

MULTIPLE NEUROVASCULAR ABNORMALITIES OF A SINGLE CADAVER-A CASE REPORT

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ABSTRACT

Neurovascular variations are of interest to anatomists, clinicians, anaesthesiologists and especially to the surgeons.

During routine dissection of a 65 years old male cadaver in Kolkata Medical College; it was found that there was no standard formation of lateral cord of brachial plexus on right side because anterior division of upper trunk continued as Musculocutaneous nerve and the Median nerve was formed medial to the first part of Axillary artery just below and behind the Clavicle by the fibres of anterior division of middle trunk via lateral root and anterior division of lower trunk via medial root. About 1.5cm distal to its formation Median nerve gave a branch which crossed the second part of the Axillary artery and supplied the Coracobrachialis muscle in addition to Musculocutaneous nerve. A single Pectoral nerve was formed by union of two nerves arising from anterior division of middle and lower trunk respectively. The Musculocutaneous nerve of opposite limb was formed by union of two nerves arising from the lateral cord of brachial plexus. In posterior thoracic wall, a left sided Azygos vein and multiple communicating veins between Azygos and Hemiazygos vein were found. An altered relation between Tibial nerve and Posterior Tibial blood vessel and an abnormal termination of latter were encountered in right lower limb.

Key Words: Brachial plexus, Median nerve, Pectoral nerves, Azygos venous system, Tibial nerve & Posterior Tibial artery.

INTRODUCTION

Anomalies in the peripheral nerves and blood vessels are quite common. Among the peripheral nerves variations are commonly observed in the branching and fusion of the different branches of the Brachial plexus (Necdet Ko Cabiyik, Hasan oza 2007¹) and their relations with the Axillary artery (Pandey S.k. et al 2007)². Even complete absence of Musculocutaneous nerve can be seen (Kosugi K, Shibata S, Yamasita 1992)³. The knowledge of such multiple variations is important as these abnormal nerves can be injured during a surgical procedure or regional anaesthesia. It can also explain some unusual clinical symptoms caused due to these variations. The aim of our study is to provide additional information about multiple neurovascular abnormalities of a single cadaver and their clinical significance.

MATERIALS AND METHODS:

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Multiple neurovascular abnormalities were encountered during routine cadaveric dissection of a 65 years old male cadaver in the Department of Anatomy, Kolkata Medical College. Courses & branches of peripheral nerves & blood vessels were traced carefully. Different structures were painted and photographs were taken.

CASE REPORT:

A] Brachial Plexus (right side):-

Formations of upper, middle and lower trunks were normal (from C5-T1) [Fig-1]. Anterior division of upper trunk continued as Musculocutaneous nerve distally. The lateral root of Median nerve was formed from anterior division of middle trunk instead of coming from lateral cord. Anterior division of middle trunk also contributed some fibres to form Pectoral nerve. Anterior division of lower trunk continued as medial cord which contributed to the formation of medial root of Median nerve as usual but at much higher level. Posterior divisions of all three trunks united to form posterior cord which continued as Radial nerve as usual.

A single Pectoral nerve was formed by union of two nerves arising from anterior divisions of middle trunk and lower trunk. [Fig-2]

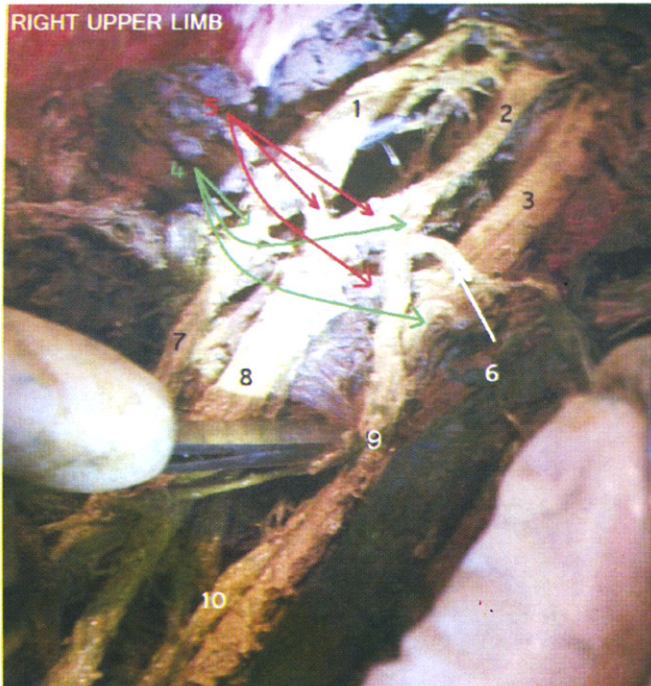


Fig-1: Showing atypical formation of cords of Brachial plexus.

- 1 = Upper trunk.
- 2 = Middle trunk.
- 3 = Lower trunk.
- 4 = Anterior divisions of all trunks.
- 5 = Posterior divisions of all trunks.
- 6 = Single Pectoral nerve.
- 7 = Musculocutaneous nerve.
- 8 = Posterior cord.
- 9 = Median nerve.
- 10 = Rest of Medial cord.

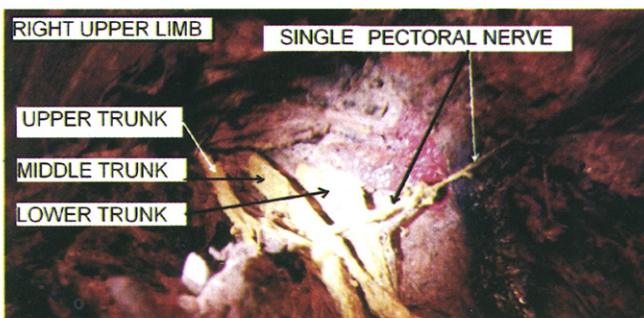


Fig-2: Showing single Pectoral nerve arising from anterior divisions of middle and lower trunks.

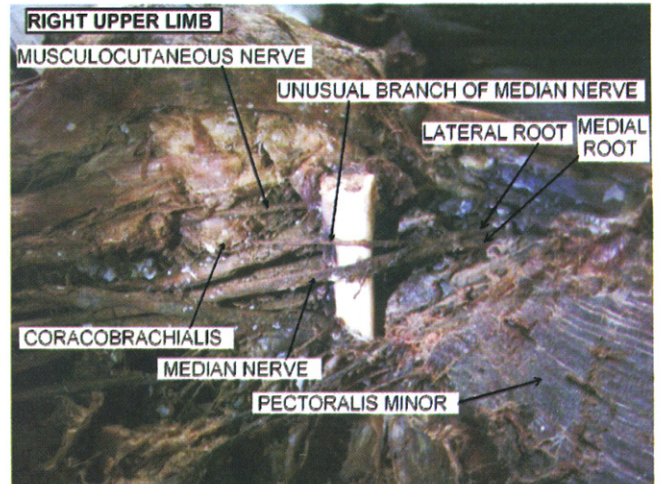


Fig-3: Showing high formation of Median nerve.

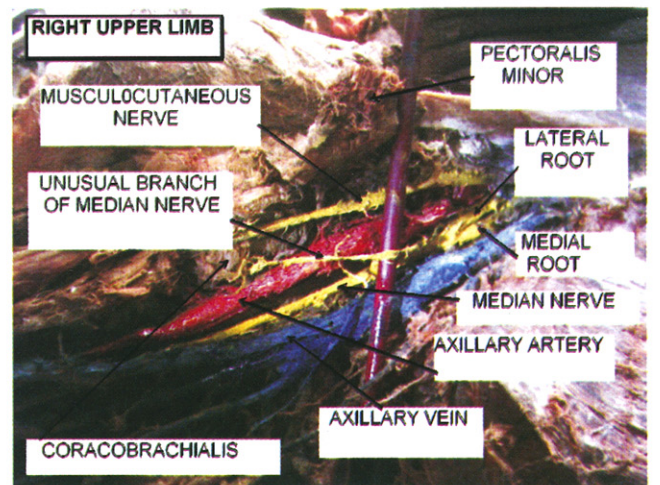


Fig-4: Showing an unusual extra branch of median nerve supplying Coracobrachialis.

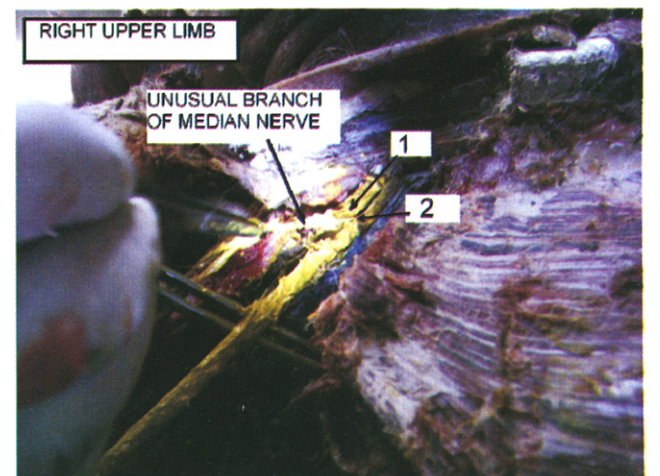


Fig-5: Showing unusual nerve arising from both lateral and medial roots of Median nerve.

- 1 = Fibres from lateral root of Median nerve.
- 2 = Fibres from medial root of Median nerve.

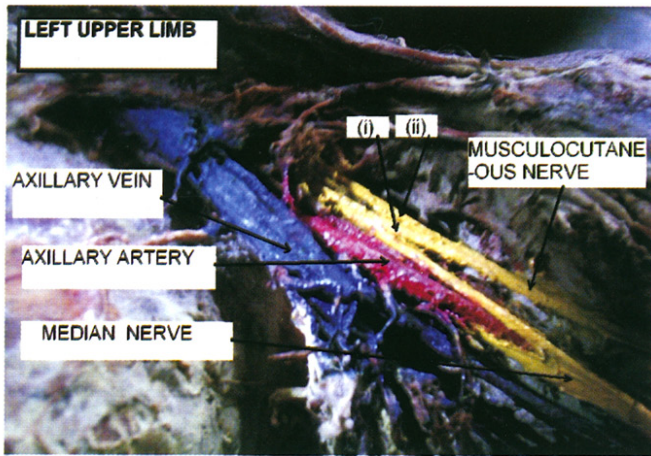


Fig-6: Showing formation of Musculocutaneous nerve on the left side by union of two branches arising from lateral cord.
(i) & (ii) = Two nerves, arising from lateral cord of brachial plexus unite to form Musculocutaneous nerve.

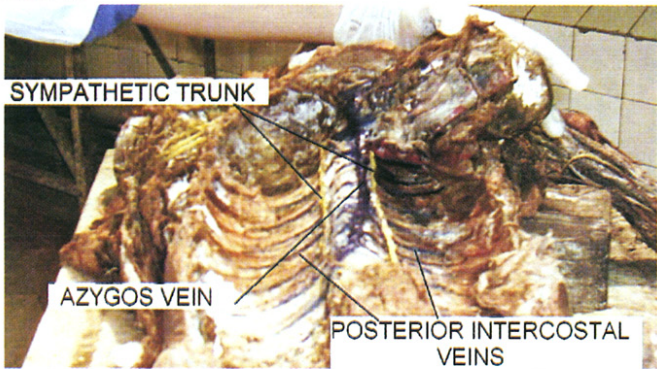


Fig-7: Showing left sided Azygos vein.

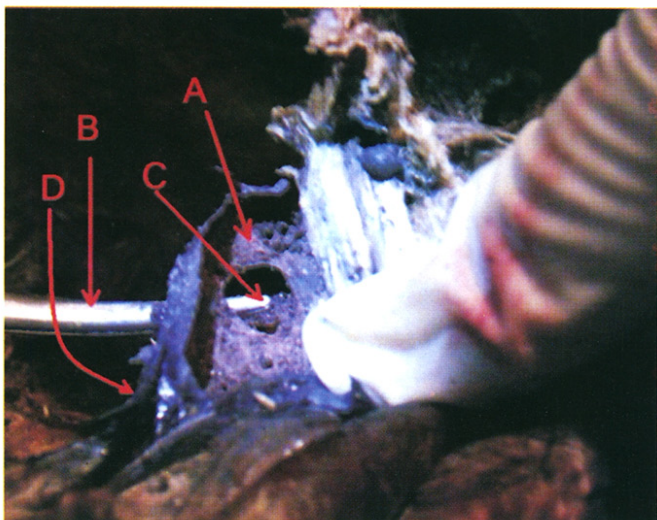


Fig-8: Showing drainage of Azygos vein in Superior Vena Cava.
A= Interior of Superior Vena Cava after opening of its anterior wall.
B= Probe introduced through the rent made at the terminal part of Azygos vein.
C= Tip of probe at the opening of Azygos vein in Superior Vena Cava.
D= Azygos vein.

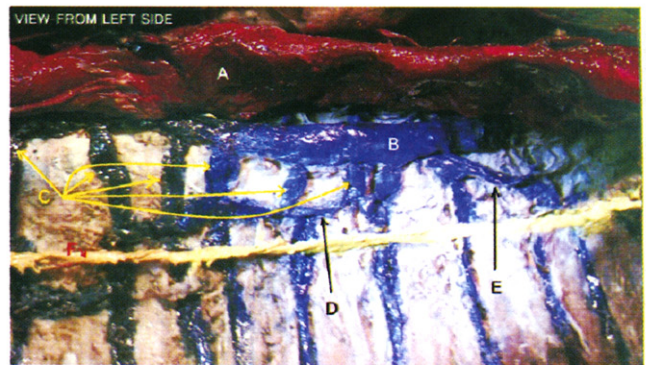


Fig-9: Showing multiple anastomosing veins between Azygos and Hemiazygos veins.
A= Descending Thoracic Aorta.
B= Azygos vein.
C= Anastomosing veins between Azygos & Hemiazygos veins.
D= Hemiazygos vein.
E= Accessory azygos vein.
F= Left sympathetic trunk.

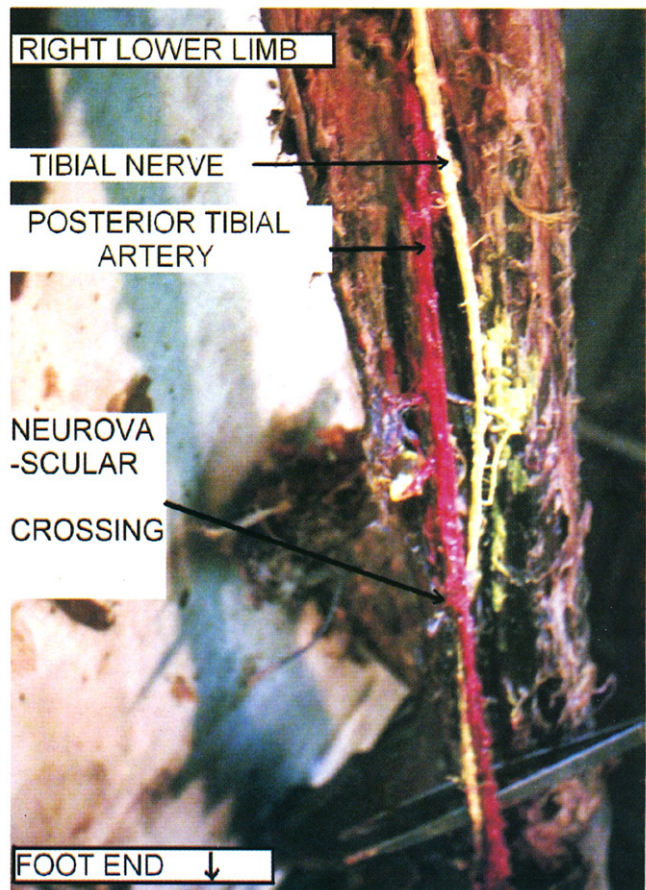


Fig-10: Showing Posterior Tibial artery is finally posterolateral to Tibial nerve.

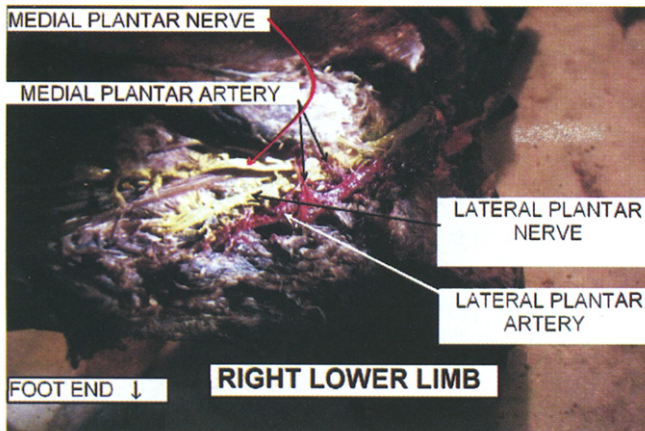


Fig-11: Showing abnormal distribution of Posterior Tibial artery at the entry to sole.

Median nerve of right upper limb was formed at an unusual high level. Union of lateral root and medial root of Median nerve was found just below and behind the Clavicle. [Fig-3] At the level of formation both roots of Median nerve and the nerve itself were medial to the first part of the Axillary artery [Fig-4]. Median nerve in its subsequent course was also medial to Axillary artery.

Median nerve about 1.5 cm distal to its formation gave a branch which crossed the second part of the Axillary artery and innervated the Coracobrachialis muscle from its proximal part.

The branch of Median nerve supplying coracobrachialis was dissected very carefully with removal of epineurium and it was found that both roots of the Median nerve [1, 2-in Fig-5] contributed fibres for its formation though major part of the contribution was from the lateral root of the Median nerve. So, the Coracobrachialis muscle was supplied by two nerves

- i) Musculocutaneous nerve as usual.
- ii) Additional branch from the Median nerve.

Other branches of different cords were normal.

B] Brachial Plexus (Left side):-

Musculocutaneous nerve was formed by union of two nerves [i, ii-in Fig-6] arising from lateral cord of brachial plexus.

No other anatomical variation was encountered on left side.

C] Azygos Venous System :-

Azygos venous system was dissected carefully and

the heart was pulled upward. The system was seen mostly on the left side [Fig-7]. Azygos vein crossed the vertebral column from right to left at the level of T11 vertebra and then ascended upwards lying on the left of the midline up to T5 vertebra where it turned to right again and drained into Superior Vena Cava. No valve was found at its termination [Fig-8].

Hemiazygos vein was on the left of Azygos vein throughout its course and drained into Azygos vein at the level of T8 vertebra. Hemiazygos vein was connected with Azygos vein additionally by six transverse anastomosing veins. [Fig-9]

Accessory hemiazygos vein received 4th to 7th left posterior intercostal veins and drained into Azygos vein at the level of T7.

Right Posterior Intercostal veins crossed the vertebral column to drain into the Azygos vein.

D] Tibial nerve & Posterior Tibial Artery (Right side):-

Up to the junction of middle and lower third of leg, the nerve was lateral to the artery. Then the nerve crossed deep to the artery and was medial to the artery in its subsequent course [Fig-10]. Therefore, deep to the flexor retinaculum the neurovascular relation was reversed. Posterior Tibial artery entered into the sole lateral to Lateral Plantar nerve. But soon it gave few small branches which crossed both Lateral & Medial Plantar nerve superficially and distributed as Medial Plantar artery [Fig-11]. Lateral Plantar artery was actually continuation of Posterior Tibial artery.

All other branches Tibial nerve & Posterior Tibial artery were found normal.

Neurovascular relations were unaltered at left lower limb.

DISCUSSION:

Normally, brachial plexus is formed by the fusion of the anterior primary rami of the C5-8 and the T1 spinal nerves. The C5 and C6 rami fuse at the lateral border of Scalenus Medius to form the upper trunk, the C7 continues as the middle trunk and the C8 and T1 rami join behind Scalenus Anterior to form the lower trunk. Each trunk, soon after its formation, divides into anterior and posterior divisions just above or behind the Clavicle (Standring S; Gray's Anatomy; 39th Edn.⁴. The anterior divisions of the upper and middle trunks form the lateral cord that lies lateral to the Axillary artery. The anterior division of the lower trunk descends at first behind and then medial to the Axillary artery and continues as the medial cord. The posterior divisions of all three trunks form the

posterior cord which at first above and then behind the Axillary artery. The cords then give rise to various branches that form the peripheral nerves of the upper limb (Sinnatamby CS. Last's Anatomy; 10th Edn.[5] & Moore KL and Dalley AF; 4th Edn.[6]).

During development, motor axons of the limb bud undergo an intricate feat of path finding to reach their target muscles. The ventral rami travel along permissive pathways. These pathways are regulated by some chemoattractants and chemorepulsants produced by mesenchyme. If there is any altered expression of these agents there is a chance of deviation of nerves from their usual course (Larsen WJ Human Embryology.4th Edn.[7]). So, this may be a possible explanation of unusual formation of Brachial plexus in our case.

According to Standring S (Gray's Anatomy; 39th Edn.⁴) the Median nerve has two roots from the lateral cord (C5, C6, C7) and the medial cord (C8, T1) which embrace the 3rd part of Axillary artery and unites anterior or lateral to it. Some fibres from C7 often leave the lateral root in the lower part of axilla and pass distomedially posterior to medial root and usually anterior to Axillary artery to join with the Ulnar nerve. They may branch from the 7th cervical ventral ramus; clinically they are to be mainly motor and to supply Flexor Carpi Ulnaris. If the lateral root is small, the Musculocutaneous nerve (C5,6 ,7) connects with the Median nerve in the arm⁴.

Various levels for fusion of roots of Median nerve have been reported. For example, Testut and Latarjet⁸ reported that the lateral root united with the medial root at the level of cubital fossa to form the median nerve. In another study of Pandey S.K et al 2006², it was found that in 4.7% cases, both roots of the median nerve were joined on medial side of Axillary artery to form a Median nerve, which traveled medial to the artery and in 2.3% cases the roots of the Median nerve did not join and both traveled separately anteromedial to Axillary and Brachial arteries.

In the present study, not only the nerve was formed at an unusual high level but the lateral root of Median nerve had no contribution of upper trunk; which was an extremely rare variation. This type of anomaly of formation of Median nerve without any contribution from upper trunk was not reported before.

Koizumi(1989)[9] showed that the human and prosimian coracobrachialis constantly received accessory branches that from the region of lateral cord of brachial plexus in addition to those from the Musculocutaneous nerve. Gumusalah Y, Yazar F, Ozan

H C (1998)¹⁰ reported that the Coracobrachialis muscle was innervated by a nerve originating from the lateral root of Median nerve but in that case the muscle was not supplied by either Musculocutaneous nerve or any branch from the lateral cord of brachial plexus. Kosugi K, Morita T, Yamashita (1992)¹¹ described in their studies that when the Musculocutaneous nerve was absent, the entire fibres of musculocutaneous nerve passed through the additional lateral root and fibres to the muscle supplied by the Musculocutaneous nerve branched out directly from the Median nerve. But in this study Coracobrachialis muscle was supplied by the anterior division of middle and lower trunk via the unusual branch of Median nerve. So, it is absolutely a unique of this study.

Normally, Lateral Pectoral nerve may arise from anterior division of upper and middle trunk, or by a single root from the lateral cord. Medial Pectoral nerve branches from the medial cord (Standring S; Gray's Anatomy; 39th Edn.⁴). Though in past many abnormalities regarding origin and way of innervations were reported in literature, single Pectoral nerve from anterior division of middle and lower trunk is still very rare.

Azygos vein is paravertebral in position. At the level of T4 vertebra, it arches forwards over the hilum of right lung & ends in Superior Vena Cava. Usually Accessory Azygos vein & Hemiazygos vein join the Azygos vein at the level of T7 &T8 vertebrae respectively. Posterior Intercostals veins, Vertebral venous plexus, Mediastinal, Esophageal & Bronchial veins are tributaries of this venous system (Standring S; Gray's Anatomy; 39th Edn.¹²). Embryologically (Larsen WJ Human Embryology.4th Edn.¹³) Azygos vein develops from right Supracardinal vein. It loses its communication with the Right Posterior Cardinal vein and forms new communication with Right Anterior Cardinal vein. If communication with Posterior Cardinal vein persists, the Azygos vein arises from Inferior Vena Cava. The left Supracardinal vein partially persists as Hemiazygos and Accessory Azygos vein. The left Posterior Cardinal vein mostly disappears and Hemiazygos veins drain into the Azygos vein to carry the blood to right atrium. Kagami and Sakai (1990)¹⁴ found that in the foetus the Azygos vein is located on the right side of the vertebral column or along the midline, moving to the left side with advancement of age. This hypothesis was confirmed by the fact that in their study the Azygos vein projected on the left side in 85% of

adults. Fukutome M (1951)¹⁵, Nathan H (1960)¹⁶ have observed that the location of the Azygos vein along the midline is more frequent (2796.3%) than on the right side of the vertebral column (3.753%). In our study, multiple communicating veins of asymmetrical length may be a possibility of left sided Azygos vein. But the exact cause of this left sided deviation in most of the adults is still not properly explained and it needs further study in future.

Tibial nerve in leg runs down the midline of the calf deep to Soleus. Posterior Tibial artery is at first lateral but soon passes anterior to it and continues downwards on its medial side to terminate under flexor retinaculum by dividing into Medial and Lateral Plantar arteries. The nerve ends under middle of the flexor retinaculum by dividing into Medial and Lateral Plantar nerves (Sinnatamby CS. Last's Anatomy; 10th Edn. ¹⁷).

According to Joshi SS & Joshi SD (2006) ¹⁸, Tibial nerve bifurcates at a higher level (proximal) to that of Posterior Tibial artery in an independent compartment (tarsal tunnel) and here vascular plane is superficial to the plane of nerves.

In our study Posterior Tibial artery did not give any terminal division deep to flexor retinaculum but the nerve was divided normally.

CONCLUSION:

According to our present study Coracobrachialis muscle has dual nerve supply from both Musculocutaneous nerve and a branch from the Median nerve which carries fibres from both lateral root and medial root of Median nerve. So, the effects of the unusual nerve lesion in presence of intact Musculocutaneous nerve and vice versa, needs further study and analysis.

The unusual branch of Median nerve crossing over the second part of the Axillary artery may lessen the blood supply of upper extremity by compressing the vessel. During radical mastectomy or other cosmetic surgery, there will be more chance of Pectoralis Major muscle paralysis due to single Pectoral nerve.

Such knowledge of variations in formation, course and innervation of various nerves are of immense importance during surgical exploration of axilla and arm region, during nerve block for avoiding injury to these abnormal nerves.

According to Francis J et al (1997)¹⁹ the Azygos vein has immense importance during the operation for esophageal atresia with tracheo-esophageal fistula. Its location helps the surgeon to locate the fistula. The

anomalous Azygos venous system may easily be confused with aneurysm, lymphadenopathy and other anomalies like tumor during computed tomography and magnetic resonance imaging of mediastinum. It is also important to remember these variations during mediastinal operations or surgery of large vessels.

Neurovascular crossing in the lower part of right leg may cause nerve entrapment. According to Myerson MS et al (1992)²⁰ and Crystal CS, Blankenship RB (2005)²¹; for posterior nerve block, Posterior Tibial artery is palpated as a landmark & needle is passed adjacent to the achilles tendon towards the Posterior Tibial artery behind the medial malleolus. So, during nerve block, surgical procedures like fixation of fractures with external nailing, medial displacement osteotomies and decompression in tarsal tunnel syndrome necessitate a proper understanding of detailed anatomy and possible variations of tarsal tunnel.

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