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The Variable Course of Subclavian and Axillary vessels in relation of Thoracic Outlet Syndrome and Breast Cancer Metastases

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***Abstract*— Background: The axillary artery is a standard continuation of subclavian artery.Objectives: The purpose of current study is to identify the variable origin and course of the axillary artery as well as the axillary vein drainage and its course with their clinical significant.Material and method: The present study includes 79 female cadavers have been dissected carefully to observe the anatomical features of axillary artery and vein. Result:The current study showed the axillary artery arises from the subclavian artery as well asthe axillary vein drains into subclavian vein in 98.7%. Therefore, 1.3% the axillary artery arose from the brachiocephalic trunk and its vein drained into brachiocephalic vein. In the present variation, the axillary vein and artery as well as the brachial plexuses run below the second ribs from ventral to dorsal direction. Further, the axillary artery originating from subclavian artery penetrated the scalenus anterior in 1.9% in present study. Conclusion:This study presents unusual course of the axillary artery and vein as well as the brachial plexus and accounts their incidences in female Caucasian population. The clinical significant is direct extension of breast cancer to the current neurovascular variations which may present with different clinical pictures. Further, the axillary artery and vein with the brachial plexusmay be in high risk of ribs entrapment result in thoracic outlet syndrome. Moreover, radiologists have to be completely aware of thevascular variation to report. This radiologist's report might help the surgeons to avoid iatrogenic injury of the axillary vein and artery leading to threatening hemorrhage.**

***Index Terms*— Axillary Vein Variation, Axillary Artery Variability, Breast Cancer Metastases, Iatrogenic Injury of Axillary vessels,Cervical rib, Scalenus anterior.**

I. Introduction

The axillary artery is a direct continuation of the subclavian artery starting from the lateral edge of the first rib and terminating at the lower edge of the teres major tendon. It has been divided into three divisions based on its course in relation to pectoralis minor.The first division of the axillary artery starts from the lateral edge of the first rib and terminates at the superior edge of pectoralis minor tendon giving the highest thoracic branch. The second division of the axillary artery runs from the upper to lower edge of pectoralis minor tendon giving thoracoacromial and lateral thoracic branches. The third division of the axillary artery begins from lower edge of pectoralis minor tendon and finishes at lower edge of the teres major tendon giving anterior and posterior humeral circumflex.

The axillary vein starts at the lower edge of the teres major which is a continuation of the basilic vein and terminates as the subclavian vein at the lateral edge of the first rib. The subclavian vein crosses over the first rib and passes ventral to scalenus anterior which terminates as it joins the internal jugular forming the brachiocephalic vein.

The brachial plexus is an amalgamation of the ventral root of the inferior four cervical and the first thoracic nerve. The ventral root of fifth and sixth cervical nerves forms the upper trunk whereas the eighth and first thoracic cervical nerves form the lower trunk. The middle trunk is a continuation of seventh cervical nerve. The previous three trunks run below clavicle as they divide into anterior and posterior divisions. The anterior divisions of the upper and middle trunks join to form lateral cord whereas the anterior division of lower trunk forms the medial cord. The posterior division of the three trunks forms the posterior cord. The three cords surround the second parts of axillary artery (Gabella, 1995; Sinnatamby, 1999).

II. Material and Method

This study includes 79 female cadavers to examine the origin and course of axillary artery and as well as drain and course of axillary vein. The thorax, neck and upper limb have been dissected during the undergraduate practical session. After skin and facial have been exposed, the anterior and posterior triangle of neck boundaries and their contents have been described. Then, the scaleni anterior and middle were clarified in relation to the subclavian artery and vein as well as the brachial plexus course. Also, the axillary artery and vein were inspected according to their anatomical features.

III. Result

The current study investigates 79 female cadavers. 158 specimens have been examined to inspect the origin and course of axillary artery as well as the drain and course of vein with the brachial plexus course in relation to external surface of the first rib. The present study found that the

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axillary artery arosefrom the subclavian artery and axillary vein drained into subclavian vein in 98.7%. While, 1.3% the axillary artery arose from the brachiocephalic trunk and its vein drained into brachiocephalic vein. In three cases, the axillary artery originating from subclavian artery penetrated the scalenus anterior in 1.9%. The current study presents rare neurovascular bundle variation observed in two cases of 79 female cadavers. Both female cadavers (67 and 73 years old Caucasian) were right upper limb variation presented with a superficial course of the axillary vein and artery as well as the brachial plexuses running below the second ribs from ventral to dorsal direction. Further, the incidence rate of this variation is 2.5% of total specimens which is more in unilateral and right side. Therefore, the variability of the axial artery course occurred in 4.3% whereas the variability of the axial vein course occurred in 2.5% as well as the brachial plexus (Tables 1, 2 and 3). Therefore, the total incidence of the vascular variation of upper limb is 6.9% of total specimens. The present study estimated the variability of the vascular variation of upper limb to be 13.8% in female Caucasian population (Table 4).

IV. Discussion

The axillary artery variability in origin, course and branching are infrequent vascular anomalies. The vascular anomaly of axillary artery is due to defects in embryogenesis (embryonic development) in which the lateral branch of seventh cervical inter segmental artery becomes the axial artery and its branches during bud develop into upper limb (Tan andTan, 1994; Jurjus 1999). Therefore, various variability forms of final destination of development are based on plexus development and regression (Hamilton and Mossman HW; 1972). This could explain the different vascular anomalies in upper limb which presented in series studies (George, et al. 2007; Magden et al. 2007; Karambelkar et al. 2011)and found to be between 11 to 24.4% (Watanabe et al. 1985) or 9% (Uglietta and Kadir 1989). In present studies, the variability of vascular variances including the axillary artery occurred in 2.5% and its vein occurred in 2.5% in relation to course to rib; and the axillary artery penetrating the scalenus anterior occurred 1.2% (Figure 1 and 2). Therefore, the vascular anomalies of upper limb in female Caucasian population found to be 6.2%.

Many review studies of axillary artery focused on description of its differentbranches variability (George, et al. 2007; Magden et al. 2007; Karambelkar et al. 2011).Based on few case reports, the variability of the axilary artery was in origin as from the arch aorta (Gabella, 1995). In present study described the axilary artery passing below the second rib therefore there is a congenital absence of subclavian artery because it did not pass below the clavicle. As result, the present study clarifies that the axilary artery originating from the arch of aorta directly.Further, different studies presented thecourse variation of axilary artery in relation to ether both esophagus and trachea or scalenus anterior (Stauffer and Pote, 1946; Sealy, 1951; Nathan and Seidel, 1983; et al. 1990; Gabella, 1995;).Occasionally, the subclavian artery penetrates the scalenus anterior instead passing dorsal to it (Harry et al. 1997; Kocabiyik et al. 2007). In current study, the axillary artery and vein with brachial plexues run between second and third ribs (Figure 1).

Series studies identified the first rib anomaly(Hashimoto et al. 1994; Adesanya , 2007; Yamaguchiet al. 2008), cervical rib(Edwards et al. 1992; Gabella, 1995;Sanders and Hammond 2004) and Hypertrophy of scalenus anterior (Edwards et al. 1992; Hashimoto et al. 1994; Katirji and Hardy, 1995; Sanders et al. 2004; Adesanya, 2007; Yamaguchi et al. 2008) are compressing factors pressurize the subclavian artery and vein as well as subclavian vein and brachial plexus result in thoracic outlet syndrome including different clinical features depending on neurovascular compression(Abdul-Jabar et al. 2009). In current research study, the axial artery pierced the scalenus anterior therefore it is highly predisposed to thoracic outlet syndrome. The variable course of axilary artery has been linked to thoracic outlet syndrome(Gouranga et al. 2012).In present studyshows the axilary artery passing superior to the upper boarder of the first rib and penetrating the scalenus anterior which may lead to thoracic outlet syndrome (Figure 2).

V. Conclusion

The current study presents the variation of axillary artery and vein as well as the brachial plexus to alert anaesthesiologist to have a different technique for nerve block. Further, it alerts surgeons to avoid iatrogenic fault during surgery of breast cancer because of their course proximity. Moreover, the oncologistshave to be aware of this variation which may present with different clinical pictures in case of breast cancer metastases from the upper outer quadrant producing unpredictable pain due to ischemic gangrene (blockage of axillary artery), superior vena cava thrombosis and / or upper limb oedema due to lymphatic vessel obstruction.

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REFERENCES

[1] Abdul-Jabar H, Rashid A, Lam F;2009. Thoracic outlet syndrome. Orthop Trauma., 23(1):69-73
[2] Adesanya O;2007. Thoracic outlet syndrome secondary to first rib anomaly; the value of multi-slice CT in diagnosis and surgical planing. Ir Med J., 100(2): 377-379.
[3] Edwards P, Moody P, Harris P; 1992. First rib anomalies in association with cervical ribs: a cause for postoperative failure in the thoracic outlet syndrome. Eur J Vasc Surg., 6: 677-681.
[4] Gabella G. Cardiovascular. In: Williams P, Warwick R, Dyson M, Bannister L, editors. 1995.Gray's anatomy. Edinburgh:Churchill Livingstone., 1529–1530.
[5] George, B. M.; Nayak, S. & Kumar, P;2007.Clinically significant neurovascular variations in the axilla and the arm – a case report. Neuroanatomy., 6(1):36-38,
[6] Gouranga santra, Siwalik Banerjee, Dibyendu De, Kuntal Bhattacharya; 2012. Right subclavian artery thrombosis due to cervical rib. JAPI., 60: 51.
[7] Hamilton WJ, Mossman HW:1972.Cardiovascular system. In: Human embryology. 4th ed. Baltimore: Williams and Wilkins., 271-290.
[8] Harry WG, Bennett JD, Guha SC;1997. Scalene muscles and the brachial plexus: anatomical variations and their clinical significance. Clin. Anat., 10: 250–252.
[9] Hashimoto H, Nikaido Y, Kurokawa S, Miyamoto K, Sakaki T;1994. Thoracic outlet syndrome due to first rib anomaly: a case report. No Shinkei Geka., 22(11): 1063-1066.
[10] Jurjus AR, Correa-De-Aruaujo R, Bohn RC;1999.Bilateral double axillary artery: embryological basis and clinical implications. Clin Anat., 12: 135-140.
[11] Karambelkar RR., Shewale AD, B.N Umarji;2011.Variations in Branching Pattern of Axillary Artery and its Clinical Significance. Anatomica Karnataka., 5(2):47-51.
[12] Katirji B, Hardy RW Jr;1995. Classic neurogenic thoracic outlet syndrome in a competitive swimmer: a true scalenus anticus syndrome. Muscle Nerve., 18: 229–233.
[13] Kocabiyik N;Yalcin B; Kilic C; Ozan H;2007.Case Report: Multiple anomalies of the brachial plexus: a case report. Neuroanatomy., 6: 21–23.
[14] Magden, O.; Gocmen-Mas, N. & Caglar, B;2007.Multiple variations in the axillary arterial tree relevant to plastic surgery: A case report. Int. J. Morphol.,25(2):357-361,.
[15] Nathan H, Seidel MR;1983.The association of a retroesophageal right subclavian artery, a right-sided terminating thoracic duct, and a left vertebral artery of aortic origin: anatomical and clinical considerations. Acta Anat., 117:362–373.
[16] Sanders RJ, Hammond SL;2004.Etiology and pathology. Hand Clin., 20: 23–26.
[17] Sealy WC; 1951. A report of two cases of the anomalous origin of the right subclavian artery from the descending aorta. J Thorac Surg., 21:319 –324.
[18] Sinnatamby CS;1999.Last's anatomy regional and applied. 10th Ed., London, Churchill Livingstone., 338–340.
[19] Stauffer HM, Pote HH;1946.Anomalous right subclavian artery originating on the left side as the last branch of the aortic arch. Am J Roentgenol., 56:13–17.
[20] Stone WM, Brewster DC, Moncure AC, Franklin DP, Cambria RP, Abbott WM;1990. Aberrant right subclavian artery: varied presentations and management options. J Vasc Surg., 11:812– 817.
[21] Tan C B, Tan C K;1994.An unusual course and relations of the human axillary artery. Singapore Med J., 35: 263-264.
[22] Uglietta JP, Kadir S;1989. Arteriographic study of variant arterial anatomy of the upper extremities. Cardiovasc Intervent Radiol., 12 145-148.
[23] Watanabe M, Takatsuji K, Sakamoto N, Morita Y, Ito H;1985.Two cases of fusion of the musculocutaneous and median nerves. Kaibogaki Zasshi.,60 1-74.
[24] Yamaguchi R, Kohga H, Kurosaki M, Tamura M, Tosaka M, Yashimoto Y;2008.Acute basilar artery occlusion in a patient with left subclavian artery occlusion due to first rib anomaly: case report. Neurol Med Chir (Tokyo)., 48(8): 355-358.

Table 1: The variability of axillary artery in origin and course in female

Cadaver *	**Incidence rate of Usual course****	**Incidence rate of Unusual course*****	**Total**
Axial artery	98.7% (156 specimens)	1.3% (2 specimens)	100%
Right axillary artery	97.5% (77 specimens)	2.5% (2 specimens)	100%
Left axillary artery	100% (79 specimens)	0%	100%
Subclavian artery	98.7% (156 specimens)	1.3% (2 specimens CAB****	100%

*158 specimens of female cadavers have been investigated including 79 left and right side.
** The usual anatomical course is the axillary artery starts from the external edge of the first rib and found to be on the left side (L=79 and R=77).
*** Unusual course is the axillary artery starts from different origin and course rather than regular behaviors in which the axillary artery pass below the right 2nd ribs.
***** In this study, the subclavian artery been proposed to be congenital absence (CAB) due the segment connected to the brachiocephalic trunk and it has no relation to clavicle.

Table 2: The variability of axillary vein in drain and course in female

Cadaver *	**Incidence rate of Usual course****	**Unusual course*****
Axial vein	98.7% (156 specimens)	1.3% (2 specimens)
Right axillary vein	97.5% (77 specimens)	2.5% (2 specimens)
Left axillary vein	100% (79 specimens)	0%
Subclavian vein	98.7% (156 specimens)	1.3% (2 specimens CAB****

*158 specimens of female cadavers have been investigated including 79 left and right side.
** The usual anatomical course is the axillary vein terminates at level of the external edge of the first rib and found to be more on the left side (L=79 and R=77).
*** Unusual course is the axillary vein terminates into brachiocephalic vein via passing below the right 2nd ribs and found to be more on the right side
**** In this study, the subclavian vein have been proposed to be congenital absence (CAB) due the piece connected to the brachiocephalic vein it has no relation to clavicle.

Table 3: The variable course of the subclavian artery in relation to scalenus anterior

Subclavian artery	Incidence rate
Running dorsal to scalenus anterior	96.8% (153 specimens)
Right subclavian artery	93.7% (74 specimens)
Left subclavian artery	100% (79 specimens)
Unusual course	1.9% (3 specimen)*

Congenital absence	1.3% (2 specimens)**

* In one case the subclavian artery penetrating the right scalenus anterior occurred in 1.3% over the right side cases.
** In current study found the subclavian artery to be congenital absence due it passes below the second rib and avoiding subclavical course which occurred in 2.5% over the right side specimens.

Table 4: The incidence rate of vascular variation of upper limb in female population

Artery	**Unusual origin**	**Unusual course**	**Total of 79 female cadavers**
Subclavian artery	No	3.8% (3 specimen)*	3.8%
Axillary artery	2.5% (2 specimens)**	2.5% (2 specimens)	5.0%
Vein	**Unusual drain**	**Unusual course**	-------
Subclavian vein	No	No	No
Axillary vein	2.5% (2 specimens)***	2.5% (2 specimens)	5.0%
Total	5.0%	8.8%	13.8%

* The subclavian artery penetrated the scalenus anterior
**The axillary artery passed below the inferior edge of second rib as a direct continuation of the brachiocephalic trunk (congenital absence of the subclavian artery).
*** The axillary vein run below the inferior edge of second rib and drained directly in brachiocephalic vein (congenital absence of the subclavian vien).

Figure legend

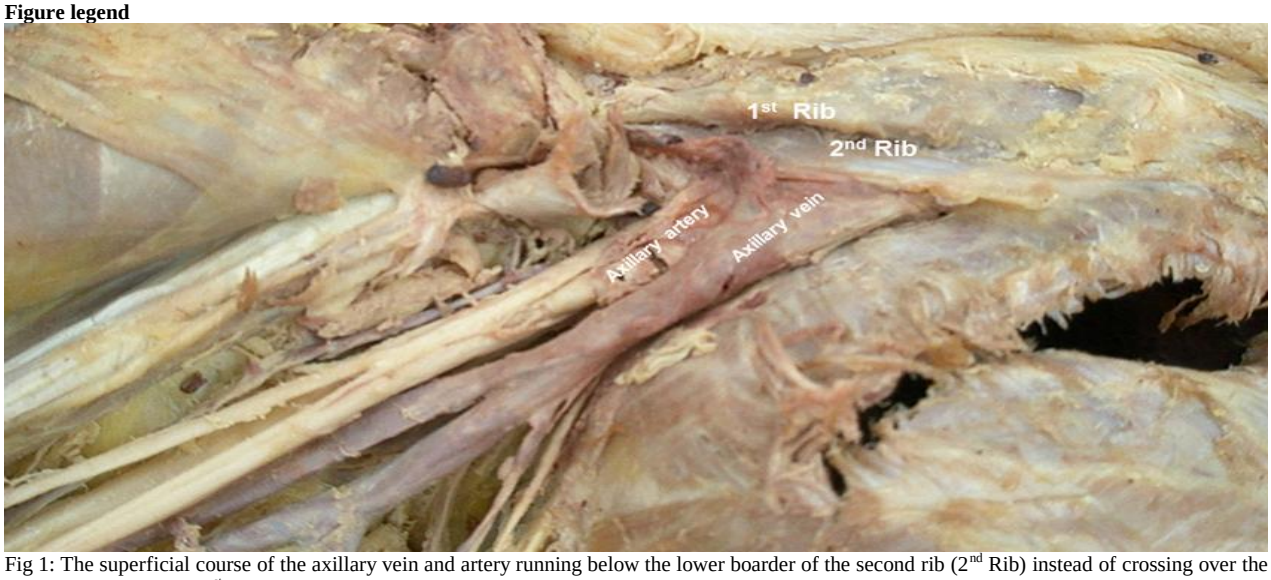

Fig 1: The superficial course of the axillary vein and artery running below the lower boarder of the second rib (2nd Rib) instead of crossing over the external surface of the first rib (1st Rib).

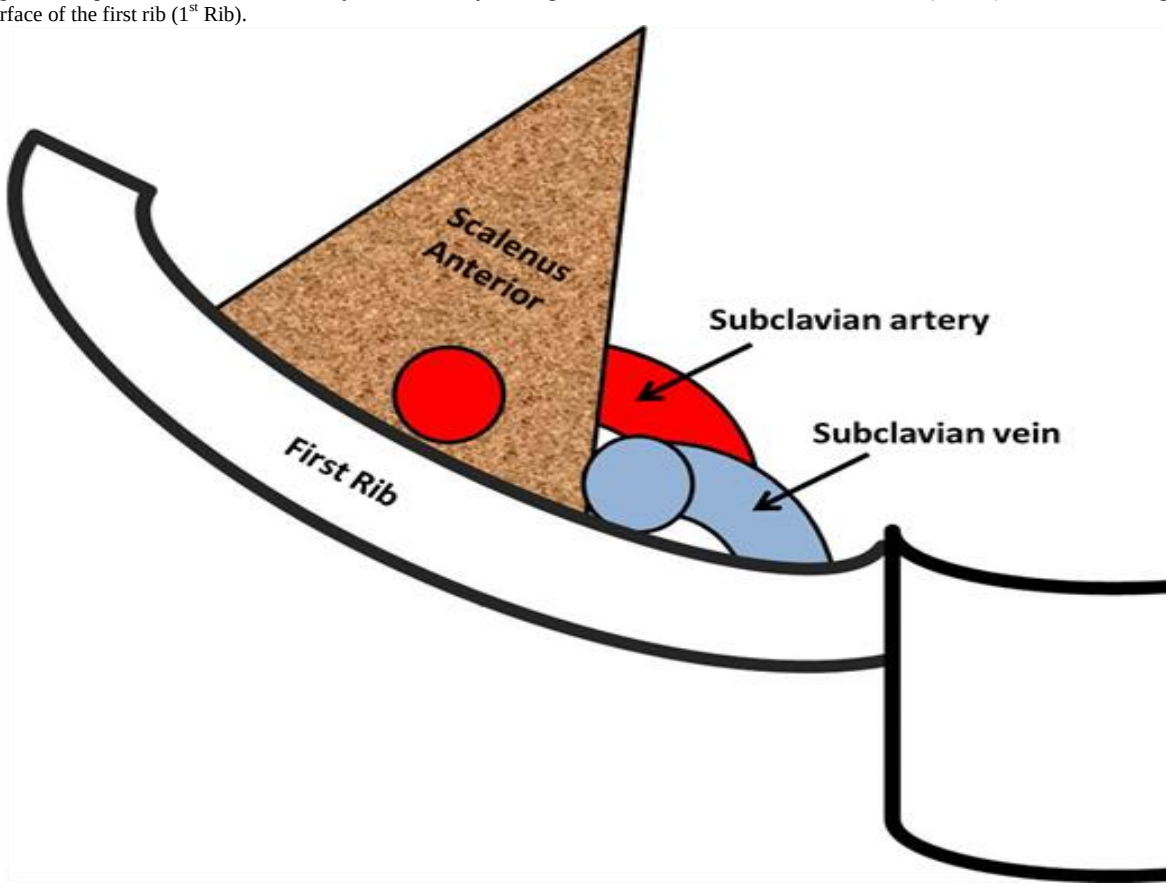

Fig 2: The subclavian artery crosses over the superior surface of the first rib (1st Rib) and penetrates the scalenus anterior.