

Case Report

TRIFURCATION OF EXTERNAL CAROTID ARTERY AND VARIANT BRANCHES OF FIRST PART OF MAXILLARY ARTERY

N. Shakuntala Rao ^{*1}, K. Manivannan ², Gangadhara ³, H. R. Krishna Rao ⁴.

^{*1} Professor, ² Assistant Professor, ³ Associate Professor, ⁴ Professor and Head.

Department of Anatomy, P E S Institute of Medical Sciences & Research, Kuppam, Andhra Pradesh, India.

ABSTRACT

The external carotid artery normally divides into two terminal branches at the level of the neck of the mandible. The terminal branches are usually the superficial temporal and maxillary arteries. The maxillary artery is described to be in three parts in relation to the lateral pterygoid muscle as the mandibular (first), pterygoid (second) and the pterygopalatine (third) parts. The second part passes behind the muscle. The branches that arise from the first part of the maxillary artery are the deep auricular, anterior tympanic, the middle meningeal, accessory meningeal and inferior alveolar arteries. The middle meningeal artery normally arises at the lower border of lateral pterygoid muscle from the first part of maxillary artery. It then ascends upwards, passes between the two roots of the auriculotemporal nerve and enters the foramen spinosum in the base of skull. During routine dissection of a male cadaver in the department of anatomy while teaching medical students variations were observed in the termination of the external carotid artery on the right side. The artery gave three branches at the termination, superficial temporal, maxillary and between the two the middle meningeal artery was seen arising close to the end of the external carotid artery. The middle meningeal artery did not pass between the two roots of the auriculotemporal nerve.

The branches of first part of maxillary artery were variable. The deep auricular branch was absent and its territory may have been supplied by the posterior auricular and anterior auricular arteries. The anterior tympanic and accessory meningeal arteries arose from the middle meningeal artery. There were two inferior alveolar arteries 1.5 cm apart arising from the first part of maxillary artery. The first artery went to the mandibular canal along with the inferior alveolar nerve. The second artery accompanied the lingual nerve to the last molar tooth. Probably this artery may have been an additional supply to the gingiva around the last molar tooth. The other variations that were noted were the absence of mylohyoid branch from the inferior alveolar artery. To the best of our knowledge these variations in the arteries have not been previously reported.

KEYWORDS: Trifurcation, External carotid artery, middle meningeal artery, double inferior alveolar arteries.

Address for Correspondence: : Dr. N. Shakuntala Rao, Professor, Department of Anatomy, P E S Institute of Medical Sciences & Research, Kuppam 517 425, Andhra Pradesh, India.

E-Mail: drshakuntala@gmail.com

Access this Article online

Quick Response code



Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 19 Aug 2014

Peer Review: 19 Aug 2014 Published (O):30 Sep 2014

Accepted: 14 Sep 2014 Published (P):30 Sep 2014

INTRODUCTION

The middle meningeal artery develops from the stapodial artery which arises from the dorsal stem of the second arch artery. This connects

with the transient artery called the ventral pharyngeal artery. The ventral pharyngeal artery arises when the first and second arch arteries begin to regress. It terminates by dividing into mandibular and maxillary branches. A vessel

from the dorsal stem of second arch artery passes through the ring of stapes and anastomoses with the cranial end of ventral pharyngeal artery. The stapedial artery follows the divisions of the fifth nerve and its three corresponding branches are named mandibular, maxillary and supraorbital. The first two branches have a common stem. The external carotid artery arises from the base of the third arch. It incorporates the stem of the ventral pharyngeal artery. The maxillary branch of external carotid artery communicates with the common trunk of origin of maxillary and mandibular branches of stapedial artery. The proximal part of the common trunk forms the stem of the middle meningeal artery. Therefore the middle meningeal artery has its origin in the stapedial artery originally. The proximal part of supraorbital artery represents the distal part of the middle meningeal artery. The maxillary artery becomes the infraorbital vessel and the mandibular branch forms the inferior alveolar artery. When the definitive ophthalmic artery differentiates as a branch of the terminal part of the internal carotid artery it communicates with the supraorbital branch of the stapedial artery. The distal part of which becomes the lacrimal artery. The dorsal stem of the second arch artery remains as a carotico-tympanic branch of the internal carotid artery.

In short the mandibular and maxillary branches which form the maxillofacial division of stapedial artery are taken in by the developing external carotid artery and the maxillary artery is formed. This also forms the part of middle meningeal artery before it enters the cranial fossa.

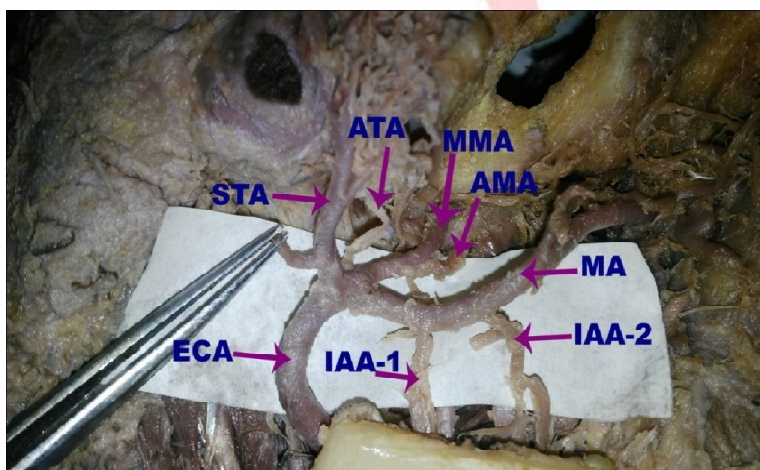
Thus the proximal part of stapedial artery forms the proximal part of middle meningeal artery. The distal part of stapedial artery which is the supraorbital division gives the intracranial segment of middle meningeal artery.

The external carotid artery normally divides into two terminal branches at the level of the neck of the mandible. The terminal branches are usually the superficial temporal and maxillary arteries. The maxillary artery is described to be in three parts in relation to the lateral pterygoid muscle as the mandibular (first), pterygoid (second) and the pterygopalatine (third) parts. The second part passes behind the muscle. The branches that arise from the first part of the maxillary artery are the deep auricular, anterior tympanic, the middle meningeal, accessory meningeal and inferior alveolar arteries. The middle meningeal artery normally arises at the lower border of lateral pterygoid muscle from the first part of maxillary artery. It then ascends upwards, passes between the two roots of the auriculotemporal nerve and enters the foramen spinosum in the base of skull.

MATERIALS AND METHODS

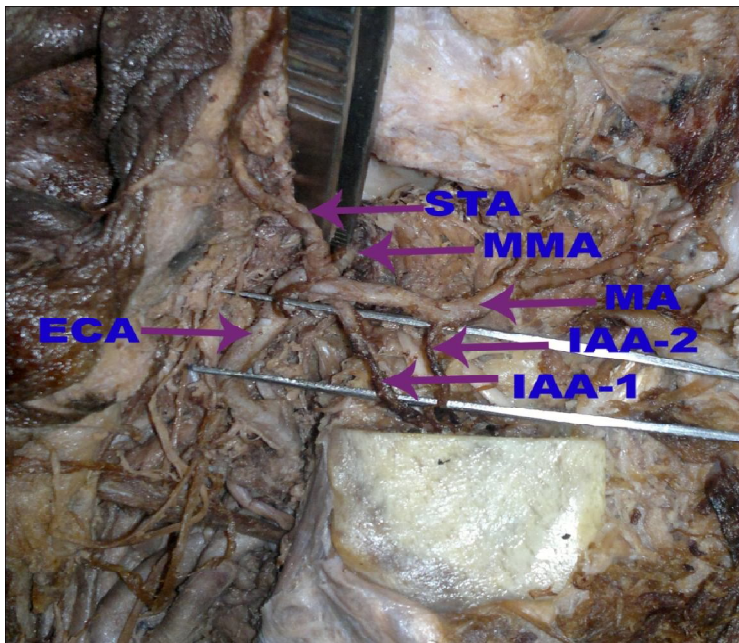
During routine dissection of an embalmed male cadaver in the department of Anatomy P.E.S. Medical College Kuppam, Andhra Pradesh, India, used for conventional teaching purposes as per the curriculum of first year medical students, variations were found in the external carotid, middle meningeal and the inferior alveolar arteries. All the branches were traced to their distal ends as much as possible and photographed.

Fig. 1: Trifurcation of External Carotid Artery on Right Side.



ECA- External Carotid Artery,
STA- Superficial temporal artery,
MMA-Middle meningeal artery,
MA-Maxillary artery,
ATA-Anterior tympanic artery,
AMA-Accessary meningeal artery,
IAA-1-Inferior alveolar artery-1,
IAA-2—Inferior alveolar artery-2.

Fig. 2: Origin Of Double Inferior Alveolar Arteries.



ECA- External Carotid Artery,
 STA- Superficial temporal artery,
 MMA-Middle meningeal artery,
 MA-Maxillary artery,
 IAA-1-Inferior alveolar artery-1,
 IAA-2—Inferior alveolar artery-2.

DISCUSSION

The origin of middle meningeal artery at the termination of the external carotid artery, close to the origin of the superficial temporal and maxillary arteries was observed. Developmentally the middle meningeal artery has two parts. The proximal part is from the common stem of maxillary and mandibular branches of the stapedal artery. The distal is from the proximal part of supraorbital branch of stapedal artery. The stapedal artery is an artery of the second branchial arch. The maxillary division of external carotid which grows as a bud from the third arch, incorporates the common stem of the maxillary and mandibular branches to form the extracranial stem of the middle meningeal artery [1]. In this case it seems that the original stapedal artery itself had three separate branches the supraorbital, the maxillary and mandibular. Thus the external carotid artery has directly incorporated the supraorbital branch of the stapedal artery to form the stem of the middle meningeal artery. Thus the external carotid artery has trifurcated in this case [figure -1].

Da Silva[2] has described the probable embryological mechanism of the origin of the middle meningeal artery in their review article. Da Silva et al in their study have said that variations though common are not described in textbooks and therefore the information related to variations is inadequate. Their work aims to

provide knowledge concerning the morphogenesis, variation, and clinical significances of the MMA, and to help promote future studies in this area. Da Silva et al concluded that these variations are of clinical significance in fractures of the squamous and petrous parts of the temporal bones and in surgical interventions involving the nerve of the pterygoid canal and maxillary artery. The review shall be useful for clinicians, surgeons and academics.

The MMA may take its origin as a branch of persistent stapedal artery (PSA) [3]. The MMA of stapedal origin is called the stapedal middle meningeal artery (SMMA). The first case was described by Hyrtl in 1836 as cited by Manjunath K.Y [3].

The PSA is a branch of the intrapetrous portion of the internal carotid artery, enters the tympanic cavity through its floor and passes through the obturator foramen of the stapes. Over the promontory it is enclosed in a bony canal and enters the facial canal. It emerges in to the middle cranial fossa under the dura and gives off the middle meningeal branch (Altman 1947). Altman F has also described anomalous development of ascending pharyngeal artery from internal carotid artery[4].

Mc LENNAN and a few more authors have described the importance of the MMA arising from the ophthalmic artery. All these have

important implications for the endovascular repair of lesions of the skull base.

Bilateral anomalous origin of the MMA has been reported by Royle and Motson. They have observed a very rare origin of MMA from the lacrimal artery in their study. MMA has been reported to take origin from the basilar artery. The first case being that by Altman followed by Seeger and Hemmer and also by Shah and Hurst.

MMA has been reported to have taken origin from the lateral medullary segment of posterior cerebral inferior artery by Tanohata et al. The origin from stapedial artery, from the intracavernosal or extra dural internal carotid artery and also from ascending pharyngeal artery have been reported.

Unilateral trifurcation of carotid artery has been reported in a case by Afitap Anil, M.D et al [5]. It has been described that the right ascending pharyngeal artery arose from the carotid bifurcation instead of the usual posterior aspect of the artery. A branch from the trunk of the ascending pharyngeal artery reached out to supply related areas. The main part of the trunk terminated as the superficial temporal artery. Here it seems like a unilateral trifurcation of carotid termination. Significantly the ascending pharyngeal continued to terminate as the superficial temporal artery. In the present case the trifurcation was at the termination of external carotid artery giving rise to middle meningeal artery as the middle branch.

Sanjeev et al [6] have quoted Skinner in their article on branching pattern of external carotid artery who said that the word *carotid* is derived from the Greek word 'Kapwrides', meaning *to stupefy or throttle* and *kapos* also means *heavy sleep*. They have quoted references (Rufus and Perrson) in which it has been said that deep sleep and aphonia are produced by compression of carotid arteries. The results of their study showed that out of 37 head and neck specimens one showed a variation in the terminal branches. The external carotid artery terminated into posterior auricular, superficial temporal and maxillary arteries. The artery terminated at a distance of 60mm from the origin on an average. The study also gave the incidence of variations in the origin of branches of the artery as also

some accessory branches. Their study has reported accessory branches which arose directly from the external carotid artery. The accessory branches were the superior laryngeal artery in two cases, artery to sternocleidomastoid muscle in two cases and artery to tonsil in one case.

Mamatha et al [7] have reported an anomalous branching pattern of the external carotid artery in which the external carotid artery gave a direct branch to the submandibular salivary gland. There was also a thyrolingual trunk, an auriculo-occipital trunk and they observed an unusual course of the facial artery. In the present case we had a deep auricular branch arising from the middle meningeal artery instead of the usual maxillary artery.

Shetty et al [8] have observed the unusual termination of external carotid artery at a level lower than the normal below the angle of the mandible. They observed that the occipital and posterior auricular arteries shared a common trunk.

T Ramesh rao [9] has observed that all branches of the external carotid artery arose from a common point just above its origin from the common carotid artery and discussed the clinical importance of the variation.

Gurbuz et al [10] have reported the trifurcation of common carotid artery on the left side. The terminal branches were the external carotid, internal carotid and occipital arteries. They also reported that the superior thyroid artery arose from the common carotid artery instead of the external carotid artery.

Regarding variation in the inferior alveolar arteries Aamir et al has described a rare variation in which the inferior alveolar artery had arisen from the external carotid artery.[11] In the present case report the inferior alveolar arteries were double [figure-2] and such a variation has not been reported earlier to the best of our knowledge. The first inferior alveolar artery entered the mandibular canal along with inferior alveolar nerve. The second inferior alveolar artery arose from the maxillary artery 1.5 cm distal to the first. It did not pass through the mandibular canal but accompanied the lingual nerve till the last lower molar tooth. The clinical implication of the artery is the potential

hazard during nerve block where it is vulnerable to vascular trauma [12]. Poirot et al have said that the artery is variable in the mandibular canal than prior to the canal. In this case it is variant prior to entering the canal [13]

CONCLUSION

The variations that have been noted in this case hold paramount importance to the clinical surgeons, facio maxillary surgeons, and in radiological procedures. The anatomy of variations are useful to provide accurate diagnosis and also to prevent errors, especially in head and neck surgeries. The variation of the external carotid artery described here has importance for transcatheter embolization procedures.

ABBREVIATIONS:

MMA- Middle Meningeal Artery

PSA- Persistent Stapedial Artery

SMMA- Stapedial Middle Meningeal Artery

Conflicts of Interests: None

REFERENCES

- [1]. Susan Standring. The Anatomical basis of Clinical Practice: Head and Neck. Elsevier Churchill Livingstone 2008; 600: 540-541.
- [2]. Da Silva TH, Ellwanger JH, Da Rosa HT and De Campos D. Origins of the middle meningeal artery and its probable embryological mechanism – A review. J. Morphol. Sci., 2013; 30(2): 69-72.
- [3]. Manjunath K.Y. Anomalous origin of the middle meningeal artery- A review. J.Anat.Soc.India 2001; 50(2): 179-183.
- [4]. Altmann F. Anomalies of the internal carotid artery and its branches. Their embryological and comparative anatomical significance. Report of a new case of persistent stapedial artery in man. Laryngoscope 1947; 57: 131.
- [5]. Afitap Anil. M.D, Variation of the branches of external carotid artery. Gazi medical journal 2000; 11: 81-83.
- [6]. Sanjeev I K, Anita H, Ashwini M, Mahesh U, Rairam G B. Branching pattern of external carotid artery in human cadavers. Journal of clinical and diagnostic research 2010; 4: 3128-3133.
- [7]. Mamatha T, Rajalakshmi Rai, Latha V. Prabhu et al. Anomalous branching pattern of the external carotid artery: a case report. Romanian Journal of Morphology and Embryology 2010; 51(3): 593-595.
- [8]. Surekha Devadasa Shetty, Satheesha Nayak Badagabettu, Naveen Kumar, Ashwini Aithal. Low level Termination of External Carotid artery and its Clinical significance: A case report. Arch Clin Exp Surg. 2015; 4(3): 10.5455/aces.20130519040427
- [9]. T Ramesh Rao. Unusual branching pattern of the External Carotid Artery in a Cadaver. Chang Gung Med J 2011; 34(6)(suppl); 24-27.
- [10]. Gurbuz J, Cavdar S, Ozdogmu O. Trifurcation of the left common carotid artery: A case report. Clin Anat 2001; 14: 58-61.
- [11]. Khaki Amir Afshin, R. Shane Tubbs, Mohammadali Mohajel Shoja, Ghaffar Shokouhi, and Ramin Mostofizadeh Farahani. A rare variation of the inferior alveolar artery with potential clinical consequences. Folia morphologica 2005; 64(4): 345-346.
- [12]. Ham SD, Durham TM. Anatomical variations and clinical implications of the artery to the lingual nerve. Clin Anat 2003; 16(4): 294-299.
- [13]. Poirot G, Delattre JF, Palot C, Flament JB. The inferior alveolar artery in its bony course. Surg. Radiol. Anat 1986; 8: 237-244.

How to cite this article:

N. Shakuntala Rao, K. Manivannan. Gangadhara, H. R. Krishna Rao. TRIFURCATION OF EXTERNAL CAROTID ARTERY AND VARIANT BRANCHES OF FIRST PART OF MAXILLARY ARTERY. Int J Anat Res 2014; 2(3): 561-565.