ONLINE FIRST

ISSN: 0015-5659

e-ISSN: 1644-3284

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DOI: 10.5603/fm.103521

Article type: Case report

Submitted: 2024-11-12

Accepted: 2025-02-24

Published online: 2025-02-25

Unique combination of two arterial variations in the neck. A case report and review of the existing literature

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ABSTRACT

Variations in the origin and branching pattern of the superior laryngeal artery are critically crucial for both anatomical understanding and clinical practice, especially for procedures involving the larynx. The superior laryngeal artery typically originates from the superior thyroid artery, a branch of the external carotid artery. However, alternative origins of this artery — such as from the external carotid artery, the common carotid artery, or other branches — have been documented in rare cases. Herein, we present a rare configuration of the external carotid artery branches identified on the left side of the neck of a 76-year-old male cadaver. A shared linguofacial trunk originated from the external carotid artery and then divided into the facial and lingual arteries. Afterward, the lingual artery gave rise to the superior laryngeal artery, which initially coursed horizontally before curving downward toward the larynx. Understanding such anatomical variations is essential for safe and effective surgical intervention and accurate diagnostic imaging, as these patterns can significantly

impact surgical approaches in laryngeal procedures, neck reconstructive surgeries, and targeted intra-arterial chemotherapy for cancers affecting the larynx and hypopharynx.

Keywords: superior laryngeal artery, linguofacial trunk, anatomical variations, clinical significance

INTRODUCTION

The superior laryngeal artery (SLA) is one of the primary vessels carrying the blood supply to the larynx [17]. SLA typically derives from the superior thyroid artery (STA), which is an anterior branch of the external carotid artery (ECA) [17]. This anatomical pattern has an incidence of 68% [16] to 94% [4]. Anatomical variations in the branching of arteries from the ECA, including shared trunks like the linguofacial trunk (LFT), thyrolingual, and thyrolinguofacial trunks, are also noted in the literature [3]. Although the LFT itself is rare, 6% [19] to 20% [6], it represents a configuration in which the lingual artery (LA), usually an independent anterior branch of the ECA, shares a common trunk with the facial artery (FA) [15]. Prior studies have identified several atypical origins of the SLA, including the common carotid artery (CCA) [2], the bifurcation of the CCA [2], the ECA [2, 8], the thyrolingual trunk (TLT) [2], the LA [2, 14, 18], the FA [2], and the ascending pharyngeal artery (APA) [2, 18]. SLA originating from the LA is a rare variation with a recorded incidence of 1.7% [4], yet SLA originating from LA, which originates from a LFT, is not documented in the literature. While variations in the origin of the SLA are uncommon, they are of considerable importance in neck surgery, including procedures such as laryngeal reconstruction, transplantation, and imaging diagnostics [1, 7]. Additionally, the SLA is a crucial route for intra-arterial chemotherapy in treating larynx and hypopharynx cancers [11, 18]. This study presents a case of SLA variation, where the SLA originates from the LA, with the LA and FA arising from a shared LFT. Additionally, we provide a brief review of SLA variation cases documented in the literature.

Case presentation

An intriguing branching pattern of the left ECA was observed during the anatomical dissection of a 73-year-old male cadaver at the Medical University of Sofia, conducted for educational purposes. Two rare anatomical variations were identified after meticulous dissection and isolation of the arterial branches from the surrounding adipose tissue and carotid fascia. The first variation involved the presence of a linguofacial trunk, originating

approximately 1.6 cm superior to the carotid bifurcation. This trunk extended for 0.3 cm before dividing into the FA, which ascended toward the digastric muscle's intermediate tendon, and the LA, which traveled transversely. After approximately 1.1 cm, the LA gave rise to the SLA, marking the second notable variation. The aberrant SLA initially traveled in a transverse direction before curving inferiorly toward the larynx. Additionally, the internal branch of the superior laryngeal nerve was observed coursing inferiorly to the variant SLA, with both structures piercing the thyrohyoid membrane together before entering the larynx. The right STA demonstrated a normal origin and anatomical position, arising from the right ECA approximately 0.5 cm above the carotid bifurcation. Upon completing the dissection on the right side of the neck, no vascular variations were noted, and the anterior branches of the ECA followed their typical pattern. The cadaver had no surgical history or visible scarring in the neck region, ruling out any previous interventions that could have altered vascular anatomy. The detailed anatomical variations observed are depicted in Figure 1.

DISCUSSION

The SLA is a crucial vessel both anatomically and clinically, underscoring the need for a comprehensive understanding of its variations [17]. Several studies have documented different deviations in the origin of the SLA [2, 4, 9, 11, 13, 16, 20]. The most common origin of the SLA is from the STA, occurring in 68% [16] to 94% [4] of cases. The second most frequent origin is from the ECA, with an estimated incidence of 5% [4]. Other rare variations include the SLA originating from the LA and the APA, with an incidence of 1.7% [4]. SLA originating from the CCA is reported in 1% [13] to 5% [20] of cases, while 4% of cases show the SLA arising from the carotid bifurcation [20]. Bergman et al. described the SLA originating from the FA, but no specific incidence is reported in the literature [2]. SLA may also derive from a common trunk with the LA, as reported by Livini in 1.5% of cases [9]. Macalister described a unique case of the SLA sharing a trunk with the hyoidean branch of the ECA [10]. Vázquez et al. concluded that the SLA is absent in 4% of cases [20]. The estimated rate of SLA arising directly from the LFT is 2.7% [11]. However, to our knowledge, there is no reported case of the SLA originating from the LA, which arises from a common LFT. Our study presents the first documented case of this rare anatomical variation.

The LFT has an incidence ranging from 6% [19] to 20% [6]. Dimitru et al. investigated anatomical variations of the LFT [5], noting that its relationship with the ECA varies, with most LFTs located anteromedially or medially and fewer cases positioned anteriorly, inferiorly, or laterally [5]. The LFT's morphology exhibits considerable individual variation,

with differences in the course and branching pattern [19]. Some LFTs follow a more convoluted path, while others have more variable origins relative to the carotid bifurcation [19]. Bilateral LFTs have been observed with symmetrical and asymmetrical branching patterns, while unilateral LFTs show notable variability in their origin relative to anatomical landmarks such as the hyoid bone; some may initially loop or descend before bifurcating [5].

Several classifications exist in the literature on the origin of the SLA [8, 11, 20]. Vázquez et al. [20] proposed a four-type classification based on the SLA's origin from the STA, ECA, CCA, or carotid bifurcation. Nayak et al. [11] also divided SLA deviations into four types: Type Ia, where the SLA has a transverse course originating from the STA; Type IIa, where the SLA ascends initially from the STA; Type II, where the SLA arises from the LA; Type III, where the SLA originates from the ECA; and Type IV, where the SLA arises from the LFT [11]. Due to the limitations of these classifications, Landzhov et al. [8] proposed a more detailed system with five groups: I) SLA originating from branches of the ECA (STA, LA, APA, FA); II) SLA originating from the carotid tree (ECA, CCA, carotid bifurcation); III) SLA arising from a common trunk (with LA, hyoidean branch of ECA, LFT); IV) double SLA; and V) absent SLA. Our case does not fit neatly into the classifications proposed by Vázquez et al. [20], but in the context of Nayak's [11] classification, it could be related to Type II and Type IV. According to the system of Landzhov et al., our case could be categorized as Type I, Subtype 2, and Type III, Subtype 3. However, none of these classifications directly account for the unique origin of the SLA in our case. The classification by Landzhov et al. is one of the most comprehensive and detailed currently available in the literature, encompassing the majority of SLA variations [8]. It categorizes SLA variations into five types: Type I variations originate from branches of the ECA, including subtypes I.1 (originating from the STA), I.2 (from the LA), I.3 (from the APA), and I.4 (from the FA). Type II covers origins from the carotid tree, with subtypes II.1 (from the ECA), II.2 (from the CCA), and II.3 (from the carotid bifurcation). Type III involves origins from a common trunk shared with other arteries, including subtypes III.1 (from a common trunk with the LA), III.2 (from a common trunk with the hyoidean branch of the ECA), and III.3 (from a LFT). Type IV describes a doubled SLA, where two separate SLAs are present. Type V denotes the complete absence of the SLA [8].

Nonetheless, the current case does not fit neatly into any of the existing classifications. The closest match is Type III, Subtype 3 from Landzhov et al.'s classification [8], which describes cases where the SLA arises from the LA. However, in our case, the SLA originates from the LA, which itself arises from the LFT branching off the ECA. This unique

configuration could serve as an enhancement to the existing Type III, Subtype 3 in Landzhov's classification, potentially expanding its scope to include such variations.

The clinical significance of the SLA originating from the LA, which arises from the common LFT, is substantial, particularly in surgical and imaging contexts. During laryngeal surgeries, such as partial laryngectomy or laryngeal transplantation, a detailed understanding of the SLA's origin is crucial to prevent inadvertent damage to this artery [1, 7]. Misidentifying the source of the SLA could lead to severe complications, including excessive bleeding, which can compromise surgical outcomes and patient safety [1, 7]. In reconstructive surgeries involving the neck or larynx, recognizing variations such as the SLA arising from the LA is essential to ensure adequate blood flow to the surgical area [20]. Anatomical variations in arterial structure can complicate imaging studies, such as angiography, affecting accurate diagnosis and preoperative planning [8]. Surgeons and radiologists must know these variations to interpret imaging studies correctly and avoid complications during surgery. The presence of an LFT can add further complexity to surgical procedures [12], and unawareness of this variation increases the risk of accidental ligation or injury to essential blood vessels in the neck, leading to tissue ischemia or necrosis [12].

During intra-arterial chemotherapy, the SLA is frequently utilized in treating cancers affecting the larynx and hypopharynx [11, 18]. The use of the SLA for drug delivery enables the direct targeting of chemotherapeutic agents to the tumor site, significantly reducing systemic exposure [18]. This localized approach can enhance the therapeutic effect while minimizing the adverse side effects commonly associated with systemic chemotherapy [18]. Microcatheters deliver drugs through the SLA or its branches, effectively treating localized cancers with minimal metastasis [18]. This method proves particularly beneficial for managing advanced laryngeal cancers, as it allows for more effective treatment while preserving surrounding healthy tissues [18].

CONCLUSIONS

Our study highlights the clinical relevance of recognizing unique SLA origins. Although such anatomical variations are rare, surgeons performing procedures in the cervical region must be aware of them. A thorough understanding of these variations is essential for reducing surgical risks and improving outcomes by facilitating precise surgical planning and ensuring patient safety during interventions involving the larynx and surrounding structures.

ARTICLE INFORMATION AND DECLARATIONS

Ethics statement

The study was approved by the Medical-Legal Office, the Local Ethics Committee, and the Institutional Review Board of the Medical University of Sofia, based on ordinance N° 2/18 May 2012.

Author contributions

Data collection: LG. Manuscript writing: LG, KP, IND. Manuscript reviewing: ŁO, BL. Data assessment and project supervision: GPG, BL.

Acknowledgments

The authors wish to express their gratitude to all those who donated their bodies to medical science.

Conflict of interest

There is no potential conflict of interest.

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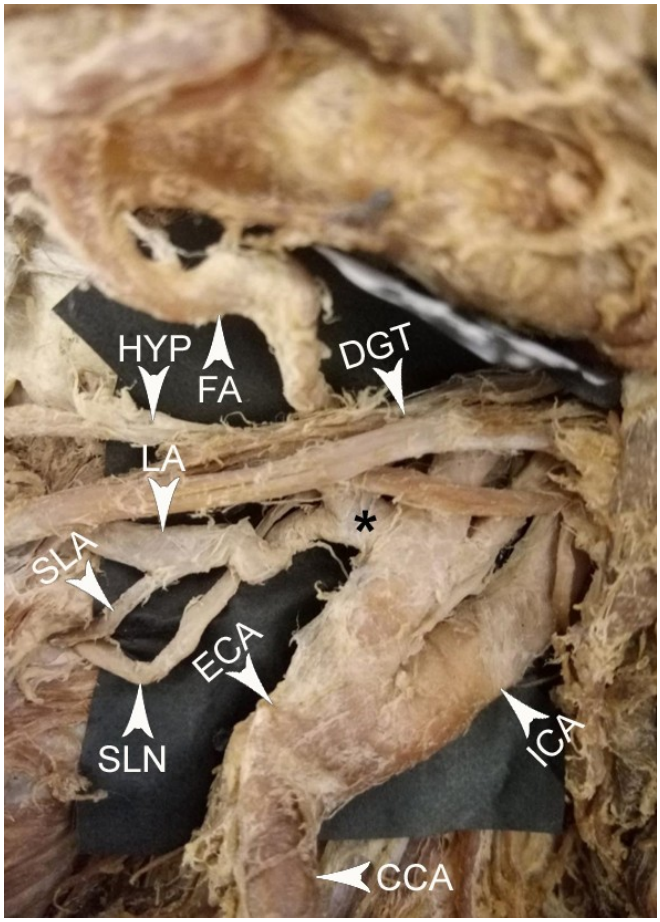

Figure 1. Image depicting the superior laryngeal artery (SLA) originating from the lingual artery (LA). The LA arises from a common lingofacial trunk shared with the facial artery (FA), branching from the external carotid artery (ECA). *Lingofacial trunk; ICA — internal

carotid artery; CCA — common carotid artery; DGT — digastric tendon; HYP — hypoglossal nerve; SLN — internal branch of the superior laryngeal nerve.

Table 1. Summary of the documented variations and incidence rates of the superior laryngeal artery (SLA) and the linguo-facial trunk (LFT).

Author(s)	**Anatomical variant**	**Incidence [%]**
Devadas et al. [4], Rusu et al. [16]	SLA originating from the STA	68–94
Devadas et al. [4]	SLA originating from the ECA	5
Devadas et al. [4]	SLA originating from the LA	1.7
Devadas et al. [4]	SLA originating from the APA	1.7
Devadas et al. [4], Quain [13], Vázquez et al. [20]	SLA originating from the CCA	1–5
Vázquez et al. [20]	SLA originating from the carotid bifurcation	4
Bergman et al. [2]	SLA originating from the FA	Not reported
Livini [9]	SLA originating from a common trunk with the LA	1.5
Macalister [10]	SLA sharing a trunk with the hyoidean branch of the ECA	Unique case
Vázquez et al. [20]	SLA absent	4
Nayak [11]	SLA arising directly from the LFT	2.7
Fazan et al. [6], Troupis et al. [19]	General incidence of LFT	6–20
Dumitru et al. [5]	Variability in LFT position	Anteromedial/medial

	relative to ECA	(common); anterior, inferior, or lateral (rare)
Dumitru et al. [5], Troupis et al. [19]	Bilateral LFT with symmetrical or asymmetrical branching patterns	Not reported

APA — ascending pharyngeal artery; CCA — common carotid artery; ECA — external carotid artery; FA — facial artery; LA — lingual artery; STA — superior thyroid artery.