

Original Research Article

VARIANT ANATOMY OF INTERNAL THORACIC ARTERY- CLINICAL IMPLICATIONS

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ABSTRACT

Background: Now a days, Internal thoracic artery (ItA) is being widely used in coronary artery bypass grafting (CABG) and in breast reconstructive surgeries. In addition, the area around its origin is also used for subclavian vein catheterization and introducing a pacemaker.

Aim: Aim of the study was to know the normal and variant anatomy of internal thoracic artery in Indian subjects in order to provide useful data to thoracic surgeons, so as to prevent iatrogenic complications in ItA dissections. Clinical applications related to variations were analysed.

Material and Methods: 30 cadavers were dissected to see the mode of origin of internal thoracic artery, diameter at its origin and relation with phrenic nerve and thyrocervical trunk.

Results: 55 arteries were showing normal origin and tend to arise opposite the root of thyrocervical trunk. Remaining 5 were arising in common with one or two branches of thyrocervical trunk. Average diameter at its origin was 2.8cm on left and 2.6cm on right. Relation with phrenic nerve was variable.

Conclusion: During CABG surgery, Breast reconstructive surgery and various interventional procedures, it is important to know the variant pattern of ItA so as to avoid iatrogenic complications

KEY WORDS: Internal thoracic artery, Thyrocervical trunk, Coronary artery bypass graft, Subclavian artery.

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INTRODUCTION

According to standard textbooks of anatomy, Internal thoracic artery (ITA) arises inferiorly from first part of subclavian artery (SA) about 2 cm above the sternal end of clavicle, opposite the root of thyrocervical trunk (TT) and near the medial edge of scalenus anterior muscle. It descends in an inward and slightly forward direction to enter the thorax behind the

cartilage of 1st rib [1,2].

Anomalous origin of the ITA has already been reported in the literature. Daseler and Anson encountered an absence of internal thoracic artery in 2 of their 400 specimens. However they are silent about the source of blood supply to the affected area in these [3]. An anomalous origin of this artery from thyrocervical trunk was

found in 9% of dissections by Anson [4]. Anomalous unilateral [5,6] or bilateral [7] ItA origin from the third portion of the SCA has also been encountered in the literature in less than 1 % of the cases [3,6,8]. They further emphasized the importance of such a variant as the area coursed by it is commonly used for percutaneous subclavian vein catheterization to determine CVP or to administer drugs and solutions in emergency or even to introduce a pacemaker [6].

In recent years, Internal thoracic artery is being widely used for CABG. It has gained importance in CABG because of long term patency [9,10] and survival rate [11,12] and improvement in post-operative quality of life [13], when compared with the results of saphenous vein grafts. Secondly, because of its adequate size and intrathoracic course it is also used as recipient vessels in breast reconstruction [14].

MATERIALS AND METHODS

30 cadavers were dissected to study the variant anatomy of internal thoracic artery. Deep dissection was done in the region of root of neck to expose the subclavian artery and its branches. Origin of internal thoracic artery was traced. Various parameters were studied in relation to internal thoracic artery. Mode of origin, Diameter at its origin and relation with phrenic nerve and thyrocervical trunk.

RESULTS

Parent artery: In the present study, internal thoracic artery originated directly from first part of subclavian artery in 55 dissections (91.7%), 27 on left side (90%) and 28 on right side (93.3%).

In rest of the 5 sides, it was a variant origin in common with one or the other branch of thyrocervical trunk. (Fig. 1, 2 & 3). On left side anomalous origin was seen in 10% and right side in 6.7%. Details are shown in Table 1.

Diameter at origin: Average diameter of internal thoracic artery at its origin was found to be 2.6 mm (range 1.5 – 4.0 mm) on left side and 2.8 mm (range 1.9 – 4.0 mm) on right side.

Relation with thyrocervical trunk: Usually the internal thoracic artery tend to group with thyrocervical trunk in 55 dissections. In present study, 5 internal thoracic arteries were showing its origin with one or two branches of thyrocervical trunk.

Relation with phrenic nerve: Phrenic nerve lies in a close relationship to ItA. It crosses ItA obliquely from lateral to medial side. It was passing anteriorly in 65% and posteriorly in 35% on right side and 70% anterior and 30% posterior to ITA on left side.

Table 1: Comparison of site and mode of origin of internal thoracic artery.

Sr.No.	Author (year)	Site and mode of origin									
		Subclavian artery									
		Directly			In common with other arteries						
		1 st part (%)	2 nd part (%)	3 rd part (%)	With suprascapular (%)	With transverse cervical (%)	With thyrocervical trunk (%)	With transverse scapular* & transverse cervical (%)	With suprascapular & superficial cervical (%)	(%) With costocervical trunk	Absent (%)
1	Quain (1844) [17]	93.5	0.3	2	1.2	–	5	1.5	–	–	–
2	Bean (1905) [18]	80	–	–	8	–	9.7	0.77	–	–	–
3	DeGaris (1924) [19]	86.7	–	0.72	1.1	–	2.5	1.1	–	–	–
4	Daseler and Anson (1959) [3]	79.19	3.64	0.78	3.77	0.78	8.84	0.28	–	–	0.28
5	Krechowiecki et al (1973) [8]	–	–	0.5	–	–	–	–	–	–	–
6	Henriquez-Pino et al (1997) [13]	82.5	–	–	9.5	–	–	3.5	–	–	–
7	Vorster et al (1998) [6]	–	–	0.83	–	–	–	–	–	–	–
8	Karaman et al (2012) [20]	99.1	–	–	–	–	0.3	–	–	0.6	–
9	Present study (2013)	91.7	–	–	1.67	–	–	3.3	3.3	–	–

* According to International Anatomical Nomenclature committee, transverse scapular artery has been renamed as suprascapular (Huelke, 1958), however since in earlier studies this name exists so mentioned here, otherwise it should be read as suprascapular artery. [21]

Fig. 1: Left subclavian artery (LSA) giving a common trunk of origin (CT) for internal thoracic (ItA) and suprascapular (SS) while inferior thyroid artery (ITA) emanates directly from it [TG- Thyroid gland ; PN- Phrenic nerve].

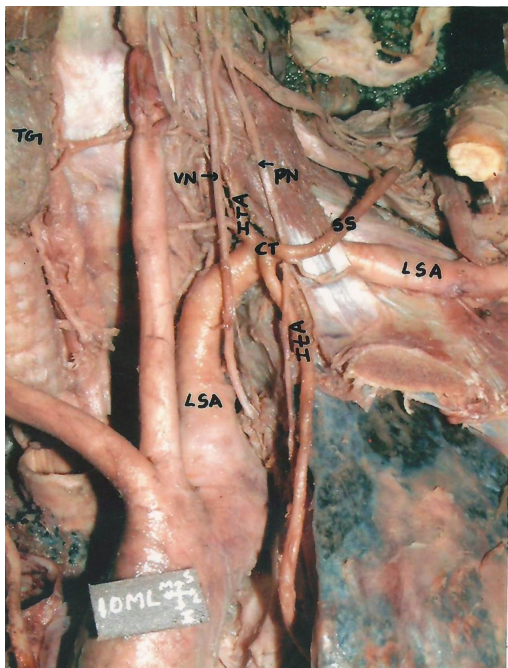


Fig. 2: A common trunk for Internal thoracic artery(ItA), Suprascapular (SS) and transverse cervical (TC) arising from left subclavian artery.

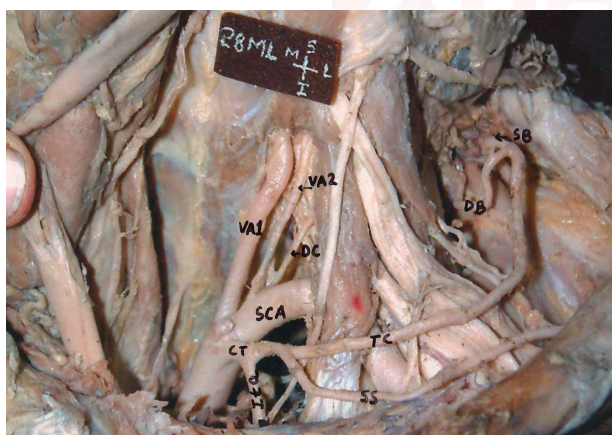
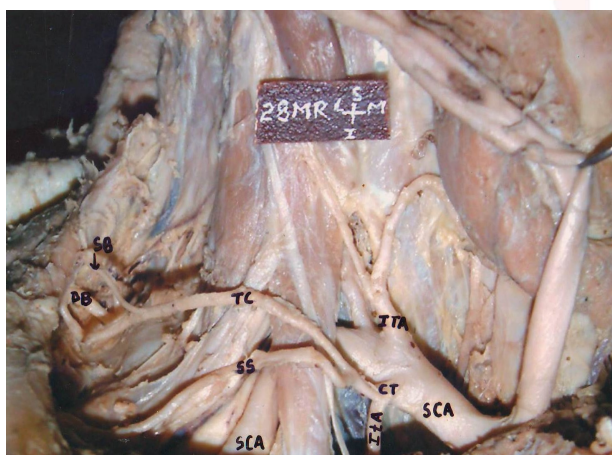


Fig. 3: A common trunk for Internal thoracic artery(ItA), Suprascapular (SS) and transverse cervical (TC) arising from right subclavian artery. Inferior thyroid artery (ITA) arising separately from subclavian artery.



DISCUSSION

Internal thoracic artery is the most commonly and appropriate term according to its localization and distribution in thorax. Initially, the artery was called “internal mammary artery” by Basle Nomina Anatomica in 1895 [15] while later on official term was utilized the “internal thoracic artery” by Paris Nomina Anatomica in 1955 [16].

ItA was taking origin from 1st part of subclavian artery either independently or in common with one or two branches of TT. Level of origin above the medial end of clavicle in our study was comparable as found in text books.

Different sites and modes of origin of this artery are compared with those described by earlier workers in Table No. 1

It is clear from Table No.1, that in majority of limbs (91.7%) internal thoracic artery came directly from 1st part of subclavian artery a finding in consonance with earlier workers [3,18,20]. Whereas no instance could be encountered of its origin directly from 2nd or 3rd part of subclavian artery, it was seen coming in common with suprascapular and superficial cervical, suprascapular and transverse cervical and with suprascapular from subclavian artery in 3.3%, 3.3% and 1.67% instances respectively. Earlier Rohlich [22] observed the internal thoracic artery arising in common with thyrocervical trunk or portions thereof in 6.2% of his dissections, a figure almost in consonance with our such incidence of 8.3% (3.3 + 3.3 + 1.67).

ItA always tend to arise opposite the root of thyrocervical trunk, but the cases in which there is common origin of ItA with branches of thyrocervical trunk, then its relation can be studied with inferior thyroid artery. Daseler and Anson emphasized that in cases TT is absent, one of its major branches usually the inferior thyroid artery occupies its usual site of origin [3].

Internal thoracic artery is often utilized as a graft for majority of CABG surgeries performed worldwide each year. Goldman mentioned that 10 year patency rate of ItA is 85% as compared to 61% for venous grafts [23]. The use of the internal thoracic artery (ItA) for myocardial revascularization in coronary artery disease increased

because of its elastic properties resistant to atherosclerosis [24,25].

Common origin of other arteries together with the ItA which is being utilized as a CABG graft, may lead to symptomatic coronary steal phenomenon due to blood flow diversion. In these instances, graft may not be able to meet the myocardium oxygen demands and the need for re-operation may arise. So, during CABG surgery it is important to reassure the variant pattern of ItA to avoid complications like these. He reviewed the literature and suggests preoperative selective angiographic evaluation involving the SCA-ItA junction, except from the cases in which serious contraindications are present [26]. The risk of the procedure is not neglectable and some authors insist on its avoidance [27].

ItA is a suitable artery for free tissue transfer in reconstructive surgery of the thoracic region, especially in breast reconstruction because of its intrathoracic course and adequate size [14]. For breast reconstruction with free flaps, the vessels in the axilla are the most common recipient vessels. But after radiotherapy, these vessels tend to be small and vulnerable. Because the artery must be large enough and easily accessible for anastomoses, the ItA diameter is important in breast reconstruction [20]. Absence of a patent ItA and even variant course have the potential to limit its use in breast reconstructive surgeries [28].

According to Karaman et al [19], Diameters at the origin of the left and right internal thoracic arteries ranged from 1.4 to 3.7 mm (mean, 2.56 mm) and 1.2 to 4.2 mm (mean 2.58) respectively and there was no gender difference. Similarly, in our studies average diameter of ItA at its origin was found to be 2.6 mm on left side and 2.8 mm on right side.

The close relationship of the ItAs with the phrenic nerves could explain some cases of paralysis of the diaphragm observed postoperatively in myocardial revascularization operations using the ItA [29,30]. Owne et al observed that there is no constant relationship between these two structures, and emphasize the need for caution when dissecting the internal mammary artery at or above the level of the first rib [29].

The area around origin of internal thoracic

artery is commonly used in patients for percutaneous subclavian vein catheterization to determine central venous pressure and to administer drugs and solutions in emergency. It is also used in introducing a pacemaker. Internal thoracic artery is the main source of blood supply to sternum and any damage to this supply results in sternal wound complications [31,32,33]. So, one must aware of possible variations regarding it to prevent iatrogenic complications.

CONCLUSION

Although, ItA is the artery of choice in coronary artery bypass grafting and in breast reconstruction, we think surgeons must be aware of rarely seen variations which can influence surgical techniques, post-operative results and prognosis. Pre-operative angiography could be helpful as variant origin of ItA with one or other branch of TT could be undetected intraoperatively. This area is also used for interventional procedures, so knowledge of its variant anatomy is must to prevent iatrogenic complications.

Conflicts of Interests: None

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