

A Cadaveric Study on Morphometry and Variation of Subclavian Artery: A Cross-Sectional Study

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ABSTRACT

Background: The subclavian artery is the source of blood supply to the upper limbs. It is the branch of the arch of the aorta on the left side and brachiocephalic trunk on the right side of the neck. It is used as cannulation site for cardiopulmonary bypass and for the insertion of intra-aortic balloon pumps. So its variations in the branching pattern are very important for surgeons and physician as well.

Method: The study was conducted on 80 embalmed cadavers over the period of 4 years from August 2013 to August 2017 during the routine dissection for the MBBS and BDS students in dissection hall of anatomy department in Jawaharlal Nehru Medical College, Belgaum, Karnataka, India. The digital vernier calliper was used to measure the morphometric parameter. The data were analysed by using the SPSS version 20.

Result: Out of 80 cadavers used for dissection, 52 (65%) were male and 28 (35%) were female. The external diameter of the subclavian artery in male was $7.15\text{mm} \pm 1.7\text{mm}$ and female was $6.85\text{mm} \pm 1.5\text{mm}$ with significant sexual dimorphism ($p=0.002$). The classical course of both subclavian arteries was found in 76 (95%) of the artery and the remaining 5% of the artery was found to have an anomalous course.

Conclusion: The subclavian artery in male had a larger diameter than in the female. The variation in the subclavian artery was common. The knowledge of its average size and its anomalous origin, course and branching pattern might be helpful for the surgeon as well as the physician disease diagnosis, interventional therapy, and surgical procedures.

Keywords: *Subclavian Artery, Morphometry, Variation, Branching Pattern, Anomalous course, Costocervical trunk*

INTRODUCTION

Understanding the normal course and branching pattern of the great vessels of the aortic arch and their variations is important not only for the endovascular interventionist but also for the diagnostic radiologist. An understanding of the variation of the subclavian artery is most important in angiography and surgical procedures where an incomplete knowledge of anatomy can lead to serious implications¹. The subclavian artery is the only source of blood supply to the upper limbs. Normally it is the branch of the arch of aorta on the left side and brachiocephalic trunk on the right side of the neck and passes through the subclavian groove on the first rib and continues as axillary artery in the upper part of the arm². It gives off various branches which supply to thoracic wall, head, neck and brain. The scalenus anterior muscle divides subclavian artery into three parts. The first part extends from its origin to the medial border of the scalenus anterior muscle; the second part lies posterior to the scalenus anterior muscle and the third part extends from the lateral border of the muscle to the outer border of the first rib. Its origin, course and the height to which it rises in the neck may vary in individuals³.

Classically, the first part of subclavian artery in both sides give off three branches (Vertebral artery, Internal thoracic artery and Thyrocervical trunk). The thyrocervical trunk again gives off inferior thyroid, transverse cervical and supra scapular artery². The costocervical trunk arises from the posterior surface of the second part of the subclavian artery on the right side and from the first part of the artery on the left side. It arches backwards over the cervical pleura then divides into the superior intercostals and deep cervical arteries at the neck of the first ribs⁴. The third part generally gives no branches but occasionally it may give rise to Superficial cervical or the suprascapular artery or dorsal scapular artery. On the left side all branches except the dorsal scapular artery arises from the first part of the artery and on the right side the costocervical trunk usually arises from the second part². The subclavian artery has many branches that supply blood to chest wall, thyroid gland, neck and cervical regions with a great role in blood supply.

Several variations in the origin, course, and branches of the subclavian artery were reported⁵. In some case, a common trunk arises from the first part of this artery that gives the ascending cervical, transverse cervical, suprascapular and dorsal scapular arteries and in other cases the right subclavian artery directly arose from arch of aorta instead of arising from brachiocephalic trunk. In other rare case, the inferior thyroid artery may be absent and the blood supply of thyroid gland is compensated by either superior thyroid artery or from anastomosing branch of costocervical and thyrocervical trunk⁶.

The subclavian artery is used as cannulation site for cardio-pulmonary bypass and for the insertion of intra-aortic balloon pumps. So its variations in the branching pattern are very important for surgeons as well as chest physician. Hence, the knowledge of variations regarding the abnormal origin, course and branching pattern of the subclavian artery is more important as it is used for diagnostic and surgical procedures⁷. An awareness of the variation is very important not only for anatomist but also for physician and surgeon for better understanding of diagnostic and surgical procedures.

METHODOLOGY

The study was conducted on 80 embalmed cadavers over the period of 4 years from August 2013 to August 2017, during the routine dissection of head, neck, and thorax region for MBBS and BDS 1st year students in the Department of Anatomy in Jawaharlal Nehru Medical Colleges, Belgaum, Karnataka, India. A fine dissection of right and left subclavian artery was done. All the branches were traced till its destination for the proper identification of its branch to identify whether the course was according to the classical textbook or not.

After fine dissection, the diameter of right and left subclavian artery was measured at its first, second and third part with the digital sliding vernier caliper. The age and sex of the cadavers were noted from the record of the Anatomy department. The data collected after dissection of each cadaver were recorded from each year of dissection and the data were analyzed and interpreted by using the SPSS version 20.

RESULTS

Out of the 80 cadaver dissected, 52 cadavers were male, and 28 were female. Age of the cadavers as recorded in the department ranges from 46 to 78 years in males and 53 to 75 in females. The mean age among female cadavers is 63.52 ± 3.5 years and among male was 65.31 ± 4.2 years as shown in the table 1. The mean diameter of the subclavian artery in male was 7.15 mm and female was 6.85 mm (table 2).

Table 1: Age and mean diameter of subclavian artery

| S.N. | Mean age in male | Mean age in female in years | Mean diameter of subclavian artery in male | Mean diameter of subclavian artery in female |
|------|-----------------------|-----------------------------|--|--|
| 1 | 65.31 ± 4.2 years | 63.52 ± 3.5 yrs | 7.15 ± 1.7 mm | $6.85\text{mm} \pm 1.5$ mm |

Table 2: Diameter of subclavian artery

| S.N. | Subclavian artery | Sex | Frequency | Diameter in mm (Range) | Mean diameter \pm S.D. |
|------|-------------------|--------|-----------|------------------------|--------------------------|
| 1 | Right | Male | 52 | 6.0 - 12.8 mm | 7.2 ± 1.8 mm |
| | | Female | 28 | 5.6 - 12.3 mm | 6.8 ± 1.5 mm |
| 2 | Left | Male | 52 | 6.0 - 12.4 mm | 7.0 ± 1.6 mm |
| | | Female | 28 | 5.4 - 12.1 mm | 6.9 ± 1.4 mm |

Among the 80 male cadavers dissected, 76 (95%) cadavers had normal origin and branching pattern as described in the Grey's Textbook of Anatomy and 4 (5%) of cadavers had found to have variation in the origin of costocervical trunk. Out of 52 male cadavers, 3 (3.7%) cadavers had variation whereas out of 28 female cadavers dissected, 1 (1.2%) cadaver had variation in their origin and their branching patterns (table 3).

Table 3: Subclavian artery with normal and anomalous course

| S.N. | Number of Cadavers | Normal subclavian artery | Subclavian artery with anomalous course |
|--------------|--------------------|--------------------------|---|
| 1 | Male (52) | 49 (61%) | 3 (3.7%) |
| 2 | Female (28) | 27 (34%) | 1 (1.2%) |
| Total | 80 | 76 (95%) | 4 (5%) |

Out of 4 cadavers, two male cadavers had anomalous course in the origin of right subclavian artery, which was arising directly from arc of aorta instead of from brachiocephalic trunk and the two cadavers has the anomalous course in the origin of costocervical trunk from the subclavian artery as shown in figure 1 and table 4.

Table 4: The variation found in right and left subclavian artery

| S.N. | Variation | No. | Sex | Side | Variation | Type of variation |
|------|-------------------|-----|--------|-------|-------------------------------|---|
| 1 | Origin | 2 | Male | Left | Origin of subclavian artery | Instead of arising from brachiocephalic trunk, it was directly arising from arc of aorta |
| 2 | Branching pattern | 1 | Male | Right | Origin of Costocervical trunk | Costocervical trunk, instead of arising from second part in right side, it was arising from 3rd part of subclavian artery (Figure 1) |
| | | 1 | Female | Left | Origin of Costocervical trunk | Costocervical trunk, instead of arising from first part of subclavian artery in left side, it was arising from 3rd part of subclavian artery (Figure 1) |

**Figure 1:** Subclavian artery and its branching pattern:

1= First part of subclavian artery, 2=scalene anterior muscle, 3=Third part of subclavian artery, 4=Costocervical trunk)

DISCUSSION

Our study showed that three male and only one female cadaver showed the anomalous course of the right subclavian artery. Similar anomalous course of the right subclavian artery was observed in a Japanese population where the right subclavian artery arose from the posterior wall of the aortic arch as its last branch, and ran rightwards between the esophagus and the vertebral column which belongs to the type

G of the Adachi-Williams-Nakagawa-Takemura classification of aortic arch branching patterns⁸.

In our present study, we found 5% of the variation in the subclavian artery. Many authors argue about the prevalence of the aberrant right subclavian artery ranges from 1% to 5.5% in different study around the globe⁸⁻¹⁰. Variations in the course and branching

pattern of the subclavian artery have been reported in many previous studies. Nevertheless, the costocervical trunk originating from the third part of subclavian artery on both sides of neck is very rarely seen which was observed in two cases of the present study. The result of our study differ with a case study by Voster et al. which showed the internal thoracic artery takes an abnormal origin from third part of subclavian artery and vertebral artery was seen having an anomalous origin from the aortic arch¹¹.

Present study found the variation in the origin and course of costocervical trunk. Most of the time it was the branch of second part of the subclavian artery on the right side and the first part of the artery on the left side; however, we observed that the costocervical trunk arose from the third part of subclavian artery on both sides. The artery on both sides reaches up to the apex of the lung and arches over it and then on reaching the neck of the first rib it was terminated by dividing into deep cervical and superior intercostal artery. The deep cervical artery runs upwards between transverse process of C7 and the neck of the first rib. The artery then passes the back of neck between semispinalis capitis and semispinalis cervicis. The superior intercostal artery runs downwards and enters the first intercostal space. It was also observed that the costocervical trunk in this case was prominently seen and the course of subclavian artery was in 'S' shaped on both sides. The other branches of subclavian artery (vertebral artery and thyrocervical trunk) arose normally and have the normal course and branching pattern as described in the Grey's Anatomy². Also the dorsal scapular artery is absent in our study.

Various studies reported that all the branches of the subclavian artery on the left side arose from the first part as an individual direct branch and it was also observed that the thyrocervical and costocervical trunk were absent⁸. The suprascapular artery arose from the anterior aspect of the first part as a separate branch and superior intercostal artery branch of costocervical trunk arose directly from postero-superior border of first part very close to vertebral artery was also observed¹². Mehrdad and Sadeghi reported that almost all branches of subclavian

artery arises from the first part only. They found that vertebral and internal thoracic artery arises from the large common trunk like that of thyrocervical trunk which is totally different than our finding though the case study was similar¹³.

The third part of the subclavian artery is the most accessible part of the artery² which is very important for the surgeon during the invasive procedure. It is used as cannulation sites for cardio-pulmonary bypass and for the insertion of intra-aortic balloon pumps¹⁴. Normally there are no branches in the third part of the artery while in this study the costocervical artery arose from the third part on both sides. But our study found the the anomalous course was observed in the origin of the costocervical trunk while the other branches of subclavian artery had a normal course and distribution. So the knowledge regarding the aberrant origin course and branching pattern is very crucial for clinical practice.

CONCLUSIONS

The subclavian artery in male had larger diameter than in female. The variation in the origin and branching pattern of the subclavian artery was common. The surgeon and physician must be aware of the fact that there might be the variation in the origin and course of subclavian artery during intervention and surgical procedures. The knowledge of its average size and its anomalous origin, course and branching pattern might be helpful for surgeon as well as physician for disease diagnosis, interventional therapy, and surgical procedures.

REFERENCES

1. Sikka A, Jain A. Bilateral variation in the origin and course of the vertebral artery. *Anat Res Int.* 2012;2012:580-765.
2. Williams P, Bannister L, Berry M, et al. Gray's Anatomy. In: Arteries of limbs and cardiovascular system. 38th ed. London: Churchill Livingstone; p 1537.
3. Singh V. Anatomy of Head, Neck and Brain. 2nd ed. Vol. III. New Delhi: Elsevier; 2011. p252-57.

4. Chaurasia B. BD's Chaurasia's Human Anatomy. 3rd ed. Vol. III. New Delhi: CBS Publisher & Distributors; 2004.p172–76.
5. Kohli S, Yadav N, Prasad A, Banerjee SS. Anatomic variation of subclavian artery visualized on ultrasound-guided supraclavicular brachial plexus block. Case Rep Med. 2014;39:49-20.
6. Lee JY, Won DY, Oh SH, Hong SY, Woo RS, Baik TK, et al. Three concurrent variations of the aberrant right subclavian artery, the non-recurrent laryngeal nerve and the right thoracic duct. Folia Morphol (Warsz). 2016;75(4):560–4.
7. Yücel AH, Kizilkanat E, Ozdemir CO. The variations of the subclavian artery and its branches. Okajimas Folia Anat Jpn. 1999 ;76(5):255–61.
8. Komiyama M, Matsuno Y, Shimada Y. Variation of the right subclavian artery as the last branch of the aortic arch in two Japanese cadavers. Okajimas Folia Anat Jpn. 1995;72(5):245–7.
9. Park JK, Kim SH, Kim BS, Choi G. Two cases of aberrant right subclavian artery and right vertebral artery that originated from the right common carotid artery. Korean J Radiol. 2008 Jul;9 Suppl:S39-42.
10. Chaoui R, Heling K-S, Sarioglu N, Schwabe M, Dankof A, Bollmann R. Aberrant right subclavian artery as a new cardiac sign in second-and third-trimester fetuses with Down syndrome. American journal of obstetrics and gynecology. 2005;192(1):257–263.
11. Voster W PDP, Meiring J. Abnormal origin of internal thoracic and vertebral arteries. Clin Anat. 1998;11(1):33–7.
12. Lemke A-J, Benndorf G, Liebig T, Felix R. Anomalous origin of the right vertebral artery: review of the literature and case report of right vertebral artery origin distal to the left subclavian artery. American Journal of Neuroradiology. 1999;20(7):1318–1321.
13. Jahanshahi M, Sadeghi Y. A case report of variation in subclavian artery branches. J Med Sci. 2007;7(3):457–9.
14. Pastores SM, Marin ML, Veith FJ, Bakal CW, Kvetan V. Endovascular stented graft repair of a pseudoaneurysm of the subclavian artery caused by percutaneous internal jugular vein cannulation: case report. American Journal of Critical Care. 1995;4(6):472–475.

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