

Research Article: Human Anatomy Case Report

## Unilateral variation in the position of internal and external carotid arteries

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Submitted December 12, 2012; accepted December 31, 2012

### Summary

During the routine dissection of the neck region of a 77 years old male cadaver in the Department of Anatomy at Bankura Sammilani Medical College, a unilateral variation in the position and course of internal and external carotid arteries was noticed on the right side of neck. The internal carotid artery was anteromedial to the external carotid artery at the site of bifurcation of the common carotid artery. Knowledge of variation in the course and relation of internal and external carotid arteries is important for surgeons to perform neck surgery and also for the radiologists to interpret carotid system imaging.

### Key words

Internal carotid artery; external carotid artery; common carotid artery.

### Introduction

The common carotid arteries are the largest bilateral arteries of head and neck. Moreover, common carotid artery (CCA) and its terminal branches, i.e. internal carotid artery (ICA) and external carotid artery (ECA), are the major sources of blood supply to the head and neck. The common carotid artery arises from the brachiocephalic trunk on the right side and from the arch of aorta on the left side. On each side it divides into external and internal carotid arteries at the upper border of thyroid cartilage i.e. at the level between the 3rd and 4th cervical vertebrae (Standring et al., 2008).

At its origin, the internal carotid artery is somewhat dilated. This part of the artery is known as the carotid sinus or the carotid bulb. The internal carotid runs vertically upwards in the carotid sheath and enters the skull through the carotid canal. During this part of its course, it is relatively superficial at its start, where it is contained in the carotid triangle of the neck and lies behind and lateral to the external carotid artery. It is overlapped by the sternocleidomastoid muscle and covered by the deep fascia, the platysma and integument. It then passes beneath the parotid gland and is crossed by the hypoglossal nerve, digastric and stylohyoid muscles, occipital and posterior auricular arteries. It is related posteriorly to the longus capitis mus-

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cle, superior cervical ganglion of the sympathetic trunk, superior laryngeal nerve and laterally with the internal jugular vein and vagus nerve. The vagus nerve is on a plane posterior to the artery. Medially, there are pharynx, superior laryngeal nerve and ascending pharyngeal artery. The cervical part of this artery has no branch (Synnatamby, 1999; Standring *et al.*, 2008).

The external carotid artery is placed nearer to the midline than the internal carotid at the site of its origin and is also contained within the carotid triangle. Then it takes a slightly curved course. At first it passes upwards and forwards and then inclines backwards and laterally to pass midway between the mastoid tip and the mandibular angle. Finally, behind the neck of the mandible it divides into the superficial temporal and maxillary arteries within the parotid gland. Medially it is related to the hyoid bone, the wall of the pharynx, the superior laryngeal nerve and a portion of the parotid gland. Lateral to it, in the lower part of its course, there is the ICA. The branches of ECA are: superior thyroid, ascending pharyngeal, lingual, facial, occipital, posterior auricular, superficial temporal and maxillary arteries; the lingual artery often arises with the facial artery (Synnatamby, 1999; Standring *et al.*, 2008).

The aim of our study is to provide additional information about altered relation and course of these blood vessels of neck, of possible clinical significance.

## Materials and methods

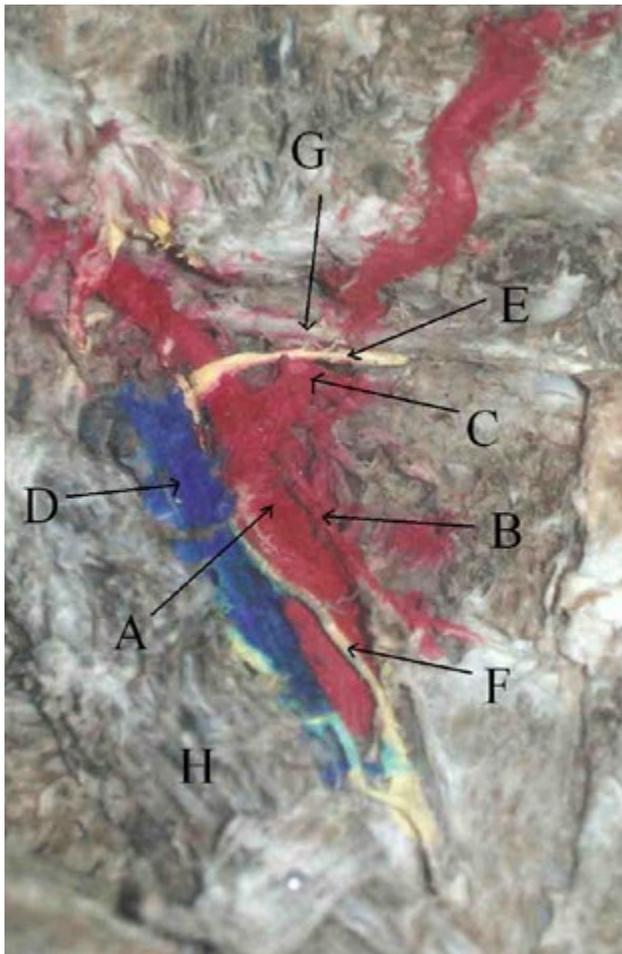
In the Department of Anatomy, Bankura Sammilani Medical College, a variation in the relation and course of internal carotid and external carotid arteries was found during dissection of neck of a 77 year old male cadaver. The anterior triangle of neck was dissected bilaterally and different structures were identified and painted with acrylic for better imaging. Finally, photographs of the dissected areas were taken.

## Case report

A variation in the position and course of the external and internal carotid arteries found on the right side of the neck. The internal carotid artery was medial and just in front of the external carotid artery, where it branched out from the common carotid artery (Fig. 1). After its initial medial deviation, the internal carotid artery ascended upwards and ultimately entered the carotid canal. The superior thyroid artery and one lingulofacial trunk were found to branch out from the anterior aspect of the external carotid artery and to cross the internal carotid artery superficially. The internal jugular vein was behind and somewhat medial to the external carotid artery, though it was lateral to internal carotid artery as usual (Fig. 2). In the neck region of the left side, the internal and external carotid arteries followed their usual relation and course (Fig. 3).

## Discussion

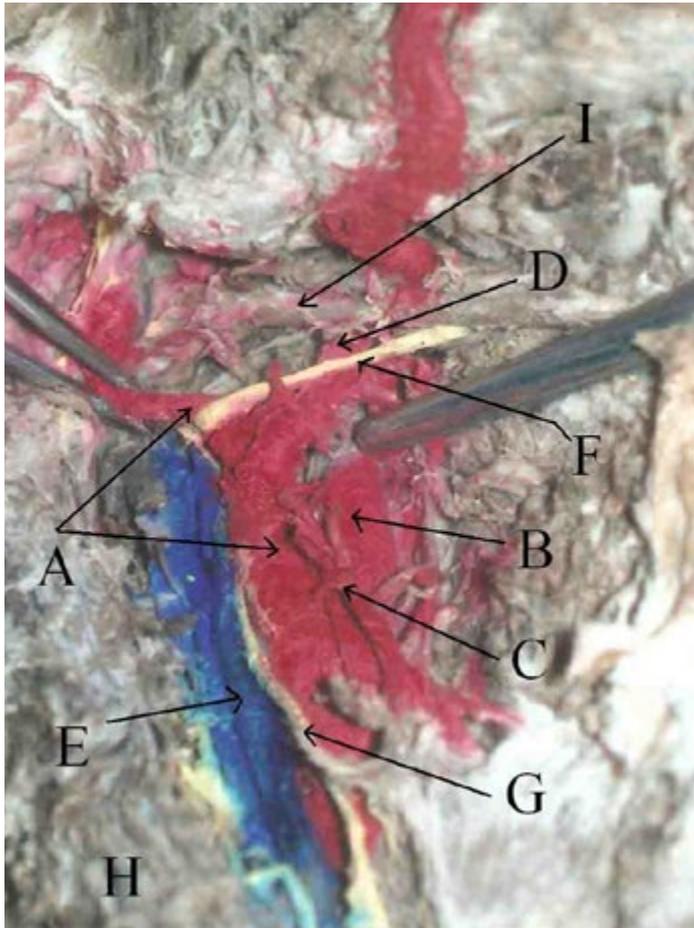
Embryologically, the carotid arteries originate from the third aortic arch and the dorsal aorta. The development of ECA first appears as a sprout, which grows headward



**Figure 1** – On the right side the external carotid artery with its branches was overlapped the internal carotid artery. A: external carotid artery; B: superior thyroid artery; C: linguofacial trunk; D: internal jugular vein; E: hypoglossal nerve; F: ansa cervicalis; G: central tendon of digastric muscle; H: sternocleidomastoid muscle.

from the aortic sac close to the ventral end of third arch artery. The CCA arises from an elongation of the adjacent part of the aortic sac, and the third arch artery becomes the proximal part of the ICA. The dorsal aortae persist on the cranial side of the third aortic arches as continuations of the ICA (Standring et al., 2008) (Fig. 4). Usually, the dorsal aortic root descends into the chest by the eighth week of development, thereby straightening the course of ICA. It has been postulated that incomplete straightening of the carotid vessels enables the embryonic angulation to persist, resulting in congenitally tortuous or aberrant ICA (Shanley, 1992; Agarwal and Agarwal, 2011).

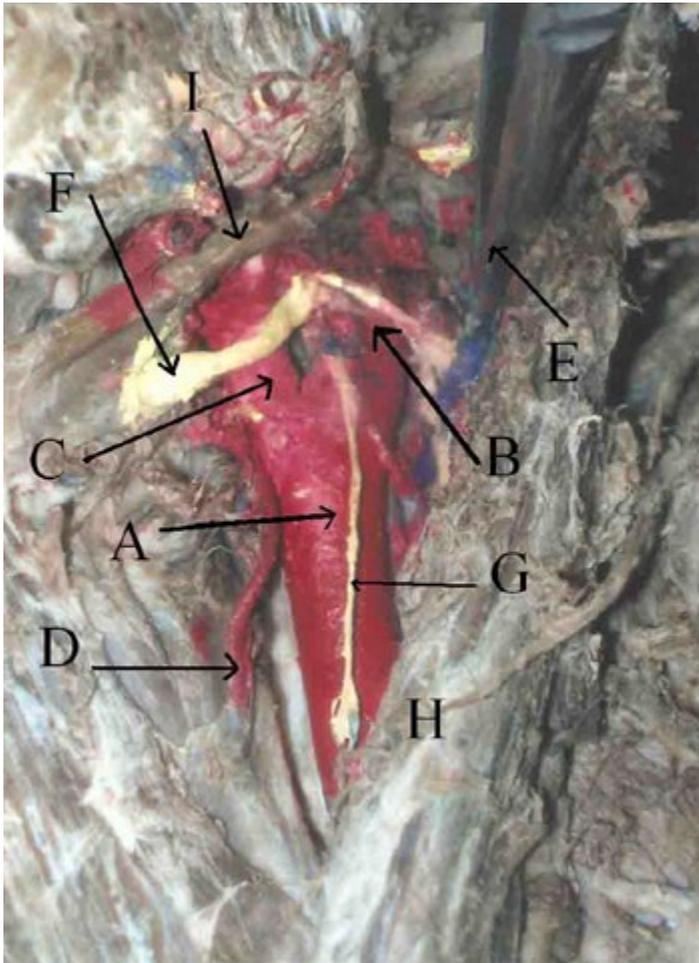
Altered relation between ICA and ECA at the point of origin must be given utmost importance before planning any neck surgery, to avoid post operative com-



**Figure 2** – On the right side the medially situated internal carotid artery was crossed by the anterior branches of the external carotid artery. A: external carotid artery; B: internal carotid artery; C: superior thyroid artery; D: linguofacial trunk; E: internal jugular vein; F: hypoglossal nerve; G: ansa cervicalis; H: sternocleidomastoid muscle; I: central tendon of digastric muscle.

plications. Such a case was reported by Manupati *et al.* in 2012, where the external carotid artery was seen anterolateral to the internal carotid artery at the bifurcation of the common carotid artery. In another study lateral position of the external carotid artery was observed in 4.3% cases (Bussaka *et al.*, 1990).

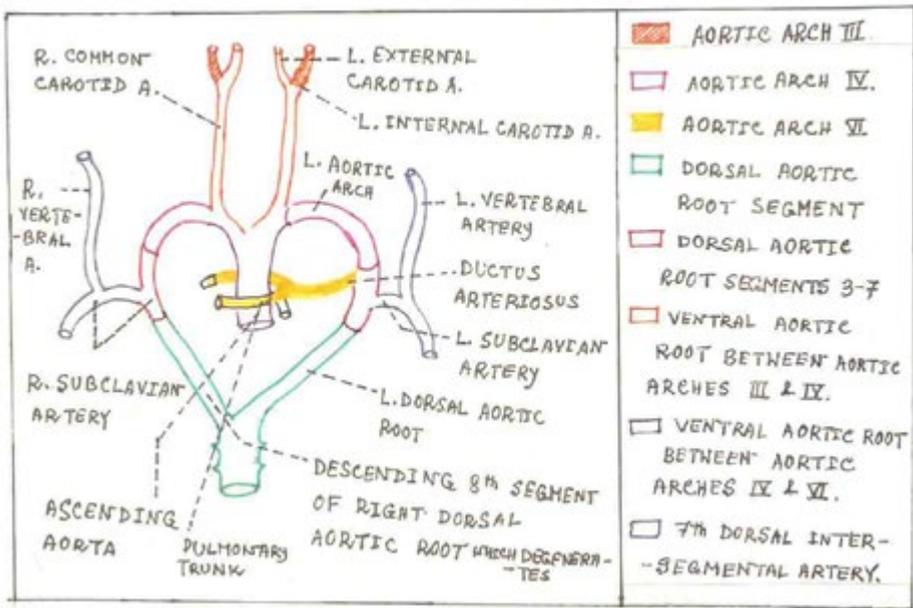
Variations in subsequent course of ICA were classified by Paulsen *et al.* (2000) as follows: (a) a straight course to the base of skull; (b) an 'S' or 'C' shaped elongation with a medial, lateral, or ventrodorsal displacement; (c) a kinking of one or more of the segments; and (d) coiling of the artery that may appear as a double loop. Moreover, in 2011, Agarwal and Agarwal reported a rare case of retropharyngeal tortuous right internal carotid artery at the second cervical vertebral level.



**Figure 3** – On the left side the internal carotid artery was lying lateral to the external carotid artery according to normal anatomy. A: common carotid artery; B: internal carotid artery; C: external carotid artery; D: superior thyroid artery; E: internal jugular vein; F: hypoglossal nerve; G: ansa cervicalis; H: sternocleidomastoid muscle; I: central tendon of digastric muscle.

In the present case an unusual ventro-medial displacement of ICA was observed. Moreover, the artery was crossed by anterior branches of the external carotid artery which was somewhat exceptional.

Such medial deviation of the internal carotid artery is a rare cause of widening of the retropharyngeal space. In patients, especially in children, the diagnosis of these variations must always be predicted to avoid catastrophic consequences after surgical procedures like adenotonsillectomy (Kay et al., 2003; Wasserman et al., 2006). Doppler ultrasonography, computed tomography, angiography and magnetic resonance angiography imaging can be employed for assessment of the course, caliber, and contour



**Figure 4** – Diagrammatic ventral view of the aortic arch complex of a human embryo (15 mm crown rump length).

of the carotid vessels to reduce the risk of accidental hemorrhagic complications associated with their variations (Galletti et al., 2002; Palacios et al., 2005).

While curvature of the internal carotid artery has been attributed to part of the normal ageing process and does not seem directly related either to a pathologic or congenital cause, kinking of the internal carotid artery has been associated with atherosclerotic change and fibromuscular dysplasia. The affected persons are aged ones with increased risk for cerebrovascular injury like thrombosis and cephalic ischaemic processes (Shanley, 1992; Paulsen et al., 2000).

Loop formation is considered to be a congenital defect of special interest in the young. When the loop is situated close to the pharyngeal wall it is known as the “dangerous loop” because of the chance of injury during any surgical procedure (Palacios et al., 2005; Windfuhr, 2009).

The awareness of these variations is essential for surgeons and radiologists to undertake a surgical or investigative procedure in the neck region.

## Conclusion

Though medial deviation of internal carotid artery is a dangerous variation, most affected people are asymptomatic and no treatment is necessary (Galletti et al., 2002). Treatment of the patients depends on the severity of the associated atherosclerotic changes and it includes: endarterectomy, covered stenting, or vessel grafting in case

of tortuous ICA (Radonic et al., 1998). The clinicians should be vigilant for cardiovascular accidents (CVA) like transient ischaemic attack (TIA), following vascular surgery in these patients. However, permanent neurologic deficit may occur in rare cases (Radonic et al., 1998; Windfuhr, 2009). This variation is a matter of interest to the anatomists also.

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