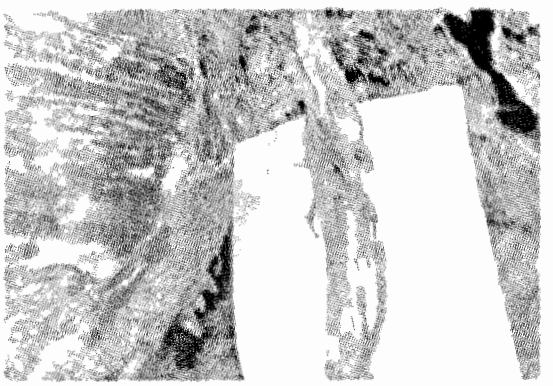

Table 1: Occurrence of the anomalous brachial plexus

Pattern	Males (%)		Females (%)	
	Right	Left	Right	Left
1	18 (12.2)	14 (9.5)	6 (18.8)	2 (6.3)
2	8 (5.4)	10 (6.8)	6 (18.8)	-
2	16 (10.8)	6 (4.1)	4 (12.5)	4 (12.5)
2	20 (13.5)	12 (28.5)	4 (12.5)	-
Total	62 (41.9)	42 (28.5)	20 (62.6)	6 (18.8)

Statistical analysis using X^2 at $P< 0.05$ is non - significant

Discussion

The brachial plexus forms the nervous web between the central nervous system and the upper extremity, the shoulder and suprascapular regions. Embryologically, at about the fifth week, the anterior nerve root arise from the cell of the basal lamina of the neural tube, and in the sixth week, cells of the neural crest develop central processes, which enter the neural tube opposite the posterior horn of the grey matter forming the posterior nerve root. The distal processes of both roots unite forming the trunk, which divide into dorsal and ventral rami. The ventral rami at the level of the growing forelimb bud form the brachial plexus. [9] However, the present observations in the plexus could not be associated with any developmental anomaly.

This study attests and extends the observations of Al-Hubbally [1] who described various anomalous cases in 54 of the 60 brachial plexuses in the Iraqis cadavers inspected. The present observations in Nigerians revealed among others, two types of anomalies similar to those previously described by Al-Hubbally and co-workers: [1] that is, patterns 3 and 4 respectively (Table 1), where in 30 plexuses the median nerve arise by multiple roots from the lateral cord, while in the Iraqis 4 such anomalies were reported; also in 36 Nigerian brachial plexuses the median and musculocutaneous nerves arose by a common stem from the lateral cord; in the Iraqis, 2 plexuses where musculocutasneous nerve carries fibers destined to join the median nerve were reported. Though no discrepancies of occurrence in either side or sex were mentioned in the previous works, the present observation too did not indicate any prevalence of the anomalies in either sex or side, though the sample size particularly the females were relatively small.

The first two patterns, that is, where separate trunks were formed each by C5 and C6 leading to an additional 4th trunk due probably to the non-union of the two spinal roots; and the anticlockwise displacement of the cord around the axillary artery, all appear to be quite unusual and hitherto not previously reported.

The awareness of such variations are useful both in the axillary or suprascapular approach of brachial plexus block. This is applicable mainly to the casualty department where anaesthetic risks include the very tough labourer, the full stomach, the chronic bronchitic and the emphysematous. These difficult anaesthetic cases presenting with fractured wrist or a lacerated hand can be safely managed by a nerve block. Apart from the lessened risk, brachial block gives muscle relaxation and plenty of time whereas to provide these with a general anaesthetic would require a major procedure that could not be carried out upon an outpatient. Reduction of a dislocated shoulder can be performed after brachial block by suprascapular approach but before carrying out the block, test should be made for motor or sensory impairment in the arm or else it would be difficult to ascertain whether such impairment was caused by the injury, the operation, or the nerve block. Another uncommon but important indication for a brachial plexus block is following accidental injection of thiopentone into an artery. The sympathetic nerve supply to the arteries of the arm travels with the spinal nerves and block of the brachial plexus will combat the vasospasm that follows this complication. A long acting local anaesthetic such as amethocaine 0.1% should be used with or without lignocaine 1%. The disadvantages of the block can be reduced by the use of the axillary approach rather than the suprascapular and the former should become the more routine procedure possible at least for the following reasons: suprascapular approach has the hazard of pneumothorax to weigh against it, risky to attempt a bilateral brachial plexus block and paraesthesiae are common and painful. The axillary approach however, cannot be used for reduction of a dislocated shoulder, and pneumothorax does not occur or elicit paraesthesiae [6]

Such other similar anomalous cases and their clinical implications had been reported in the quadriceps muscles of the thigh, [11, 12] in the innervations of the upper extremities [13] and in the gonadal artery. [14, 15]

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References

1. Al - Hubally AY, Al – Ashou AH, Al – Annaz MS. Anatomical study of the brachial plexus variations: Proceedings of anatomical society of Great Britain and Ireland, 1990; 231.
2. Adebisi SS, Ekanem PE, Asala SA. Anatomical study of the patterns of formation and distribution of the brachial plexus. Proceedings of the 6th international congress of the Anatomical Society of West Africa. Ile-Ife, 1991; 19.
3. Bosomworth PP, Egbert LD, Hamelberg W. Block of the brachial plexus at the axilla: its value and complications, Ann Surg 1961; 54: 911 – 914.
4. De Jong RH. Modified axillary block with block of musculocutaneous nerve Anaesthesiology 1965; 26: 515 – 618.
5. Lockhart RD, Hamilton GF, Fyfe FW. Anatomy of the human body. Faber and Faber, London, 1974; 284 – 285.
6. Clive J. Analgesia of the upper extremity: Brachial plexus block. In: Local analgesia. Lewis, London, 1962; 42 – 46.
7. Romanes GJ. Cunningham manual of practical anatomy. Oxford University Press,
8. Oxford, 1981; 19 – 24.
9. McMinn RMH. A colour atlas of human anatomy. Wolfe, Holland, 1985; 116 – 118.
10. Minna EY, Tachos AA, Rashad MN. Human embryology for medical students. Modern Egyptian Bureau, Alexandria, 1968; 274.
11. Olson IA. The origin of lateral cutaneous nerve of forearm and its implication for modified brachial plexus block. J Anat 1969; 105: 381 – 382.
12. Mestdagh H, Champeter J, Mauroy B, Leclet H, Drizenko A, Vasseur J. The supernumerary muscle of the leg: a report of two cases. Acta Anat 1990; 134: 263–264.
13. Nwoha PU, Adebisi S. An accessory quadriceps femoris muscle in Nigerians. Acta Anat Nippon 1994; 69: 69 – 71.
14. Adebisi SS, Asala SA, Singh SP. Descending and recurrent branches of the medial cutaneous nerve of the forearm. Nigerian J Surg Res (in press).
15. Grine FE, Kramer B. Arched gonadal arteries in the South African Negroes. J Anat 1981; 132: 387 – 390.
16. Adebisi SS, Singh SP. Anomalous gonadal artery in relation to the renal vein: a preliminary study in Nigerians. Nigerian J Surg Res 2000; 2: 148 – 151.