Case Report
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Tri-ramification of left external carotid artery associated with anatomical variation of its branches and aneurysm formation

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Abstract: Essential sources of arterial vascularisation in the head and neck region are the left and right common carotid arteries (CCA) and their branches. The left CCA (LCCA) originates from the arch of the aorta and the right CCA originates from the brachiocephalic trunk. In this case report, there was a bilateral higher division of CCA at the plane of the greater cornua of the hyoid bone, unilateral tri-ramification of the LCCA and the left external carotid artery (LECA), and the origin of the linguo-facial trunk and the pharyngo-occipital trunk from the LECA. An aneurysm formed in the distal part of LECA before its termination. In this case, we propose a novel categorization called the punnapatla classification for the anatomical variance branching forms of ECA. These kinds of variations are important to the surgeons, and anaesthetists, during the surgeries of the head and neck.

Key words: Carotid arteries, Neck, Aneurysm, Cadaver, Classification of the external carotid artery

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Introduction

Essential sources of arterial vascularisation in the head and neck region are the left and right common carotid arteries (CCA) and their branches. The left common carotid artery (LCCA) originates from the arch of the aorta and the right CCA originates from the brachiocephalic trunk. The CCA artery ascends into the carotid triangle where it bifurcates into the external carotid artery (ECA) and internal carotid artery (ICA) at the plane of the superior border of thyroid cartilage ventrally and dorsally correlate with C3 and C4 vertebrae. In the neck region, the ECA provides six branches, ventrally the superior thyroid artery (STA), the lingual artery (LA), the facial artery (FA), medially the ascending pharyngeal artery (APA), and posteriorly the occipital artery (OA), and the posterior auricular artery (PAA). The ECA ascends behind the mandible where it terminates into the maxillary and the superficial temporal arteries [1].

In this case report, there was a bilateral higher division of CCA at the plane of the greater cornua of the hyoid bone, unilateral tri-ramification of the LCCA and the left external carotid artery (LECA), and the origin of the linguo-facial trunk (LFT) and the pharyngo-occipital trunk (POT) from the LECA. An aneurysm formed in the distal part of LECA before its termination.

The intent of our study is we propose a novel categorization called the Punnapatla classification for the anatomical variance branching forms of ECA and the plausible explanation for the embryological basis of these abnormalities. These kinds of variations provide valuable information during head and neck surgeries.

This is the unique cadaveric report of the origin of the combination of the LFT and POT from the LECA and aneu-

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rysm formation in the distal part of the LECA which was not reported in any literature.

Case Report

During the usual dissection of a 62-year-old male cadaver for the first year M.B.B.S students in the Department of Anatomy, there was a bilateral higher division of the CCA at the plane of the greater cornua of the hyoid bone, unilateral tri-ramification of the LCCA as the STA, the ECA, and the ICA. The left STA had a tortuous course as shown in (Figs. 1, 2).

On further dissection, there was a unilateral tri-ramification of LECA as the LFT, POT, and the third branch continuing as the distal LECA. The LA and FA originated from the LFT and the APA and OA originated from the POT. To trace the remote part of the LECA we dissected the base of the mandible where the PAA originated from it. An aneurysm formed in the distal part of the LECA before its termination into the maxillary and superficial temporal arteries as shown in (Figs. 1, 2).

Discussion

Shreevastava et al. [2] described bilateral higher trifurcation of CCA as the ECA, the ICA, and the APA originating between the two arteries. There was a bilateral LFT originating from the ECA. The hypoglossal nerve is quite close to the termination in cases of high CCA termination, making it susceptible to damage from a variety of surgical procedures, including carotid endarterectomy, carotid stenting, and radical neck dissection [2].

According to Fazan et al. [3], LFT was found in 20% of cases on the right verge and 24% of cases on the left. Ozgur et al. [4] stated that LFT was present in 7.5% of cases. Additionally, they disclosed that 4.9% of cases had bilateral LFT [4]. The incidence of LFT was reported by Lucev et al. [5] to be 20%.

According to Charles et al. [6], POT was detected in 23% of patients, and auriculo-occipital trunk (AOT) was found in 13% of cases. According to Hayashi et al. [7], POT was found in 19% of patients.

In their study, Vázquez et al. [8] reported thyro-linguo-facial trunk (TLFT) in 0.3% of the subjects and thyro-lingual trunk (TLT) in 0.6% of instances. Devadas et al. [9] identified TLFT in 1% of their cadaveric cases.

Based on the variations stated in this case and the cited literature, we propose a novel categorization called the Punnapatla classification for the anatomical variance branching forms of ECA as shown in Table 1 [6, 8, 9] and Fig. 3. There was no taxonomy for these kinds of variations till now. As

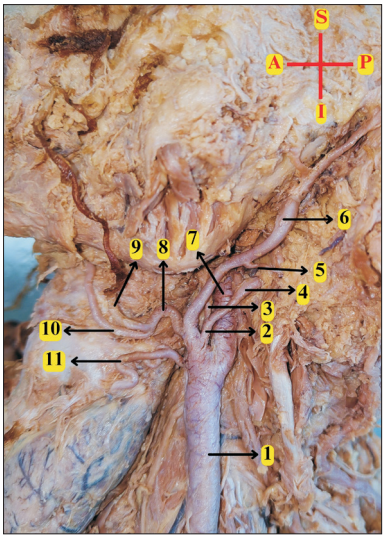

Fig. 1. Shows tri-ramification of both left common and external carotid arteries (ECA) and common trunks of ECA and aneurysm. 1, left common carotid artery; 2, pharyngo-occipital trunk; 3, ascending pharyngeal artery; 4, occipital artery; 5, posterior auricular artery; 6, aneurysm of the distal part of the left external carotid artery; 7, internal carotid artery; 8, linguo-facial trunk; 9, facial artery; 10, lingual artery; 11, superior thyroid artery; A, anterior; P, posterior; S, superior; I, inferior.

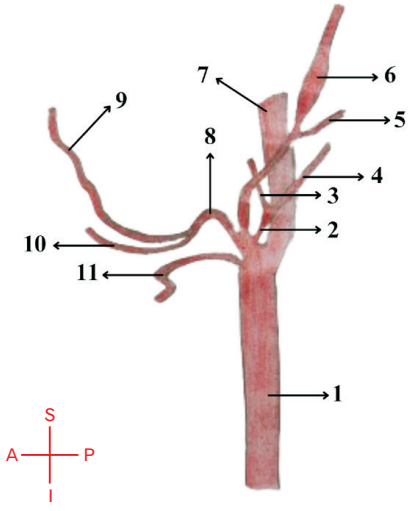

Fig. 2. Schematic diagram of variation of the left external carotid artery (LECA). 1, left common carotid artery; 2, pharyngo-occipital trunk; 3, ascending pharyngeal artery; 4, occipital artery; 5, posterior auricular artery; 6, aneurysm of the distal part of the LECA; 7, internal carotid artery; 8, linguo-facial trunk; 9, facial artery; 10, lingual artery; 11, superior thyroid artery; A, anterior; P, posterior; S, superior; I, inferior.

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per this classification, the variations present in this case were type IV and type V.

According to the Punnapatla classification, type I was a classic type, normal branching pattern of the external carotid artery, and type II was described as the superior thyroid, the lingual and the facial arteries arising from the common trunk named the TLFT, and type III was described as the thyroid and lingual arteries arising from the common trunk named the TLT, and type IV was described as the lingual and facial arteries arising from the common trunk named the LFT, and the type V was described as the ascending pharyngeal and the occipital arteries arising from the common trunk named the POT, and the type VI was described as the posterior auricular and the occipital arteries arising from the common trunk named the AOT.

Aneurysms of the ECA and its ramifications are extremely rare. These are caused by trauma, iatrogenic deterioration, tooth extraction, and head and neck carcinomas caused by tumour infiltration or radiation therapy. Endovascular surgery is the most effective therapy option [10].

In the present exemplar, we reported a higher division of CCA and arteries of ECA emerging from common trunks may be due to the inordinate cranial extension of truncus arteriosus resulting in an upward shift of the aortic arches, causing higher origin of the CCA eventually leading to a higher CCA termination. Due to this, the ECA branches get small space in the region of the neck [2].

In conclusion, the head and neck development is very complex, which results in hemodynamic changes in the blood vessels and leads to branching pattern variations in the arterial system. This was the unique cadaveric case report with tri-ramification of LECA and the origin of branches from the common trunks associated with aneurysm formation in the distal part of LECA which was very rare. For the first time, we introduced a new Punnaptla classification for the branching pattern variations of ECA. These kinds of variations are important to the surgeons, and anaesthetists, during the surgeries of the head and neck.

Table 1. Shows description of the Punnapatla classification of external carotid artery branching patterns variations

Type	Description	Study
Type I	Classic type – normal branching pattern of ECA.	Normal
Type II	The STA, LA, and FA originate from the common trunk named the TLFT.	Devadas et al. [9]
Type III	The STA and LA originate from the common trunk named the TLT.	Vázquez et al. [8]
Type IV	The LA and FA originate from the common trunk named the LFT.	Present case
Type V	The APA and OA originate from the common trunk named the POT.	Present case
Type VI	The PAA and OA originate from the common trunk named the AOT.	Charles et al. [6]

ECA, external carotid artery; STA, superior thyroid artery; LA, lingual artery; FA, facial artery; TLFT, thyro-linguo-facial trunk; TLT, thyro-lingual trunk; LFT, linguo-facial trunk; APA, ascending pharyngeal artery; OA, occipital artery; POT, pharyngo-occipital trunk; PAA, posterior auricular artery; AOT, auriculo-occipital trunk.

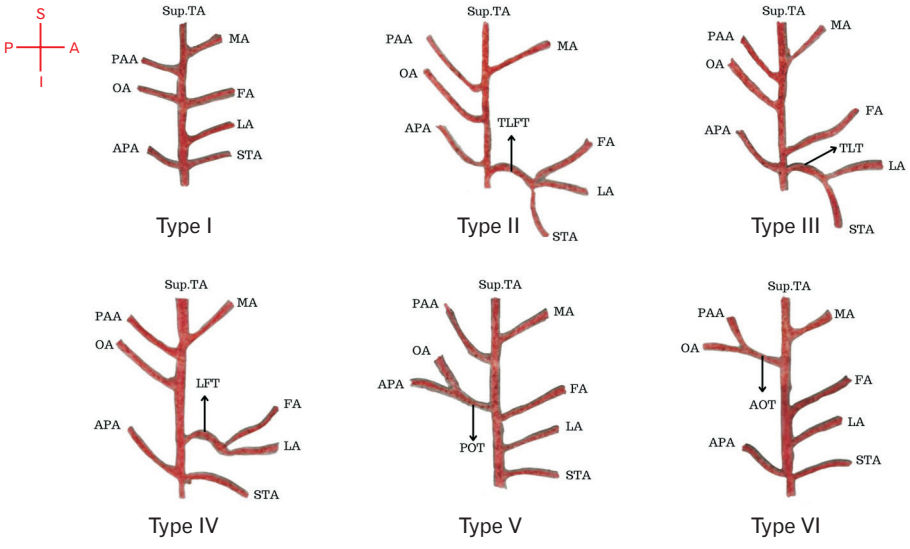

Fig. 3. Punnapatla classification of the external carotid artery branching pattern variations. Sup. TA, superficial temporal artery; MA, maxillary artery; PAA, posterior auricular artery; OA, occipital artery; FA, facial artery; LA, lingual artery; APA, ascending pharyngeal artery; STA, superior thyroid artery; TLFT, thyro-linguo-facial trunk; TLT, thyro-lingual trunk; LFT, linguo-facial trunk; POT, pharyngo-occipital trunk; AOT, auriculo-occipital trunk; A, anterior; P, posterior; S, superior; I, inferior.

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Conceptualization: PR, MC. Data acquisition: PR. Data analysis or interpretation: PR, MC, RM. Drafting of the manuscript: PR, RM. Critical revision of the manuscript: MC, PR, RM. Approval of the final version of the manuscript: all authors.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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