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Research Article

Study of Variations in Branching Pattern of External Carotid Artery

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Abstract

Vascular surgeons frequently depend on their knowledge of anatomy to effectively approach the blood vessels in the head and neck area. It is important for various healthcare professionals to understand the different branching patterns of the external carotid artery (ECA).

Objective: The present study observes variation in the branching pattern of ECA.

Materials and Methods: The present study was conducted on 64 well embalmed human cadavers in the dissection hall at Department of Anatomy, Pt. B. D. Sharma PGIMS, Rohtak. ECA and its course was observed and its branching pattern was noted in all the cadavers and its specimen.

Results: The linguofacial trunk was the most common variation being observed in three cases (4.68%).

Conclusions: The results of this study are significant for anatomists, clinicians, and surgeons, as they provide valuable insights into the anatomical arrangement of neurovascular structures in the neck region, which can be crucial for planning and performing surgical procedures.

Keywords: ECA; Linguofacial Artery; Variation

Abbreviations

ECA: External Carotid Artery; CCA: Common Carotid Artery; ICA: Internal Carotid Artery; SThA: Superior Thyroid Artery; LA: Lingual Artery; FA: Facial Artery; APA: Ascending Pharyngeal Artery; MA: Maxillary Artery; OA: Occipital Artery; STA: Superficial Temporal Artery; LFT: Linguofacial Trunk; PAA: Posterior Auricular Artery; SMG: Submandibular Gland; HN: Hypoglossal Nerve; IJV: Internal Jugular Vein; T: Tongue; PD: Pulley of Digastric Muscle; ThC: Thyroid Cartilage; ThG: Thyroid Gland

Introduction

The external carotid artery (ECA) and its branches are key vessels that supply blood to a significant portion of the head and neck, which is particularly relevant for radiological and surgical procedures. The ECA typically has eight branches: the superior thyroid artery (SThA), lingual artery (LA), facial artery (FA), ascending pharyngeal artery (APA), occipital artery (OA), posterior auricular artery (PAA), superficial temporal artery (STA), and maxillary artery (MA). It also plays a role in providing alternative blood flow to the brain through its connections with the internal carotid artery and

vertebral artery. Usually, the first three branches—the superior thyroid, lingual, and facial arteries—originate independently from the anterior side of the ECA. However, variations in the branching pattern of the ECA are of considerable importance for surgeons when planning and conducting operations, especially considering the anatomical arrangement of neurovascular structures in the neck area. Furthermore, radiologists rely on the anatomy of these structures for various interventions, such as intra-arterial infusion chemotherapy, carotid stenting, and endarterectomy. Therefore, a thorough understanding of both the standard and variant anatomy of the ECA is crucial for surgeons, radiologists, and anatomists alike.

The external carotid artery (ECA) originates from a direct branch of the aortic sac, while the first and second pharyngeal arches receive blood from the ventral pharyngeal artery. At about 40 days of development, the origin of the ECA moves from the aortic sac along the third arch as the heart quickly descends. This migration determines where the carotid bifurcation will occur, with the third arch developing into the forerunner of both the common and internal carotid arteries [4]. The common carotid artery emerges from the third aortic arch, with its proximal section forming the internal carotid artery. The rest of the internal carotid artery is created from the cranial part of the dorsal aorta. The ECA itself develops as an offshoot from the distal end of the third aortic arch [5].

Materials and Methods

The present study was conducted in the Department of Anatomy, Pt. B. D. Sharma PGIMS, Rohtak, Haryana along with undergraduate teaching in the dissection hall on 18-formalin fixed human cadavers and 14 -formalin fixed head and neck preserved specimen over the branching pattern of ECA (Figure 2). Neurovascular structures were carefully dissected in the head and neck region. Variant branching patterns of ECA were noted in some of the specimens. The normal branching pattern (Figure 1) and variations in the ECA were carefully noted and documented. The normal pattern and variations in branching of ECA have been digitally photographed.

Results and Discussion

Variations in the branching pattern

Anterior branches

In a study of 18 human cadavers preserved in formalin, the anterior branches of the external carotid artery (ECA)—specifically the superior thyroid artery (SThA), lingual artery (LA), and facial artery (FA)—were examined for their origins. It was meticulously recorded and observed that the most common variation found was the linguofacial trunk, which was seen in 3 of the cadavers (4.68%). This variation is depicted in figures 2, 3, and 4.

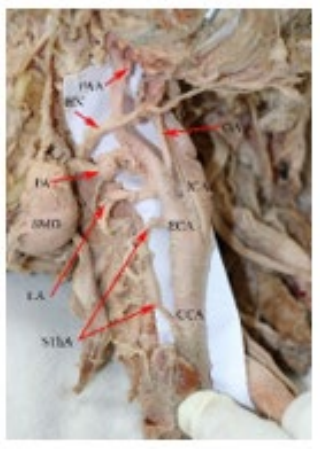

Figure 1: Photograph showing left side Common Carotid Artery (CCA) and its branches as External Carotid Artery (ECA), internal carotid artery (ICA). External Carotid Artery (ECA) further branching as Superior Thyroid Artery (SThA), Lingual Artery (LA), Facial Artery (FA), Posterior auricular artery (PAA), Occipital artery (OA). Submandibular Gland (SMG) and Hypoglossal nerve (HN) are also shown.

In the other 15 cadavers, no common trunks were formed; instead, the branches followed their typical anatomical course and pattern.

It was noted that there were no instances of thyrolingual trunks or thyrolinguofacial trunks observed in any of the cadavers.

Additionally, among the 3 linguofacial trunks identified, none were present on both sides of the body (bilaterally).

Medial branches

No significant variations were observed in the branching pattern of APA.

Posterior branches

No significant variations in the branching pattern of the occipital and posterior auricular arteries were observed.

Terminal branches

In all the cases examined, the external carotid artery (ECA) ended at the level of the neck of the mandible by splitting into the superficial temporal and maxillary arteries. No significant variations were observed in this study.

Accessory branches

No other pattern of accessory branches were noted in the branching pattern and course of ECA in all the cases.

The findings are summarized in Table 1.

Branching pattern	Number (%) (n = 64)
Linguofacial trunk	3(4.68)
Thyrolingual trunk	0
Thyrolinguofacial trunk	0

Table 1: Variations in the anterior branches of external carotid artery (Figure 2,3,4).

Discussion

Many variations of the major blood vessels in the head and neck region have not yet been fully explored, which is crucial for preventing the risk of iatrogenic bleeding during interventions in this area. The linguofacial trunk (LFT) is considered a relatively rare variation, and only a few authors have reported on it. In the current study, only a unilateral linguofacial trunk has been observed [2]. The different ways in which the external carotid artery (ECA) branches may not be noticed during a person's lifetime, but they become very important when age-related issues arise, such as the artery becoming less elastic or forming aneurysms, which are signs of disease [1].

According to published reports (Table 2), the linguofacial trunk (LFT) seems to be a variation that occurs fairly often. In this particular study, the LFT was seen in 4.68% of cases. Understanding the different variations of the external carotid artery (ECA) is therefore crucial. Knowledge about these variations is especially important for surgeons when planning and carrying out various surgical procedures and treatments.

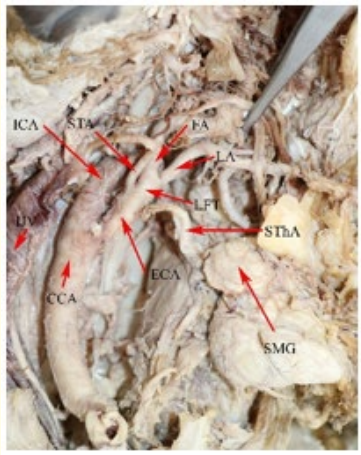

Figure 2: Photograph showing right side Common Carotid Artery (CCA) and its branches as External Carotid Artery (ECA), internal carotid artery (ICA). External Carotid Artery (ECA) further branching as Superior Thyroid Artery (SThA), Linguofacial Trunk (LFT) and Superficial Temporal Artery (STA). Linguofacial Trunk (LFT) further divides into Facial Artery (FA) and Lingual Artery (LA). Submandibular Gland (SMG) and Internal Jugular Vein (IJV).

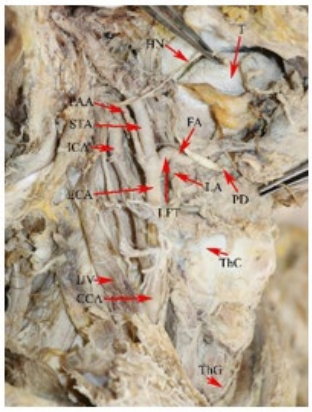

Figure 3: Photograph showing right side Common Carotid Artery (CCA) and its branches as External Carotid Artery (ECA), internal carotid artery (ICA). External Carotid Artery (ECA) further branching as Superior Thyroid Artery (SThA), Linguofacial Trunk (LFT) and Superficial Temporal Artery (STA) and Posterior Auricular Artery (PAA). Linguofacial Trunk (LFT) further divides into Facial Artery (FA) and Lingual Artery (LA). Tongue (T), Hypoglossal Nerve (HN), Pulley of Digastric Muscle (PD), Thyroid Cartilage (ThC), Thyroid Gland (ThG) and Internal Jugular Vein (IJV).

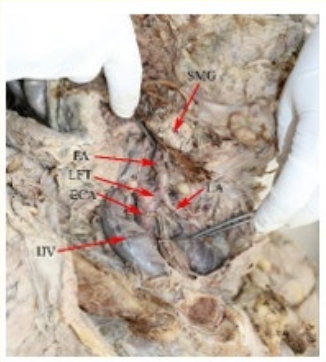

Figure 4: Photograph showing right side Common Carotid Artery (CCA) and its branches as External Carotid Artery (ECA). ECA further branching Linguofacial Trunk (LFT) which further divides into Facial Artery (FA) and Lingual Artery (LA). Submandibular Gland (SMG) and Internal Jugular Vein (IJV).

Study	Year	Linguofacial Trunk (%)
Babu B P., *et al*. [6]	2001	3
Zumre., *et al*. [7]	2005	20
Sugavasi., *et al*. [8]	2011	1
Acar., *et al*. [9]	2013	23.5
Present study	2023	16.67

Table 2: Incidence of linguofacial trunk in various studies.

In this study, a unilateral variation in the branching pattern of the external carotid artery (ECA), specifically the linguofacial trunk (LFT), was observed in 4.68% of cases. Other researchers have reported similar findings, such as Zumre et al., who found an incidence of 20% [7].

These studies hold great clinical significance as they uncover variations that typically go undetected throughout a person's life [1].

According to Baik et al [10], due to variations in the branching pattern of the external carotid artery (ECA), such as the formation of common linguofacial trunks, the lingual artery (LA) and facial artery (FA) might be located near the tonsillar fossa. This proximity increases the risk of iatrogenic vessel injuries and traumatic pseudoaneurysms following tonsillectomy procedures. To ensure proper exposure and successful placement of cross-clamps for the effective removal of plaque, and to minimize postoperative complications by maintaining a bloodless surgical field, it is crucial to identify the key landmarks provided by the varying patterns of the external carotid artery (ECA) branches. Lack of thorough knowledge about these branching variations can lead to bleeding in the areas supplied by the ECA when ligatures are applied incorrectly during surgical procedures.

Therefore, this study aims to offer surgeons, radiologists, and anatomists a clear understanding and insight into improving the overall outcomes of procedures and preventing life-threatening complications during surgeries in the specific region of the neck.

Conclusion

The external carotid artery, a vital vessel that supplies blood to the head and neck, shows significant anatomical variation. Understanding the different branching patterns of the external carotid artery is beneficial for head and neck surgeons, vascular surgeons, and radiologists to prevent diagnostic mistakes and avoid complications during surgeries and other medical interventions.

Acknowledgements

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Conflict of Interest

There is no conflict of interest in this study.

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