

ORIGINAL ARTICLE

Variable Origin of the Superior Laryngeal Artery and Its Clinical Significance

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Abstract: The superior laryngeal artery (SLA) is the dominant arterial supply of the laryngeal muscles, mucosa and glands. The purpose of the present study was to document the variable origin of the SLA in the carotid triangle. Although the variation in the SLA origin and morphology is important during the partial laryngectomy and reconstruction surgery of the larynx, the description of the SLA in modern literature is vague. The anatomy of SLA was studied in 37 adult South Indian preserved cadavers aged between 48 to 81 years. The antero-lateral region of the neck was exposed. After the visualization of laryngeal prominence, the strap muscles were resected and the SLA and the internal branch of the superior laryngeal nerve (ILN) were exposed. The variable origin of SLA was observed. The origin of the SLA was variable and was classified in to four different groups. Type I: Subtype Ia, the SLA originates from the superior thyroid artery (STA) (SLA with a transverse course) [75.6%] and subtype Ib, the SLA originates from the STA (SLA with an initially ascending course) [4%]; type II: the SLA originates from the lingual artery [5.4%]; type III: the SLA originates directly from the external carotid artery (ECA) [12.1%]; type IV: the SLA originates from the linguo-facial trunk [2.7%]. In addition to above variations, in a single case the SLA was duplicated and in three instances the posterior glandular branch of the thyroid gland was arose from the SLA.

Keywords: Superior laryngeal artery. Origin. Partial laryngectomy. Indian population

Introduction

The superior laryngeal artery (SLA) accompanies the internal branch of the superior laryngeal nerve (ILN) deep to the thyrohyoid muscle and pierces the inferior aspect of the thyrohyoid membrane to supply the muscles, mucous membrane, and glands of the larynx before anastomosing with the branch from the opposite side and with the inferior laryngeal artery [1]. The knowledge of the arterial variation in the neck and especially in the carotid triangle is important in various surgical procedures. In the treatment of the partial laryngectomy, reconstruction surgery of the larynx, laryngeal transplantation and carotid endarterectomy the SLA plays a significant role [2, 3, 4]. Although variations of the SLA are rare, understanding the anatomy and variable origins of the SLA is required to prevent postoperative complications and blood loss

in the carotid triangle. Variations in the SLA origins are very rare. The SLA has been reported to arise from the lingual, facial or ascending pharyngeal arteries [5]. Recently Rusu et al. (2007) studied the topography and morphology of SLA and they observed that the SLA either originated from the STA or directly from the ECA [6]. In the present study, the variable origins of the SLA, within the carotid triangle, was observed.

Materials and Methods

The anatomy of the SLA was examined in thirty seven adult formalin-fixed cadavers (29 male, 8 female; 74 sides) used for gross anatomy dissection at the Kasturba Medical College, Mangalore for undergraduates during 2007 to 2008. The mean age of the cadavers was 56 years (range, 48 to 81 years). The cadavers had been fixed in 10 % formalin solution. None of the specimens revealed any evidence of previous surgical procedures, traumatic lesions, or gross pathologies to the neck. The anterior neck was exposed by a midline incision and the dissection extended laterally to the angle of mandible superiorly, and along the clavicle inferiorly. The skin overlying the neck, the superficial layer of the cervical fascia, platysma and sternocleidomastoid muscles were removed, the carotid sheath was gently peeled away from the underlying structures. After visualizing the laryngeal prominence of the thyroid cartilage, the strap muscles were resected and the SLA and ILN were exposed. The origin of the SLA and its relation with the ILN, at the thyrohyoid membrane was observed and photographed. The length of the SLA between its origin and the thyrohyoid membrane; and its external diameter at its origin were measured with the help of a digital caliper. In order to compare the values obtained from the right and left side measurements, the Student's t-test has been applied. $P \leq 0.05$ was considered to be significant.

Results

All variations in the origin of the SLA was observed and classified in to four types according to the observation made in the present study (Table 1). Type I: Subtype Ia, the SLA originates from the superior thyroid artery (STA) (SLA with a transverse course) [75.6%] and subtype Ib, the SLA originates from the STA (SLA with an initially ascending course) [4%]; type II: the SLA originates from the lingual artery [5.4%]; type III: the SLA originates directly from the external carotid artery (ECA) [12.1%]; type IV: the SLA originates from the linguo-facial trunk [2.7%] (Fig 1-5). In addition to above variations, in a single case the SLA was duplicated (Fig 3) and in three instances the posterior glandular branch of the thyroid gland branched from the SLA (Fig 1). The mean external diameter of the SLA on the left and right sides was 1.34 ± 0.07 mm and 1.36 ± 0.05 mm respectively. The mean length of the SLA between its origin and the thyrohyoid membrane on the left and right side was 38.41 ± 0.27 mm and 40.15 ± 0.19 mm respectively (Table 2). Statistically there were no significant observation made in the diameter or in the length of the SLA, when compared on the left and right sides. The SLA ran down towards the larynx with the ILN lying cranial to it in 28 instances (37.8%) (Fig 5) and in the remaining 46 cases (62.1%) the SLA was observed caudal to the ILN (Fig 1), in relation to thyrohyoid membrane.

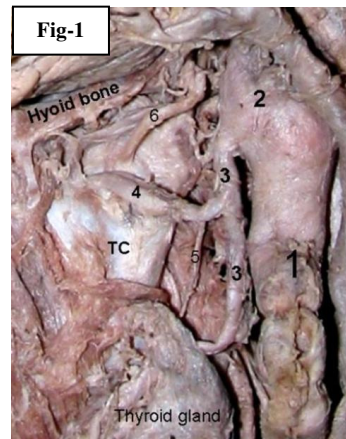
Table-1: The variable origin of the superior laryngeal artery (SLA) in dissected specimens.

The origin of superior laryngeal artery (n=74)	Right side (Percentage) (n=37)	Left side (Percentage) (n=37)	Total (Percentage) (n=74)
Type I: Ia, from the superior thyroid artery (SLA with a transverse course)	31 (41.8%)	25 (33.7%)	56 (75.6%)
Type I: Ib, from the superior thyroid artery (SLA with an initially ascending course)	0	3 (4%)	3 (4%)
Type II: from the lingual artery	1 (1.3%)	3 (4%)	4 (5.4%)
Type III: directly from the external carotid artery	4 (5.4%)	5 (6.7%)	9 (12.1%)
Type IV: from the linguo-facial trunk	1 (1.3%)	1 (1.3%)	2 (2.7%)

Table-2: Mean length and external diameter of the superior laryngeal arteries of the left and right sides (in millimeters). Data expressed as Mean± standard error of mean, standard deviation (in parentheses) and range.

Mean length (mm)		Mean external diameter (mm)	
Left	Right	Left	Right
38.41±0.27 (6.6) 27.6- 49.1	40.15±0.19 (6.42) 29.1- 50.7	1.34±0.07 (0.36) 1.27-1.43	1.36±0.05 (0.32) 1.29- 1.44

Figure-1: Left side; anterior lateral aspect of head and neck region showing



Common carotid artery-1, external carotid artery-2, superior thyroid artery-3, superior laryngeal artery-4, posterior glandular branch of thyroid gland-5, the internal branch of the superior laryngeal nerve -6, thyroid cartilage-TC. Note the superior laryngeal artery lies caudal to the internal branch of the superior laryngeal nerve, in relation to thyrohyoid membrane

Figure-2: Left side; anterior lateral aspect of head and neck region showing

Common carotid artery-1, external carotid artery-2, common trunk for superior laryngeal and superior thyroid arteries-3, superior thyroid artery-4, superior laryngeal artery-5, the internal branch of the superior laryngeal nerve-6, lingual artery-7, hypoglossal nerve-8, submandibular gland-SG, thyroid cartilage-TC

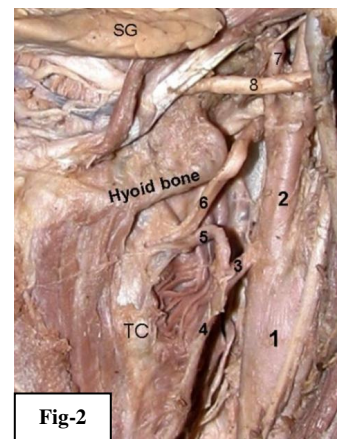
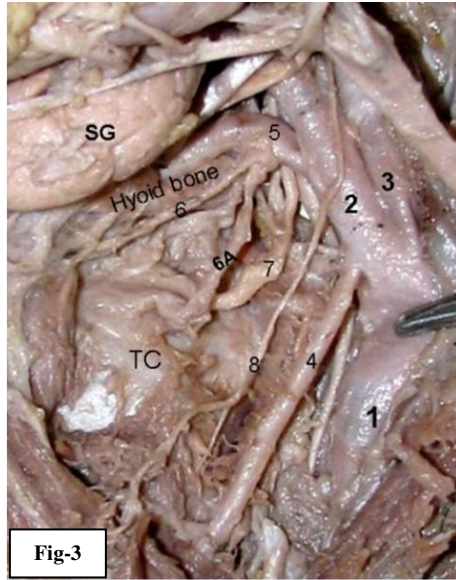
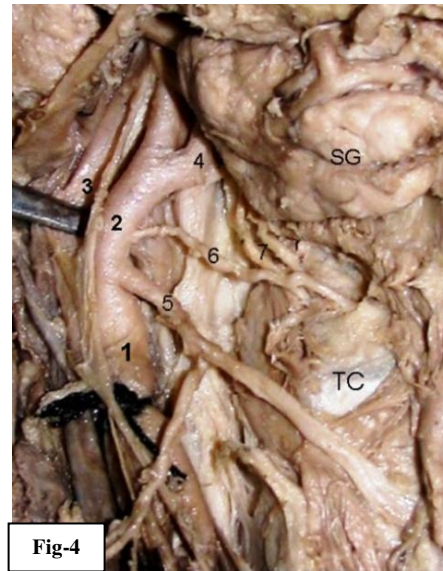


Figure-3: Left side; anterior lateral aspect of head and neck region showing



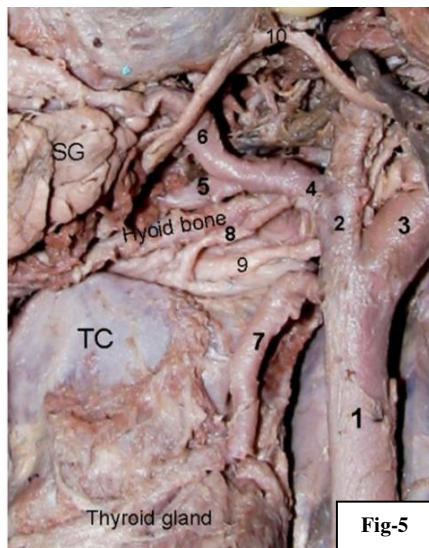
Common carotid artery-1, external carotid artery-2, internal carotid artery-3, superior thyroid artery-4, lingual artery-5, superior branch of superior laryngeal artery-6, inferior branch of superior laryngeal artery-6A, the internal branch of the superior laryngeal nerve -7, ansa cervicalis-8, submandibular gland-SG. Note the double superior laryngeal arteries taking origin from the lingual artery.

Figure-4: Right side; anterior lateral aspect of head and neck region showing



Common carotid artery-1, external carotid artery-2, internal carotid artery-3, linguo-facial trunk -4, superior thyroid artery-5, superior laryngeal artery-6, the internal branch of the superior laryngeal nerve -7, submandibular gland-SG, thyroid cartilage-TC

Figure-5: Left side; anterior lateral aspect of head and neck region showing



Common carotid artery-1, external carotid artery-2, internal carotid artery-3, lingo-facial trunk-4, lingual artery-5, facial artery-6, superior thyroid artery-7, superior laryngeal artery-8, the internal branch of the superior laryngeal nerve -9, hypoglossal nerve-10, submandibular gland-SG, thyroid cartilage-TC. Note the superior laryngeal artery lies above the internal branch of the superior laryngeal nerve, in relation to thyrohyoid membrane

Discussion

The human larynx is an anatomically complex organ with a multiplicity of sophisticated and critical functions. The bulk of the blood to the human larynx is delivered via the SLA; the first major branch of the STA [1]. Usually the SLA arises from the STA. In the present study, it was found that in 75.6% of the cases, the SLA originated from the STA. The above occurrence was observed between 68% to 84% cases by various authors [7, 6, 8]. Lang et al. (1987) mentioned that the SLA was a branch from the ECA only in 6.8% of cases. In this study it was found to be in 12.1% of the sample [5/7]. Rusu et al. (2007) found the above variation of the origin of the SLA in 32% of cases, which is high when comparing it to the results found in the present study [6]. The SLA may arise from the facial artery or ascending pharyngeal artery [5, 9]. In the present case we did not observe the SLA arising from the facial or ascending pharyngeal arteries. Terayama et al. (2006) when performing carotid angiography on patients with laryngeal cancer, they observed a single instance in which the SLA originated from the lingual artery. In the present study the same variation was found in 5.4% of the cases [9]. In the present study it was observed that the SLA arose from the linguo-facial trunk in two instances. The above-mentioned origin has yet to be described within the literature. Although the duplication of the SLA is rare, Nayak and Soumya (2008) observed a double SLA in a routine dissection class [10]. In the present study we also found the SLA was duplicated, in the left side of a male cadaver. The duplication of the SLA is extremely important in laryngeal surgeries. In such situation both the arteries have to be ligated in order to minimize bleeding [10]. In three specimens the posterior glandular branch of the thyroid gland originated from the SLA, in the present study.

In the present study the external diameter of the SLA was 1.34 ± 0.07 mm on the left side and was 1.36 ± 0.05 mm on the right side. Ozgur et al. (2009) found the external diameter of the SLA was 1.42 ± 0.47 mm in their study. Lang et al. (1987) observed the average external diameter of SLA was 1.23 mm on the right side and 1.39 mm on the left. Understanding the precise surgical anatomy of the SLA and its relationship with other structures of the neck is important in microsurgery in the anterior neck and larynx [7]. If the SLA cannot be found during surgery, an aberrant SLA (ASLA) must be considered [6/11]. Liu et al. (2007) recommended that surgeons should look for the ASLA at the foramen which is located at the oblique line of the thyroid cartilage inferior to the superior thyroid tubercle [5]. Toni et al. (2004) mentioned that it is essential to identify the origin of SLA for superselective intraarterial infusion and partial laryngectomy [12]. Superselective intra-arterial infusion chemotherapy is sometimes attempted on patients with head and neck cancer to obtain a greater therapeutic effect, and regional intra-arterial chemotherapy has the potential advantage of delivering a higher concentration of chemotherapeutic agent to the tumor site and reducing systemic side effects [13]. As SLA is the dominant artery to the laryngeal and hypolaryngeal region, the knowledge regarding the SLA variation can help the clinicians in the superselective intra-arterial chemotherapy for laryngeal and hypopharyngeal cancers. Ozgur et al. (2009) described that the management of the SLA should be considered for conservation of the functions

of the arytenoid region and laryngeal part of pharynx on partial laryngectomy and partial reconstruction of the larynx [14]. The knowledge regarding the variable origin of the SLA will help the surgeons in the successful radical neck dissection and will also assist them in minimizing postoperative complications in a bloodless surgery. The anatomy of the SLA can also help in the treatment of the partial laryngectomy, reconstruction surgery of the larynx, and laryngeal transplantation.

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