

INTERRELATION BETWEEN THE INTERNAL THORACIC ARTERY AND PHRENIC NERVE IN THE SUPERIOR THORACIC APERTURE

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SUMMARY :

Purpose : Internal thoracic artery is in close anatomic relationship with the phrenic nerve at the superior thoracic aperture, and the phrenic nerve may be injured in coronary artery revascularization surgery. In classical anatomy textbooks, there is vague about the exact relationship of these two structures. Therefore, we studied the exact relationship of these two structures in the superior thoracic aperture and reported our findings. **Methods :** The relationship between the internal thoracic artery and phrenic nerve in the superior thoracic aperture was examined in 28 adult formalin fixed human cadavers bilaterally, and the measurements were noted. **Results :** A symmetrical relationship was observed in 16 of the 28 specimens (57.1 %). In 11 of these specimens (39.2 %), the phrenic nerve crossed anterior to the internal thoracic artery, and in 5 of them (17.9 %), it crossed posterior to the artery on both sides. The distance between the origin of internal thoracic artery from the subclavian artery and the artery's and nerve's crossing point ranged between 0.65-1.32 cm (mean value: 0.92 ± 0.11 cm). The distance between the most medial side of sternoclavicular joint and the artery's and nerve's crossing point ranged between 3.21-6.37 cm (mean value: 4.63 ± 0.97 cm). **Conclusion :** The relationship between the internal thoracic artery and phrenic nerve in the superior thoracic aperture is very variable and this fact must always be taken into consideration by the surgeon. Additionally, the morphometric measurements showing the distance between the internal thoracic artery's and phrenic nerve's crossing point and certain anatomical landmarks have not been reported previously, and they may help to the surgeon for the exact localization of these two structures during operations.

Key Words: Internal Thoracic Artery, Phrenic Nerve, Relationship.

INTRODUCTION

The internal thoracic artery is now being used with increasing frequency for coronary artery bypass grafting, because of its superior long-term patency compared with the saphenous vein grafts (1-4). This artery is in close anatomic relationship with the phrenic nerve at the superior thoracic aperture and injury can be caused to the phrenic

nerve in coronary artery revascularization surgery (5-8).

The internal thoracic artery arises from the root of the neck inferiorly from the first part of the subclavian artery and descends behind the first six costal cartilages. It divides into musculophrenic and superior epigastric branches in the sixth intercostal space (9, 10). As the internal thoracic

artery enters the thorax, the phrenic nerve crosses it obliquely, but in classical anatomy textbooks, there is vague about the exact relationship of these two structures (9-12). Depending upon this knowledge, we studied the exact relationship of these two structures in the superior thoracic aperture and reported our findings.

MATERIAL AND METHODS

The relationship between the internal thoracic artery and phrenic nerve in the superior thoracic aperture was examined in 28 adult formalin - fixed human cadavers, bilaterally. Their ages varied between 24 to 73 years. Seventeen of them were male and 11 of them were female. None of these cadavers had undergone any prior thoracic surgical procedure. In all of the specimens, bilateral dissection of the superior thoracic aperture was performed by the same two researchers and the results were recorded.

Secondly, the distance between the origin of internal thoracic artery from the subclavian artery and the artery's and nerve's crossing point was measured by using a millimeter caliper. Then, the distance between the most medial side of sternoclavicular joint and the artery's and nerve's crossing point was measured by using a millimeter caliper, in our series.

RESULTS

There is vague about the description of anatomical interrelation between the internal thoracic artery and phrenic nerve in the literature. In our opinion, it will be more suitable to name it as anterior and posterior, according to anatomical position. On the left side of the cadavers, the phrenic nerve was found to cross anterior to the internal thoracic artery in 20 of the 28 specimens (71.4 %) in the superior thoracic aperture (Fig. 1). This nerve crossed posterior to the artery in the remaining 8 specimens (28.6 %). On the right side of the cadavers, the nerve crossed posterior to the artery in 9 of 28 specimens (32.1 %) (Fig. 2, 3A) and anterior to it in 19 of the 28 specimens (67.9%) (Fig. 3B).

We observed a symmetrical relationship in 16 of the 28 specimens (57.1%). In 11 of these specimens (39.2%), the phrenic nerve crossed anterior to the internal thoracic artery and in 5 of them (17.9%), it crossed posterior to the artery on both sides. The findings are summarized in Table 1.



Fig - 1 : Photograph of the phrenic nerve, crossing anterior to the internal thoracic artery on the left side of a specimen. n: phrenic nerve, a: internal thoracic artery, m: scalenus anterior muscle, v: vertebral artery.

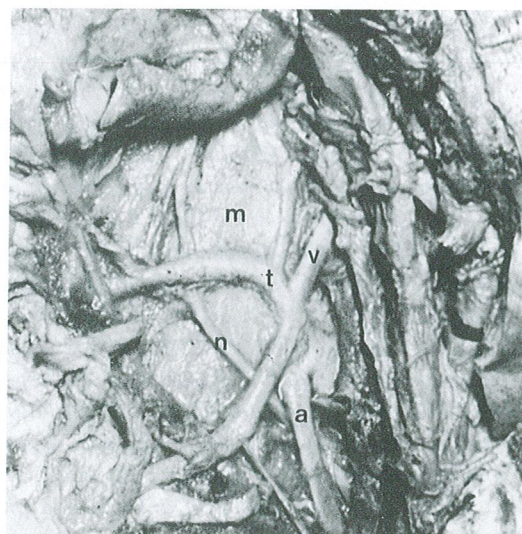


Fig - 2 : Photograph of the phrenic nerve, crossing posterior to the internal thoracic artery on the right side of a specimen., n: phrenic nerve, a: internal thoracic artery, m: scalenus anterior muscle, v: vertebral artery, t: thyrocervical trunk.

The distance between the origin of internal thoracic artery from the subclavian artery and the artery's and nerve's crossing point ranged between 0.65-1.32 cm (mean value: 0.92 ± 0.11 cm). The distance between the most medial side of sternoclavicular joint and the artery's and nerve's crossing point ranged between 3.21-6.37 cm (mean

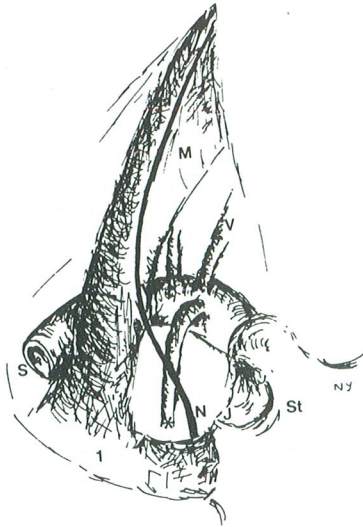


Fig - 3A : Schematic drawings showing the interrelation between the internal thoracic artery and phrenic nerve on the right side. The phrenic nerve (N) crosses posterior to the internal thoracic artery (*).

M: Scalenus anterior muscle, S: Subclavian artery, N: Phrenic nerve, V: Vertebral artery, St: Sternum, 1: First rib
*: Internal thoracic artery, J: Sternoclavicular joint

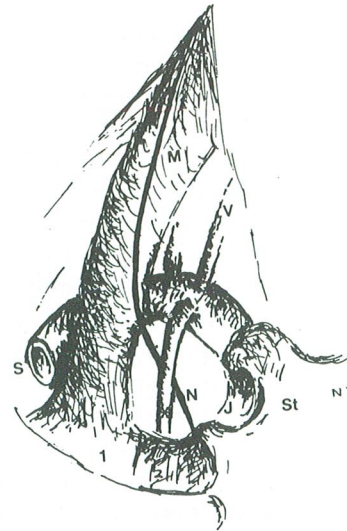


Fig - 3B : Schematic drawings showing the interrelation between the internal thoracic artery and phrenic nerve on the right side. The phrenic nerve (N) crosses anterior to the internal thoracic artery*.

M: Scalenus anterior muscle, S: Subclavian artery, N: Phrenic nerve, V: Vertebral artery, St: Sternum, 1: First rib
*: Internal thoracic artery, J: Sternoclavicular joint

Position of phrenic nerve	Side of thorax		Symmetrical pattern in the same specimen
	Left	Right	
crossing anterior to internal thoracic artery	20 (71.4%)	19 (67.9%)	11 (39.2%)
crossing posterior to internal thoracic artery	8 (28.6%)	9 (32.1%)	5 (17.9%)

Table 1 : The relationship between the internal thoracic artery and phrenic nerve in the superior thoracic aperture.

value: 4.63 ± 0.97 cm).

DISCUSSION

Phrenic nerve injury is one of the most important complications of internal thoracic artery grafting in coronary artery revascularization surgery (2, 5-8, 13). Therefore, the interrelation between the internal thoracic artery and phrenic nerve needs a detailed anatomical knowledge of this region.

Setina et al. demonstrated the anatomical interrelation between the phrenic nerve and internal thoracic artery (8). These authors found a different course on the left and right sides. On the left, the phrenic nerve ran between the subclavian

artery and vein laterally from the internal thoracic artery, crossing it medially on entering the thorax. On the right, the nerve passed between the subclavian vein and artery medially from the internal thoracic artery. In a study of 22 specimens, Owens et al. examined the relationship of the phrenic nerve to the internal thoracic artery as it passed from lateral to medial behind the first rib. On the left, the nerve was found to cross superior to the artery and then medial to it in 14 of 22 specimens; on the right, this was found in 10 of 22 specimens (13). Henriquez-Pino et al. studied the origin of the internal thoracic artery and its relationship to the phrenic nerves. In their study, the left and right phrenic nerves crossed the artery anteriorly in 54% of the cases and posteriorly in 14% (14).

Our results confirm the studies of Owens et al. (13) and Henriquez-Pino et al. (14) with some differences, as in our cases the phrenic nerve crossed anterior to the internal thoracic artery in 71.4% of the cases on the left side and 67.9% of the cases on the right side. Additionally, the right and left phrenic nerves both crossed the artery anteriorly in 39.2% of the cases and posteriorly in 17.9%. In conclusion, the relationship between the internal thoracic artery and phrenic nerve is very variable in the superior thoracic aperture, and cardiovascular surgeons must always remember this fact when dissecting the internal thoracic artery in coronary artery revascularization surgery. Additionally, the morphometric measurements showing the distance between the internal thoracic artery's and phrenic nerve's crossing point and certain anatomical landmarks have not been reported previously, and they may help the surgeon for the exact localization of these two structures during operations.

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