

Clinical Significance of Tortuosity of The Carotid Artery and Higher Bifurcation: Report of A Case and Review of Literature.

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Abstract

Background: An aberrant carotid artery is at risk of injury during routine procedures if the vessel is placed into altered relationship with structures. The incidence of these variations is reported to be between 6-40% in various series.

Case presentation: We present a case of 46 year old male presented with cancer of the buccal mucosa wherein a high bifurcation of carotid artery along with tortuosity of the common carotid and internal carotid artery was found.

Conclusions: the anatomical variations of the carotid vessels can place these vessels at risk of injury at the time of surgery and hence knowledge of these variations is essential.

Key words: carotid artery; external carotid; internal carotid; internal jugular vein; spinal accessory artery; neck dissection.

Introduction

Aberrant course of Internal carotid artery in the temporal bone is often discussed, however, its variations in the neck though not rare are less frequently described [1]. Dr. John Carney of Department of Anatomy, University of Otago, New Zealand in 1924, highlighting this variation and its importance noted that "internal carotid artery may in some cases be tortuous is mentioned in the recent editions of most of our standard textbooks, usually in small type under the heading of peculiarities or of variations" [2]. Quoting Gray (Gray's Anatomy, 22nd edition, p. 625, 1923) he mentioned that,

"The course of the artery, instead of being straight, may be very tortuous" and quoting Pierson (Pierson's Human Anatomy, 7th edition, p. 747, 1919), "In its cervical portion the internal carotid occasionally takes a somewhat sinuous course, and, especially in its upper part, may be thrown into a pronounced horseshoe-shaped curve" [2]. Till 1924 when his paper was published he could identified 12 published reports beside mentions in the textbooks and contributed 36 cases of his own, describing various tortuosities in detail. In an editorial in the same issue [3] Alejandro Rodriguez Cadarso, and Juan Jose Barcia Guyanese, confirmed the findings of Cairney and added one of their cases. Since, then the various variations of the cervical Internal Carotid artery has been identified and described. We report here one case of aberrant tortuosity of ICA in neck found during neck dissection and discuss its clinical significance.

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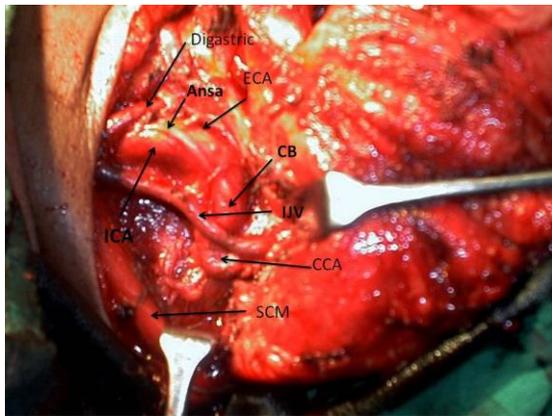


Figure 1: intraoperative photograph showing tortuous common carotid artery, high carotid bifurcation and anomalous internal carotid artery (ECA-External carotid artery; ICA- Internal carotid artery; CCA- common carotid artery; IJV-Internal jugular vein; SCM- Sternocleidomastoid muscle)

Case Report

A 46 year old male presented with non healing ulcer on right buccal mucosa. On examination a 4 x 3 cm ulceroproliferative lesion was present in the right buccal mucosa extending from premolar to 3rd molar, both upper and lower gingivobuccal mucosa was free. There were no other abnormalities in the oral cavity. Examination of the neck revealed multiple lymph nodes in level Ia, Ib and II, largest lymph node was 4cm size in level II. Systemic examination was unremarkable. A punch biopsy was taken that showed non keratinizing squamous cell carcinoma. Patient was planned for a surgical excision and hematology and biochemistry was ordered that was found to be normal. A CT scan was performed that showed primary lesion as thickening of the buccal mucosa without any bony involvement and multiple lymph nodes in the right neck.

He underwent wide local excision with right modified radical neck dissection. Intraoperatively the Common carotid artery was found to have tortuous course with curvature to the right coming out underneath the internal jugular vein and then turning left at carotid bulb and bifurcating with external carotid Artery going behind the Internal carotid artery with ansa cervicalis on top of it (Figure 1). Due to presence of this tortuosity of the CCA

and high bifurcation with again tortuosity of Internal carotid artery, this came to lie in the plane of dissection, which normally is always lateral to IJV as the arteries are almost always medial to IJV. The patient made fine recovery and was sent home on 5th postoperative day.

Discussion

Anomalies of the carotid arterial system including the developmental anomalies are not very common and has very high importance for head neck surgeons. According to the classical descriptions the Right CCA arises from the brachicephalic trunk and the carotid bifurcation lies at the level of upper border of thyroid cartilage at C3-C4 vertebral level. The ICA runs straight to skull base, while ECA runs to a point behind mandible giving altogether 8 branches in the neck. However, variations in the anatomy have been reported in 10-40% of the population, most of these variations are minor and does not have much significant clinical relevance [4-10]. On the other hand the variations also present with symptoms and clinical diseases like ischemia and stroke and symptomatic neck masses [11-18]. Pronounced variations may place the vessel in the operating field of the surgeon making it at risk of injury, such can occur during the endoscopic nasal surgery, tonsillar surgery, parapharyngeal surgeries and neck dissections for malignancy as in the present case. Anu et al., [18] reported on 95 cadaveric dissections and found higher bifurcation at the level of C2 vertebra in 10% of their cases like the present case. They also reported that in their patients with higher bifurcations some of the arterial supply to the neck like the superior thyroid artery was seen arising from CCA, however in their case the CCA was straight and did not form any loop or show any tortuosity as in the present case [18].

Weibel and Fields in 1965 [19, 20] first introduced a classification system for the variations that is still quite useful. Their work helped to distinguish tortuosity, kinking, and coiling of the carotid arterial system. In 2008, Pfeiffer and Ridder [1] introduced another classification wherein they included the

distance from pharyngeal wall and the anatomical location as well. This classification is very useful for surgeon while performing parapharyngeal surgeries. Out of 265 dissections in the series of Paulsen et al., [5] carotid artery showed no curvature in 191 cases, but in 74 cases it had a medial, lateral or ventrocaudal curve. Desai et al., [21] in a review stated that "The cause of these loops is related to embryological development" they further elaborated that as this arises from 3rd aortic arch its abnormally kinked in the embryo. "Straightening occurs when the fetal heart and large vessels recede in the thoracic cavity. If the embryological state persists, it produces different kinds of undulations, loops, and kinks" [21].

Though described sparingly in the classical literature the interest in the anatomical variations in the carotid arterial system arose after series of injuries during neck, pharyngeal, sinus and tonsillar surgeries in 20th centuries and since then almost every variation in the carotid anatomy has been reported, coupled with increasing use of carotid angiography for ischemia and stroke, the incidence of variations are now reported to be as high as 40%. Though over 100 different variations have been described these can still be conveniently into tortuosity, kinks and coils with or without variations of bifurcation. Its importance during the surgery cannot be understated as in the present case a higher bifurcation at the level of C2 vertebra along with the lateral coiling of CCA that brought it lateral to the Internal jugular vein and therefore into the operating field placed it at a risk of injury. This was further compounded by a very laterally placed accessory nerve and posteriomedially curved ECA.

Learning points

The anomalies of carotid artery anatomy are present in upto 40% of the patients.

These could be in the CCA, ECA or in ICA

Bifurcation of the carotid though normally at C3-C4 could be higher at C2 in 10% of the cases

The distance from the pharyngeal wall also varies to as close as less than 1mm.

Its important to know of these variations to prevent injuries during surgery.

Author Contribution

MP: did the literature search and wrote the manuscript.

Conflict of Interest

The authors declare that there are no conflict of interests

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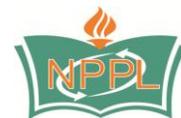
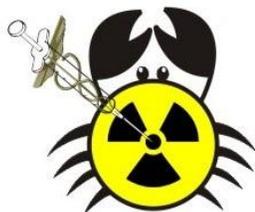
None

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