

Unusual Branching Pattern of the External Carotid Artery in A Cadaver

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With the increasing use of invasive diagnostic and interventional procedures in cardiovascular disease, it is important to document and understand the types and frequencies of vascular variations. A sound knowledge of neurovascular variations is important for surgeons who remove cervical lymph nodes, for anesthesiologists, and for vascular surgeons. The external carotid arterial system is a complex vascular system which nourishes the terminal areas of the head, face and neck. The branches of the external carotid artery are the key landmarks for adequate exposure and appropriate placement of cross-clamps on the carotid arteries during carotid endarterectomy, and understanding their anatomy is necessary to successfully remove plaque and minimize postoperative complications in a bloodless surgical field. Variations in the course, branching, and distribution of the carotid arteries are commonly encountered. We report an extremely rare variation in the branching of the external carotid artery noted during routine cadaver dissection. All branches in the carotid triangle arose close together from a common point just above the origin of the external carotid artery from the common carotid artery. The clinical importance of this variation is discussed. (*Chang Gung Med J 2011;34(6 Suppl):24-7*)

Key words: external carotid artery, internal carotid artery, common carotid artery, vascular variation

In humans, the external carotid artery is a major artery of the head and neck. It arises from the common carotid artery, lateral to the upper border of the thyroid cartilage, level with the intervertebral disc between the third and fourth cervical vertebrae. From its origin it takes a slightly curved course, passes upward and forward, and then inclines backward to the space behind the neck of the mandible, where it divides into the superficial temporal artery and maxillary artery within the parotid gland. It rapidly diminishes in size in its course up the neck, owing to the number and large size of the branches extending from it. In children, it is somewhat smaller

than the internal carotid; but in adults, the two vessels are nearly equal in size. At its origin, it is in the carotid triangle and lies anteromedially to the internal carotid artery. It later becomes anterior, and then lateral, to the internal carotid artery as it ascends. This can be explained embryologically, since the external carotid artery arises mainly from the ventral aorta and the internal carotid artery arises mainly from the dorsal aorta. At mandibular levels the styloid process and its attached structures intervene between the vessels. The internal carotid is deep, and the external carotid is superficial, compared with the styloid process. A fingertip placed in the carotid tri-

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angle perceives a powerful arterial pulsation, which represents the termination of the common carotid, the origins of the external and internal carotids and the stems of the initial branches of the external carotid.

The external carotid artery has eight named branches distributing to the head and neck. The superior thyroid, lingual and facial arteries arise from its anterior surface, the occipital and posterior auricular arteries arise from its posterior surface and the ascending pharyngeal artery arises from its medial surface. The maxillary and superficial temporal arteries are its terminal branches within the parotid gland. In the carotid triangle the hypoglossal nerve winds round the lower sternomastoid branch of the occipital artery and crosses superficial to the internal carotid, external carotid and the loop of the first part of the lingual artery, to pass on to the digastric triangle.

CASE REPORT

This is a report of an unusual branching pattern of the external carotid artery only on the right side. Using conventional dissection techniques, the anterior triangles of a 65-year-old well-built, embalmed male cadaver were dissected during preparation of teaching and museum anatomical specimens for

medical students at Kasturba Medical College (KMC) International Center, Manipal, India. The medical history of this cadaver was not available. The skin, superficial fascia and deep fascia were removed systematically on both sides. Special attention was given to the branching pattern of the external carotid artery. Following fine dissection, the external carotid artery and its branching pattern were photographed.

The external carotid artery had eight named branches distributed to the head and neck. For the first time at KMC International Center, Manipal we found that all the branches arose close together from a common point just above the origin of the external carotid artery from the common carotid. The hypoglossal nerve crossed all branches of the external carotid artery near their origin, except for the superior thyroid artery (Figure). The finding was unilateral and other vascular anomalies were not observed. The embryogenesis of this combination of anomalies is not clear, but the anatomic consequences may have important clinical implications.

DISCUSSION

Many studies have shown variations in the branching pattern of the external carotid artery. But we could find no published reports with photographs

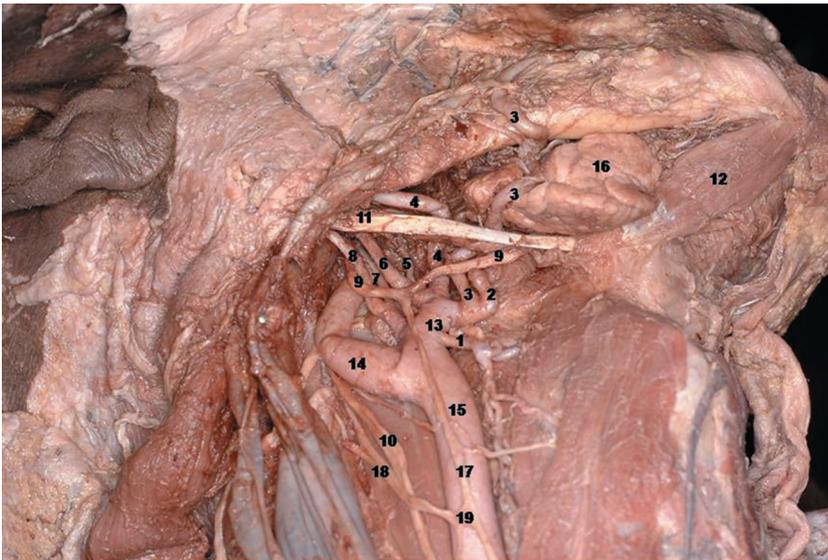


Figure The external carotid artery and neighboring structures in the cadaver of a 65 year-old man.

1. Superior thyroid artery
2. Lingual artery
3. Facial artery
4. Maxillary artery
5. Ascending pharyngeal artery
6. Superficial temporal artery
7. Posterior auricular artery
8. Occipital artery
9. Hypoglossal nerve
10. Vagus nerve
11. Posterior belly of digastric muscle
12. Anterior belly of digastric muscle
13. External carotid artery
14. Internal carotid artery
15. Common carotid artery
16. Submandibular gland
17. Descendens hypoglossi
18. Descendens cervicalis
19. Ansa cervicalis.

to support our findings, in which all branches arose close together from a common point just above the origin of the external carotid artery from the common carotid.

The external carotid may be absent unilaterally or bilaterally. When it is absent unilaterally, the branches usually derived from it arise from the upward continuation of the common trunk or from the contralateral vessel. The artery is sometimes located superficially, and runs lateral to the stylohyoid muscle or between the posterior belly of the digastric muscle and stylohyoid muscle.

The branches of the external carotid may arise irregularly or be diminished or increased in number. When increased in number (by two or more), they arise as a common stem or by the addition of branches not usually derived from this artery, such as the sternomastoid branch of either the superior thyroid or occipital artery. On occasion, all branches arise close together from a common point just above the origin of the artery from the common carotid. A curious variation is an external carotid composed of two separate trunks that unite behind the condylar process of the mandible forming an annulus from which various branches arise.⁽¹⁾

Basekim et al found triple developmental anomalies, with bilateral absence of the external carotid arteries, a left brachiocephalic trunk, and a type I proatlantal artery. The branches that usually emanate from the external carotid artery arose directly from the common carotid artery. Although these anomalies are usually asymptomatic and found incidentally, they may be important in diagnosis and therapy.⁽²⁾

An explanation for absence of the external carotid artery is that the development of the external carotid artery arising from the ventral aorta is disturbed by unknown factors in the early embryonic stage. In the process of embryonal development, the internal carotid artery and branchial arteries (that are to be components of the external carotid artery) do not connect and there is no development of the external carotid artery trunk.⁽³⁾

The branches of the external carotid artery are the key landmarks for adequate exposure and appropriate placement of cross-clamps on the carotid arteries. The branches of the carotid arteries located in the carotid triangle are also the key landmarks for adequate dissection of the carotid arteries and should be identified before cross-clamps are placed and an arte-

riotomy is performed.⁽⁴⁾

Gurbuz et al found carotid trifurcation during routine dissection. The left common carotid artery gave off three terminal branches: the external carotid, internal carotid, and occipital arteries. The level of trifurcation was 35 mm above the superior margin of the thyroid cartilage. Further, the superior thyroid artery arose from the common carotid artery instead of the external carotid.⁽⁵⁾

Two cases of a lateral external carotid artery have been identified during cadaveric dissection. This variation would result in limited access to the internal carotid artery during carotid endarterectomy. Vascular surgeons should be aware of this anomaly so that the surgical technique can be appropriately adjusted to allow a safe carotid endarterectomy, avoiding unnecessary nerve injury.⁽⁶⁾

In 12% of cases, the right common carotid artery arises above the level of the sternoclavicular joint, or it may be a separate branch from the aorta. The left common carotid artery varies in origin more than the right and may arise with the brachiocephalic artery. Division of the common carotid may occur higher, near the level of the hyoid bone, or, more rarely, at a lower level alongside the larynx. Very rarely it ascends without division, so that either the external or internal carotid is absent, or it may be replaced by separate external or internal carotid arteries which arise directly from the aorta, on one side, or bilaterally.⁽⁷⁾ Although the common carotid artery usually has no branches, it may occasionally give rise to the vertebral, superior laryngeal, ascending pharyngeal, inferior thyroid or occipital arteries.⁽⁸⁾

There is one report in which the right common carotid artery bifurcated at a level between the second and the third cervical vertebrae, giving rise to the ascending pharyngeal artery just below the bifurcation. The right external carotid artery branched directly at its origin into the superior thyroid, lingual and occipital arteries and the distal part of the external carotid artery. The latter gave rise to the right facial artery and finally bifurcated into the maxillary and superficial temporal arteries. The right posterior auricular artery arose from the right occipital artery. The finding was unilateral and other vascular anomalies were not observed.⁽⁹⁾

Anu et al observed that the level of bifurcation of the common carotid artery extended from the second cervical vertebra level to the fourth vertebra

level. Anatomical knowledge of the origin, course, and branching pattern of the external carotid artery, as well as the level of bifurcation of the common carotid artery, would be useful to surgeons when ligating vessels in the head and neck regions during surgery and to avoid unnecessary complications during carotid endarterectomy.⁽¹⁰⁾ The presence of a high common carotid artery bifurcation should caution surgeons that the hypoglossal nerve lies in closer proximity and is more vulnerable than in more common presentations. Preoperatively documenting the level of the common carotid artery bifurcation may be helpful in identifying patients at increased risk of iatrogenic injury.⁽¹¹⁾

Zumre et al did a study of the bifurcation levels of the common carotid artery and origin variations of the branches of the external carotid artery in human fetuses and concluded that knowledge of variations in the origin and course of the external carotid artery and its branches is of great importance in surgery and radiological examinations.⁽¹²⁾

Conclusion

Detection of developmental variations in the external carotid artery and evaluation of its stenotic areas are very important in surgical intervention, and involve specific diagnostic imaging techniques for vascular lesions including contrast arteriography, duplex ultrasonography and magnetic resonance imaging. Examination of the obtained images in cases of unusual and complicated variations of vascular patterns of the external carotid may lead to confusion in interpretation of data. Awareness of details and the topographic anatomy of variations of the external carotid may be useful for both radiologists and vascular surgeons to prevent diagnostic errors, influence surgical tactics and interventional procedures and avoid complications during surgery in the cervical region.

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