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Original Research Article

Study of Branching Pattern of External Carotid Artery

Shivaprakash S *[1], Ashok K R [2].

[*1] Assistant Professor, Department of Anatomy, JSS Medical College, JSS Academy of Higher Education and research, Mysuru, Karnataka, India.

[2] Associate Professor, Department of Anatomy, BGS Global Institute of Medical Sciences, Bengaluru, Karnataka, India.

ABSTRACT

Background: Anatomical information of vasculature is of need for the surgeons and radiologists. Carotid artery and its branches supply most of head, neck, and brain. Injuries to the external carotid artery and its branches is often complex and results in high mortality. Knowledge of types and frequencies of vascular variations of external carotid artery is of help for invasive diagnostic and interventional procedures.

Materials and methods: 50 external carotid arteries were dissected to study the branching pattern of external carotid artery.

Results: Conventional branching pattern was seen in 58% specimens. Superior thyroid artery originated from common carotid artery in 12% specimens. Linguofacial trunk was observed in 16%. Occipital artery and ascending pharyngeal artery rose from a single trunk in 12%. Origin of facial artery from maxillary artery was observed in one specimen.

Conclusion: Study of variations in the branching pattern of the external carotid artery adds to the existing anatomical knowledge. Variations in the branching pattern is of definite help for interventional radiologists, vascular, craniofacial and neck surgeons.

KEY WORDS: External carotid artery, Facial artery, Linguofacial trunk.

Corresponding Author: Dr Shivaprakash S, Assistant Professor, Department of Anatomy, JSS Medical College, JSS Academy of Higher Education and research, Mysuru, Karnataka, India. Phone No: 91 – 9740010544 **E-Mail:** shivaprakashs@jssuni.edu.in

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INTRODUCTION

Carotid artery and its branches take care of most of the nutritional needs of head, neck, and brain. While internal carotid artery is destined to supply the interior of cranial cavity, external carotid artery is the major vascular source for exterior parts of head and neck.

External carotid artery arises from the common carotid artery at the level of upper border of thyroid cartilage. It ascends and passes midway between the tip of the mastoid process and the angle of the mandible and enters the substance of parotid gland. When it reaches the neck of mandible it divides into two terminal branches – superficial temporal artery and maxillary artery [1]. In the neck, external carotid artery gives rise to six branches – ascending pharyngeal, superior thyroid, facial, lingual, posterior auricular and occipital. Various anastomosis between external carotid artery with internal carotid artery and vertebral artery provides collateral blood supply to the brain [2]. Stenosis of the external carotid artery in ipsilateral

internal carotid occlusion can produce ischemic sequelae [3].

Injuries to the external carotid artery and its branches is often complex and results in high mortality. Transcatheter embolization is effective in controlling the haemorrhage [4]. Blunt injuries might result in pseudoaneurysm of branches of external carotid artery. Superficial temporal artery, maxillary artery and facial artery are the most affected ones [5]. External carotid artery and its branches are used for intraarterial infusion chemotherapy of head and neck cancer [6]. External carotid artery stenting is effective in preserving neurological functions in ipsilateral internal carotid artery diseases [3].

With the increasing use of invasive diagnostic and interventional procedures in cardiovascular diseases, it is important to document and understand the types and frequencies of vascular variations of external carotid artery. A sound knowledge of these variations is important for surgeons, anaesthesiologists, and radiologists.

MATERIALS AND METHODS

50 External carotid arteries and their branches were studied in Kasturba Medical college, Mangalore and JSS Medical college, Mysuru.

Neck dissection was performed as instructed in the Cunningham's manual of practical anatomy. Carotid sheath was exposed to visualise the common carotid artery and its branches. Branches of external carotid artery were traced and photographed.

Fig. 1: Origin of superior thyroid artery from common carotid artery. (CCA – Common carotid artery, ECA – external carotid artery, ICA – internal carotid artery, StA – Superior thyroid artery)

Fig. 2: Linguofacial trunk. (CCA – Common carotid artery, ECA – external carotid artery, ICA – internal carotid artery, LFT – Linguofacial trunk, FA – Facial artery, LA – lingual artery)

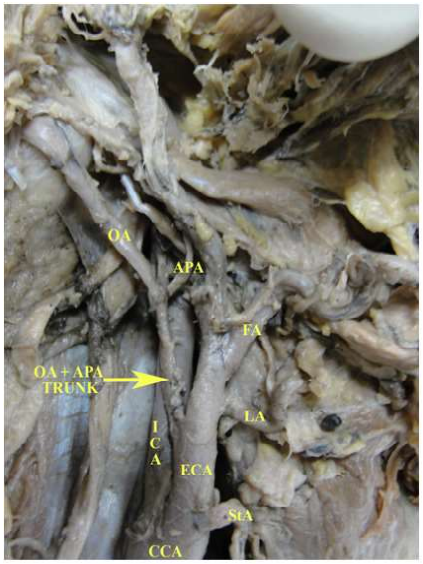

Fig. 3: Common trunk of occipital and ascending pharyngeal artery. (CCA – Common carotid artery, ECA – external carotid artery, ICA – internal carotid artery, OA – occipital trunk, APA – ascending pharyngeal artery, FA – Facial artery, LA – lingual artery, StA – superior thyroid artery)

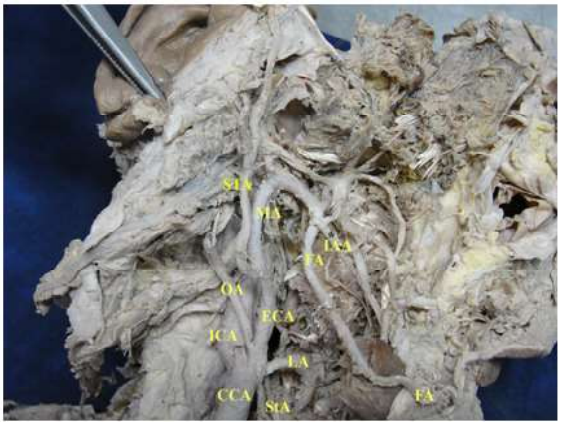

Fig. 4: Facial artery originating from maxillary artery. (CCA – Common carotid artery, ECA – external carotid artery, ICA – internal carotid artery, OA – occipital trunk, FA – Facial artery, LA – lingual artery, StA – superior thyroid artery, IAA – Inferior alveolar artery, STA – superficial temporal artery, MA – maxillary artery)

RESULTS AND DISCUSSION

Out of 50 specimens, 29 specimens (58%) showed conventional branching pattern. In 6 specimens (12 %), superior thyroid artery originated from common carotid artery. Linguo – facial trunk was observed in 8 specimens (16 %). Occipital artery and ascending pharyngeal artery rose from a single trunk in 6 specimens (12%). In one specimen, facial artery originated from first part of maxillary artery. This is one of the rare variations appreciated in the present study.

The origin of superior thyroid artery from common carotid artery has been reported in many studies. Table 1 compares our findings with other studies. As depicted in table 1, the incidence of superior thyroid artery originating from common carotid artery varies from 9 to 45 %.

Table 1: Origin of Superior thyroid artery compared with other studies.

Study	Percentage
Faller et al [7]	18%
Chandralekha G et al [8]	30%
Smith SD et al [9]	45%
Rimi KR et al [10]	18%
Sanjeev et al [11]	35.14%
Anitha T et al [12]	21%
Chandrakala SP et al [13]	9.10%
Hayashi N et al [14]	30%
Present Study	**12%**

Table 2: Presence of Linguo – facial trunk compared with previous studies.

Author	Percentage
Anangwe D et al [16]	7%
Ozgur Z et al [17]	7.50%
Mata JR et al [18]	19.40%
Yonenaga K et al [19]	20%
Zumre O et al [20]	20%
Sanjeev I K et al [11]	18.90%
Ogengo'o J et al [15]	44.70%
Lappas DA et al [21]	14%
Shintani et al [22]	31%
Lucev et al [23]	20%
Hayashi N et al [14]	18%
Present Study	**16%**

Linguo – facial trunk is the commonest variation in the branching pattern of external carotid artery. Various studies estimate the occurrence of this variation at around 10-20%. Ogengo'o J et al reported the higher incidence of linguo – facial trunk [15]. In their study of 224 carotid arteries, they reported linguofacial trunks in 100 arteries. Table 2 compares our findings with previous studies.

Origin of ascending pharyngeal artery with occipital artery was reported by Sanjeev I K et al (24.32%) [11], Lappas DA et al (20%) [21], Bergman et al (18%) [24]. In our study we found the pattern in 12 % of cases. Bergman also reported that in 6% cases ascending pharyngeal artery originated from common carotid artery [24]. Kaneko K et al reported a case where occipital artery originated from internal carotid artery [25]. Gurbuz J et al reported a case of trifurcation of common carotid artery into internal carotid, external carotid, and occipital artery [26].

Origin of facial artery from maxillary artery is a rare variation. Facial artery originated from the first part of Maxillary artery after the origin of Middle meningeal artery in the infratemporal fossa. A short trunk arose from the inferior aspect of the maxillary artery at 42 mm from its origin. The length of this trunk was 2 mm. From this trunk facial artery and inferior alveolar artery originated. Facial artery ran downwards and laterally behind the mandibular foramen parallel to inferior alveolar nerve between the internal surface mandibular ramus and medial pterygoid muscle. It then traversed between the submandibular gland and body of mandible and entered the face along the antero- inferior angle of masseter and ascended in the face where it conformed to its normal course. Ashutosh Mangalgiri et al observed high origin of facial artery just below the origin of maxillary artery in two cadavers [27]. Tubbs RS et al [28] and Eid N et al [29] reported unilateral agenesis of facial artery. The absence of facial artery was compensated by giant transverse facial artery. Eretter K et al [30] and Rusu M C et al [31] reported cases of maxillofacial trunk. Higher origin of facial artery or origin of facial artery from maxillary artery as noted here is liable to damage during parotid surgeries [27].

Thyrolingual trunk (2-3.5%) [11, 20, 22, 32, 33], thyrolinguofacial trunk (1-3.3%) [12, 20, 33, 34, 35] are reported by various authors but we didn't find any such variation in our study.

Sanjeev I K et al [11] reported 2.7% cases of auriculo-occipital trunks, Zumre O et al [20] reported the auriculo-occipital trunks in 12.5% cases. Common trunk for ascending pharyngeal artery and posterior auricular artery was reported by Lappa et al (13.5%) [21] and Luzsa et al (3.9%) [36].

Variations in the branching pattern of external carotid artery may arise from disarrangements of the complex process of the development of vascular system [15]. The variations in the vascular pattern result from the persistence of the primitive vascular channels that normally disappear or from the disappearance of the normally persisting blood vessels.

Origin of facial artery from maxillary artery is a rare occurrence. Embryonic maxillofacial trunk which provides infraorbital and mandibular branches originates from hyostapedial artery, a dorsal aortic derivative [37]. In later course of development embryonic maxillofacial trunk connects to the external carotid artery, a ventral aortic derivative [37, 38]. Embryonic maxillofacial trunk now becomes maxillary artery. Primitive facial artery originates from external carotid artery, a ventral aortic derivative. Rusu M C et al speculates that if external carotid artery origin of facial artery glides cranially on embryonic maxillofacial trunk origin of facial artery or if embryonic maxillofacial trunk fuses with the facial artery bud instead of joining the external carotid artery a common maxillofacial trunk can be seen [31]. Cranial gliding of facial artery on embryonic maxillofacial trunk could be the reason for the anomalous origin of facial artery from maxillary artery.

Awareness of variations of the branching pattern of external carotid artery is of use for radiologists and vascular surgeons to reduce the diagnostic errors, helps to improve the surgical management and helps to plan interventional procedures and avoid complications during surgeries.

CONCLUSION

Study of variations in the branching pattern of the external carotid artery adds to the existing anatomical knowledge. The knowledge of branching pattern will be useful to surgeons when ligating the vessels in the head & neck regions during surgery and helps the surgeon to avoid haemorrhagic complications during carotid endarterectomy. Variations in the branching pattern is of definite help for interventional radiologists, vascular, craniofacial and neck surgeons.

Author Contributions

Shivaprakash S has done all the dissection work, photographed the specimens, collected relevant references and wrote the manuscript.

Ashok K R collected relevant references and assisted in drafting the manuscript.

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